Making Connections in Math and Science
Final Report
June 12, 2007

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Partnerships:

	Institution/District/Organization	Location/Contact Person
Education Division	Department of Elementary, Early & Special Education, College of Education Southeast Missouri State University	Cape Girardeau, MO Kathy Conway, Ph.D.
Arts & Sciences Division	Department of Mathematics, College of Sciences & Mathematics Southeast Missouri State University	Cape Girardeau, MO Candide Walton, Ph.D.
High-Needs School Districts	1. Charleston R-1 School District	Charleston, MO Darrell Hoppe
	2. South Pemiscott County R-V School District	Steele, MO Karen Farley
	3. Bernie R-XIII School District	Bernie, MO Robin Ritchie
Additional Partners	1. Department of Science, College of Arts and Sciences Mineral Area Community College	Park Hills, MO Nancy Petersen
	2. Southeast Regional Professional Development Center Southeast Missouri State University	Cape Girardeau, MO Cheri Fuemmeler
	3. Missouri Higher Education Loan Authority (MOHELA)	Chesterfield, MO Quentin Wilson

Abstract/Summary

This project began on July 10, 2007, with a week-long workshop on brain research (2 days) and cooperative learning (3 days). This workshop introduced teachers to research-based strategies that have been shown to be highly effective in differentiating instruction and increasing student achievement. Participants then attended either a week-long science or math institute where they were shown ways to incorporate the previously introduced strategies into their content area. Integrating math and science content into collaborative lessons were also demonstrated during each content week. Participants attended two follow-up regroup sessions in which strategies from the summer institute were reviewed and reinforced. To further support teachers, Linda Null, the RPDC Math Consultant, and William Reeves, Science Institute presenter, made 1-2 classroom visits for the purpose of coaching.

Higher Education Faculty that were also involved with this grant were Kathy Conway and Candide Walton from Southeast Missouri State University and Nancy Petersen from Mineral Area Community College.

Other resource people involved with the grant included Donna Shaver from the Jackson R-II School District, and Martha Short, David Stuart, and William Reeves, all independent math/science consultants.

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Participating Districts:

The following school districts participated in this grant.

School Districts	Number of Participants	
	Math	Science
Bernie R-XII*	4	3
Charleston R-I*	7	4
Delta C-7	1	
Meadow Heights	1	
Sikeston R-I	2	
Southland C-9		1
South Pemiscott*	4	3

*High-Need School Districts

The average number of contact hours per participant was 80 hours over a time period from July 10, 2006 to March 7, 2007.

Session	Date	Time	Hours
Brain Research and Cooperative Learning	July 10-14	9:00 – 3:00	30
Science Institute	July 24-28	9:00 – 3:00	30
Math Institute	July 31-Aug 4	9:00 – 3:00	30
Fall Regroup	October 11-12	9:00 – 3:00	12
Spring Regroup	March 2	9:00 – 3:00	6
Classroom Visits	November 2006 –March 2007	varies	2

Description of project activities completed by participants:

Participants began the project on July 10 and 11 with a two-day workshop on brain research. The first day was conducted by RPDC Consultants, Connie Hebert and Carol Reimann. They demonstrated how environmental factors can influence student learning, modeled some differentiated instructional strategies, and addressed how to involve emotion in the learning process through the use of music, cartoons, skits, models, etc. The second day, Chris Ward and Jim Craigen presented "Brain Theory and the Implications for Teachers." Participants were asked to pick one item from the presentation to try in their classroom and keep a journal of how well it worked.

On July 12-14, Participants were involved in three days of cooperative learning presented by Chris Ward and Jim Craigen. Teachers were given intense training in which a variety of cooperative structures were modeled and practiced. At the end of the workshop, participants working in groups were given the challenge of picking a content topic and teaching it to another group using 2-3 cooperative strategies. The session closed with participants given a template to help them design lessons for the upcoming school year that would integrate the instructional strategies they had learned into their content level.

The next phase of the grant required that participants choose between math and science. The week-long institutes were held July 24-28, 2007, for Science and July 31-August 4 for Math. It should be noted that even though

the subjects were divided, that within each institute, participants were integrating both math and science content within their activities.

The Science Institute was built around five kits which incorporated the following topics: forces, momentum and acceleration, scientific inquiry, simple and complex machines, and plate tectonics. The participants were introduced to each kit through a classroom presentation of the materials. During the presentations possible instructional strategies, classroom management, and safety concerns were emphasized. The first kit demonstrated was Bridge Building. Students using balsa wood to construct model bridges explored the concepts of static and dynamic forces. The activity ended in destructive testing by applying a load until the bridge collapsed. The second kit was a Rocket Kit. Students were introduced to the concepts of momentum, conservation of energy, forces, and acceleration through the use of water bottle rockets made from soda bottles. The activity was reinforced with solid fuel model rockets. The third presentation was a GEMS Kit called Dry Ice Investigations. This kit used students' curiosity about dry ice to capture their attention and served as a powerful unit on scientific inquiry while covering the properties of matter, phase change, solids, and gases. The fourth kit was the Fischertechnik Universal Kit, which is a construction set that can be used to build models of simple to more complex machines. This kit allowed participants to construct and explore their own models of machines. The last kit was Plate Techtonics, which provided materials for the teacher to establish student stations to explore convection currents, plate movement, mountain formation, earth's interior, and planetary processes. In addition to the experiments with these kits, strategies such as concept attainment, graphic organizers, and cooperative learning were presented by Nancy Petersen on each day. The last day, time was given to participants to develop a lesson plan that implemented ideas presented throughout the week.

For the Math Institute, a disaster theme was chosen with lessons on earthquakes, floods, tornadoes, hurricanes, global warming, spread of disease, crop pests, and oil spills. Lessons were modeled using a variety of strategies, including cooperative learning. Participants were given time at the end of each lesson to process and think about how they could apply the lesson to their classrooms. Collaboration was also modeled by the five consultants who worked together in planning the week's activities. These five consultants were as follows:

Linda Null	RPDC Math Consultant
Donna Shaver	STARR Teacher - Southeast Region

Martha Short	Elementary Math & Science Resource Consultant
Kathy Conway	College of Education, Southeast Missouri State University
Candide Walton	College of Sciences & Mathematics Southeast Missouri State University

Dr. David Stuart did a presentation on earthquakes on a field trip to the New Madrid Earthquake Museum. Speakers from the American Red Cross and the NASA Resource Center also presented and emphasized their availability as additional resources for their classrooms. In addition, participants were given many resources as part of their kit. See the attached list of all the resources handed out during both the Math & Science Institutes.

At the end of the math week, participants were given the assignment of choosing a lesson topic and designing a lesson that incorporated a variety of instructional strategies. They were reminded to use the template previously given to them by Chris Ward and Jim Craigen. In addition, a list of prompts was supplied to help them brainstorm their lesson ideas along with a journal book to record their reflections.

The first follow-up regroup was held October 11-12 with Chris Ward and Jim Craigen reviewing and extending their cooperative learning structures. On the second day, facilitators for both the Math and Science Institutes conducted re-group sessions with the participants to discuss their successes and concerns and to schedule classroom visits/observations. This opportunity for sharing their experiences with one another enabled facilitators to gauge progress towards the grant's goals.

Linda Null made classroom visits in September, October, November, and March. The purpose of these visits was to observe the teachers using the lessons they had designed with their students. All teachers were making an effort to change from a teacher-centered approach to a student-centered approach. They also were attempting to teach using a variety of strategies, versus just one, so that they could better address the diverse learning styles in their classroom. However, some were struggling with using the cooperative learning because of classroom management issues.

Participants were brought together March 2 for their Spring Regroup. Martha Short reviewed using glyphs as an instructional tool. Donna Shaver taught a cooperative lesson that integrated both math and science. Suggestions were made on how to integrate science and math for the upcoming PI Day (March 14). Kathy Conway led participants in critiquing lessons that participants had brought with them for essential cooperative

learning pieces. The afternoon session was focused on assessment for learning, completing their on-line surveys, and taking the post-test.

Modifications:

The grant originally specified that first year participants would be teachers in grades 5-8 with secondary teachers added in succeeding years. But due to the revision of the program to one year, we took applicants from grades 4 through 12. Nearly 50% (13/30) of our participants taught high school math or science. (See attached data form).

Objective 1: Improve Student Achievement in Math and Science

MAP Data from the three partnership schools indicated they had deficit areas in several areas. See Table 1 for those identified deficits according to the Show-Me Standards.

Table 1: Topics Addressed

Mathematics		**Science**	
Content Standard 4	Patterns & Relationships	Standard E	Structure of Matter
Content Standard 5	Mathematical Systems	Standard H	Energy
Content Standard 6	Discrete Math	Standard I	Motion

Also, data from the same schools indicated that a majority of their students were performing in the bottom two levels of the MAP Test in both Math and Science for three consecutive years (2003-2005). Note that this data is for grades 7 (Science) and 8 (Math) only, and several of our teachers were high school teachers. It should also be noted that Grade Level Testing began in 2006 so the Grade Level Expectations are not reflected within this project.

It was the intent of the project for schools to use their 2006 and 2007 MAP data to inform them of whether this project had any impact on their students. Using assessment data was going to be our primary focus for the second year of the project. Since the grant did not get renewed and MAP scores are not available yet, there is no student data to support the project's impact on student achievement.

Objective 2: Increase Teachers' Knowledge and Content Understanding

Using the MAP data from the partner schools, lessons in math and science were designed which addressed the topics (see table 1). Also, a pre- and post test were administered to participants based on the content of the lessons. Table 2 shows the results of the math pre- and post-tests in content.

Table 2: Math Pre- and Post-Tests

Participant	Pre-Test *Raw Scores	Post-Test *Raw Scores	Gain Score
1	6	8	2
2	6	5	-1
3	3	3	0
4	2	4	2
5	3	1	-2
6	8	8	0
7	7	7	0
8	7	4	-3
9	5		
10	5		
11	6		
12	5		
13	0		
14	2		
15	3		
16	7		
17	1		
18	7		
19	6		
Average	4.7	5	-0.25
Standard Deviation	2.3	2.5	

*Content portion of test consisted of 10 test items.

There were 19 pre-tests with only 8 participants returning for the post-tests. As is evident from the table, a negative gain score is shown. Possible factors for this include the time lapse between the two tests and the fact that the test included high school content questions and many of our participants were

elementary level. Poor test questions (questions #1 and #6 specifically) probably contributed to the negative gain score as well.

Table 3 shows the results of the science pre- and post-tests. It should be noted that the science participants took their post-test at the end of their science institute week, unlike the math participants who waited until the spring regroup. This is reflected in their average gain score of 3 points.

Table 3: Science Pre- and Post-Tests

Participant	Pre-Test *Raw Scores	Post-Test *Raw Scores	Gain Score
1	10	14	4
2	5	14	9
3	12	14	2
4	15	14	-1
5	11	14	3
6	14	14	0
7	13	14	1
8	15	15	0
9	9	15	6
10	6	14	8
11	14	14	0
Average Correct	11.27	14.18	2.9
Standard Deviation	3.467	0.405	

*Content Portion of test consisted of 15 test items.

For additional qualitative data from both the math and science institutes, please see comments from the RPDC Evaluations beginning on page 14.

Objective 3: Improve Teachers' Pedagogical Knowledge and Use of Best Practices

In math, teachers were given a pre and post survey concerning pedagogy and best practices. Based upon these surveys, participants showed 75% improvement in increasing the number of cooperative learning strategies they used. However, in the classroom observations Linda Null made prior to the Spring Regroup, it was noted that their implementation of cooperative learning wasn't effective in certain classrooms. Many times what was

observed was group work where one person out of a group was engaged, while the rest looked on. Therefore, the focus of the March 2nd regroup was to work on analyzing sample lessons to see what essential pieces of cooperative learning (positive interdependence, individual accountability, equal participation, and simultaneous interaction) were possibly missing from the lesson. Suggestions were made on how to make the activity truly cooperative learning in which all students were engaged.

Objective 4: Enhance Participants' Use of Assessment Data

Each participant was given a journal at the end of the Math Institute and asked to reflect on what worked and didn't work in their classroom. They were also encouraged to have their students journal at the end of a unit or after new content had been introduced. Linda Null observed some classrooms where teachers checked for understanding through this practice of student journals. The teachers who used this strategy frequently reported that it helped them gauge their students' understanding better and that their students felt more comfortable in asking questions in their journals, knowing that only the teacher was going to read them.

Objective 5: Demonstrate Impact on Preparation of Pre-service Teachers

Both Kathy Conway and Candide Walton reported that their pre-service teacher classes were enhanced as a result of their involvement with the grant. Kathy Conway listed the following changes that were made in her methods of teaching mathematics and science for elementary teachers:

- More cooperative learning techniques were incorporated into her college instruction along with explanations of why the strategies were effective.
- Reflection prompts were adjusted to include a prompt about cooperative learning in the teacher candidate's field placements.
- Peer observations were changed to include prompts that relate to cooperative learning.
- Increased attention was given to cooperative learning opportunities during her observations of the teacher candidates.

Candide Walton reported using more cooperative learning strategies in her mathematics methods courses as well.

Dissemination of Project Information

The dissemination of the project activities will be shared primarily through newsletters compiled by Southeast Regional Professional Development Center, through attendance at various professional development training programs and conferences, and within the RPDC network. The greatest and most sustaining impact for the training available through the grant activities will be the participants' conversations with colleagues within the Southeast region as well as statewide. All information related to the Making Connections in Mathematics and Science will be shared to all making individual requests.

Conclusion:

Overall, the project accomplished several of its objectives. Teachers were exposed to new ways of teaching that are research based and effective. As an example, Denise Harrison, one of the Math Institute's participants, conducted an action research project for her thesis and incorporated several strategies she learned as a result of this grant. Although some teachers had difficulties implementing some of the cooperative learning strategies due to classroom management issues, efforts were made to incorporate the new strategies. For many of the teachers, more on-going professional development over a longer time frame is needed to ensure that teachers will improve their instructional strategies to the level that they have an impact on their students' learning. Having this grant for two additional years would have been desirable.

The project had a minimal impact on the participants' use of assessment data. There was some use of student journals for assessment. However, this was not consistent among all the participants. Since the grant was originally a three-year grant, facilitators had made a decision to focus more on assessment the second year, while emphasizing instructional strategies the first year. Since it is recognized that instruction, curriculum, and assessment all work together as a cohesive unit, assessment should have been addressed more.

The information from the sessions that were a part of this grant did contribute to pre-service teacher preparation. Information was incorporated in both the methods courses for elementary and middle school/secondary teachers.

Math Participant Kits

Junior High/High School	
Real – World Math Binder	Cooperative Learning Math Lessons
The Wartville Wizard	Children's Literature Book
What's Your Angle Pythagoras?	Children's Literature Book
Relational Geo-Solids Kit & Book	Manipulatives and Teacher's Guide
Dinah Zike's Big Book of Math Middle and High School	Resource Book Teaching Strategies
Math for Humans: Teaching Math Through the Eight Intelligences	Resource Book Teaching Strategies for Multiple Intelligences
Navigating Through Data Analysis & Probability	NCTM Resource Book Probability Lessons & Strategies
Proofs of Pythagoras	Manipulative Models
Clinometer	Measurement Manipulative
Percent Protractor	Measurement Manipulative
Centimeter Cubes	Manipulatives
Double Dice	Manipulatives
Pi Hoop	Manipulatives
Overhead Counters	Manipulatives
Kagan's Cooperative Learning PIES Chart & Structures	Resource Book Teaching Strategies
Elementary	
The Wartville Wizard	Children's Literature Book
What's Your Angle, Pythagoras?	Children's Literature Book
G is for Googol	Children's Literature Book
Navigating Through Data Analysis & Probability	NCTM Resource Book Probability Lessons & Strategies
Super Graphs, Venns, and Glyphs	Resource Book Teaching Strategies

Dinah Zike's Big Book of Math Elementary K-6	Resource Book Teaching Strategies
Dinah Zike's Big Book of Science	Resource Book Teaching Strategies
Dinah Zike's Big Book of Earth Science	Resource Book Teaching Strategies
Kagan Cooperative Learning PIES Chart & Structures	Resource Book Teaching Strategies
The Tri-State Tornadoes	Resource Book
The Eruption of Mt. St. Helens	Resource Book
Weather Sense: Temperature, Air Pressure, and Wind	Resource Book
Extreme Weather Kit and Teacher's Guide	Resource Book
Large Manipulite Geometric Solids	Manipulatives
Exploring Geometric Solids	Teacher's Guide
Centimeter Cubes	Manipulatives
Double Dice	Manipulatives
Overhead Counters	Manipulatives

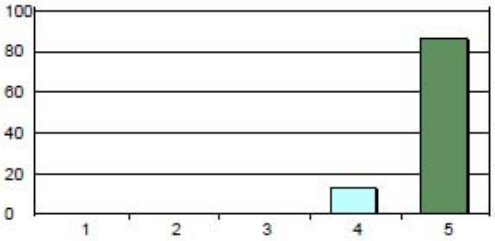
Science Participant Kits

1. Bridge Building Kit
2. Rocket Kit
3. GEMS Kit
4. Fischertechnik Universal Kit
5. Plate Techtonics Kit

Making Connections in Math and Science
July 31- August 4, 2007

Creation Date: 6/26/2007
Time Interval: 8/8/2006 to 6/15/2007
Total Respondents: 30

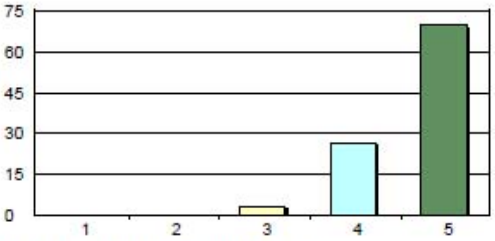
1. Was knowledgeable on the subject matter.



1. Strongly Disagree	0	0%
2. Disagree	0	0%
3. Neutral	0	0%
4. Agree	4	13%
5. Strongly Agree	26	87%
Total Responses:	30	

Mean: 4.87 Standard Deviation: 0.35

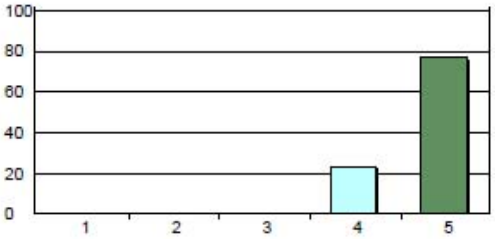
2. Provided a high quality presentation.



1. Strongly Disagree	0	0%
2. Disagree	0	0%
3. Neutral	1	3%
4. Agree	8	27%
5. Strongly Agree	21	70%
Total Responses:	30	

Mean: 4.67 Standard Deviation: 0.55

3. Had a professional approach and style



1. Strongly Disagree	0	0%
2. Disagree	0	0%
3. Neutral	0	0%
4. Agree	7	23%
5. Strongly Agree	23	77%
Total Responses:	30	

Mean: 4.77 Standard Deviation: 0.43

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Making Connections in Math and Science
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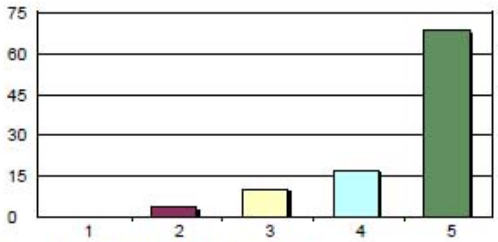
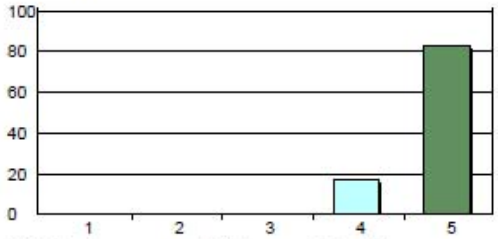
4. Presentation was appropriate for the audience.



1. Strongly Disagree	0	0%
2. Disagree	1	3%
3. Neutral	3	10%
4. Agree	5	17%
5. Strongly Agree	20	69%
Total Responses:	29	

Mean: 4.52 Standard Deviation: 0.83

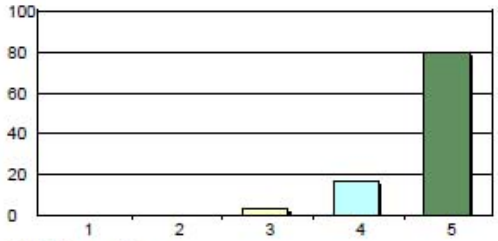
5. Used appropriate and current resources.



1. Strongly Disagree	0	0%
2. Disagree	0	0%
3. Neutral	0	0%
4. Agree	5	17%
5. Strongly Agree	24	83%
Total Responses:	29	

Mean: 4.83 Standard Deviation: 0.38

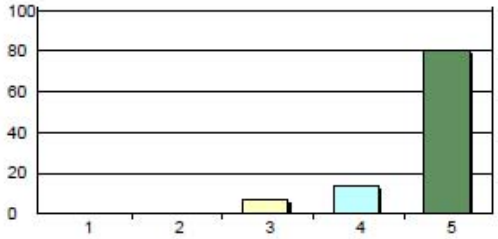
6. Made an impact on my thinking toward the subject matter.



1. Strongly Disagree	0	0%
2. Disagree	0	0%
3. Neutral	1	3%
4. Agree	5	17%
5. Strongly Agree	24	80%
Total Responses:	30	

Mean: 4.77 Standard Deviation: 0.50

7. Will be useful to me.



1. Strongly Disagree	0	0%
2. Disagree	0	0%
3. Neutral	2	7%
4. Agree	4	13%
5. Strongly Agree	24	80%
Total Responses:	30	

Mean: 4.73 Standard Deviation: 0.58

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Making Connections in Math and Science
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What is the most useful information that you learned in this meeting?

I loved the elementary material that was given to us.

Please write additonal comments, questions and/or suggestions in the space below.

Plenty of pass arounds. Most helpful

What is the most useful information that you learned in this meeting?

The different structures and that students need to be doing the learning.

Please write additonal comments, questions and/or suggestions in the space below.

Concentrate more on the math part of the math and science connection.

What is the most useful information that you learned in this meeting?

Cooperative learning works well with math.

What is the most useful information that you learned in this meeting?

Cooperative learning is great

Please write additonal comments, questions and/or suggestions in the space below.

I hope I can do as great a job as you did

What is the most useful information that you learned in this meeting?

Different cooperative learning strategies

Please write additonal comments, questions and/or suggestions in the space below.

Too much on science

What is the most useful information that you learned in this meeting?

How to incorporate cooperative learning into my classroom

Please write additonal comments, questions and/or suggestions in the space below.

Love the idea of HeyMath!

What is the most useful information that you learned in this meeting?

The earthquake information.

Please write additonal comments, questions and/or suggestions in the space below.

At times, it was a little slow-paced.

What is the most useful information that you learned in this meeting?

The different strategies taught will be most uesful.

Please write additonal comments, questions and/or suggestions in the space below.

Best workshop I have attended. I will change my teaching. Thank you.

What is the most useful information that you learned in this meeting?

That after 20+ years in math education, there are still things to learn.

Please write additonal comments, questions and/or suggestions in the space below.

I feel energized! What a great staff you have (and resource for me). :)

What is the most useful information that you learned in this meeting?

The lesson plans that have been actually used.

What is the most useful information that you learned in this meeting?

Valuable information in how to use cooperative learning structures in math.

What is the most useful information that you learned in this meeting?

The implementation process for the strategies and manipulatives. I finally feel I received practical advice and support for trying out new strategies.

What is the most useful information that you learned in this meeting?

Actual practice with the activities (helps me estimate time needed, difficulty level, etc.)

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Making Connections in Math and Science
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Please write additonal comments, questions and/or suggestions in the space below.

awesome and I loved the food!

Please write additonal comments, questions and/or suggestions in the space below.

for the specific grant program, we had guidelines for module development that could have been addressed more thoroughly

What is the most useful information that you learned in this meeting?

websites, resources, and just actually doing the activities

Please write additonal comments, questions and/or suggestions in the space below.

Absolutely wonderful workshop. Spending two weeks of summer break could not have been more worth it!

What is the most useful information that you learned in this meeting?

How to make this knowledge cross-curricular

Please write additonal comments, questions and/or suggestions in the space below.

Loved the resources given - can't wait to utilize them.

What is the most useful information that you learned in this meeting?

Cooperative learning strategies
Websites
Foldables!

Please write additonal comments, questions and/or suggestions in the space below.

Resources are great!! :)

What is the most useful information that you learned in this meeting?

Organizational skills

Please write additonal comments, questions and/or suggestions in the space below.

Great!

What is the most useful information that you learned in this meeting?

Mind maps, cooperative learning

Please write additonal comments, questions and/or suggestions in the space below.

Loved It. :)

Please write additonal comments, questions and/or suggestions in the space below.

We need more GLE help

What is the most useful information that you learned in this meeting?

Everything was VERY useful! This workshop was awesome! I really liked the labs.

Please write additonal comments, questions and/or suggestions in the space below.

Very informative ~ much to consume ~ quite enjoyable!

What is the most useful information that you learned in this meeting?

Too much to mention it all. Lots of stuff that I will use.

Please write additonal comments, questions and/or suggestions in the space below.

Probably the best workshop I've ever been to.

What is the most useful information that you learned in this meeting?

How to use dry ice in the classroom.

What is the most useful information that you learned in this meeting?

Water bottle rockets.
Ideas for teaching the scientific method.

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Making Connections in Math and Science
July 31- August 4, 2007

Please write additonal comments, questions and/or suggestions in the space below.

Enjoyed.

What is the most useful information that you learned in this meeting?

How to use the activity kits in my classroom, questions the kids might have, how to align activities to the GLEs.

Please write additonal comments, questions and/or suggestions in the space below.

Excellent workshop. Instructors were very helpful and knowledgeable.

What is the most useful information that you learned in this meeting?

Water bottle launcher - inquiry
platetectonics

What is the most useful information that you learned in this meeting?

For a first-time physics teacher, the kits are going to be wonderful. I also enjoyed sharing ideas with teachers from other schools who teach similar subject matter. I enjoyed working with the other science teachers in my district.

Please write additonal comments, questions and/or suggestions in the space below.

I thought this week was to be designed to help us with certain GLEs that my district was weak in. It was not.

What is the most useful information that you learned in this meeting?

Handheld computers and free stuff. I also like the concept attainment as a beginning anticipatory set.

Please write additonal comments, questions and/or suggestions in the space below.

Time was wasted at times and seems we spent too much time on activities when we were finished. But overall, 80% of my time was productive.

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