Final Evaluation Report

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EXECUTIVE SUMMARY

Project Pi r^2 is a science teacher professional development project designed and implemented by the Northwest Ohio Center of Excellence in Science and Mathematics Education (NWO) and funded by the Ohio Board of Regents. The focus of Project Pi r^2 is providing science teachers with high-quality professional development and outreach services from community partners. As a result, the project aims to improve the overall quality of the participating teachers' science lessons and thus increase the quantity and quality of the science learning done by the participating teachers' students. Project Pi r^2 is designed to meet five goals:

1. Help retain and support teachers in science and technology

2. Expose teachers to effective models in science instruction

3. Integrate educational resources in the region's classrooms to model inquiry and increase class time spent on STEM subjects

4. Improve student inquiry science process skills and science achievement

5. Promote the use of research-based best practices in science teaching in northwest Ohio classrooms consistent with local, state, and national standards

The evaluation of Project Pi r^2 is designed to measure the implementation of the project's activities as well as the impact of those activities on the participating teachers and their students. Therefore, several evaluation questions were developed based on that foundation:

1. How successful was the implementation of Project Pi r^2 activities? What challenges arose during the implementation of the activities, and how were the challenges addressed?

2. What impact did Project Pi r^2 have on teachers' science content knowledge?

3. What impact did Project Pi r^2 have on teachers' attitudes and beliefs toward and use of inquiry-based science teaching strategies?

4. What impact did Project Pi r^2 have on teachers' awareness and use of community resources in their classrooms?

5. What impact did Project Pi r^2 have on students' science content knowledge?

Thirty teachers from several districts in northwest Ohio participated in the project from June 2009 to September 2010.

Overall, the project's three major activities – the Community Resources Workshop, the Inquiry Series professional development sessions, and the classroom outreach programs – were successfully implemented. The activities involved with the classroom outreach programs were not always implemented in the intended manner, but were nevertheless engaging and valuable for both teachers and students.

The project was evaluated both quantitatively and qualitatively with several surveys, interviews, and observations. Most of the evaluation instruments were administered multiple times during the project to measure the change in participant outcomes. The project can be credited with the following accomplishments:

The project increased teachers' awareness of and confidence using community resources in their classrooms.

The results of the Community Resources Workshop Survey demonstrated that after the Community Resources Workshop, teachers were more aware of and more confident with using community resources in their classrooms.

Teachers' science content knowledge significantly improved as a result of participating in the project.

The results of the Teacher Science Content Knowledge Test demonstrated that teachers significantly improved their science knowledge as a result of participating in the project. Responses on the Teacher Reflection Surveys indicated that some teachers attributed their increase in science knowledge to the monthly professional development sessions, and others to the outreach programs that were implemented in their classrooms.

The project increased teachers' positive beliefs and behaviors regarding science teaching.

The results of the Teacher Beliefs Instrument demonstrated that, after participating in Project Pi r^2, teachers 1) were significantly more self-efficacious about teaching science, 2) used reform-based teaching strategies more frequently, 3) perceived reform-based teaching strategies to be more important, and 4) were significantly more prepared to use reform-based teaching strategies. Responses on the Teacher Reflection Surveys and Outreach Worksheets indicated that teachers increased their understanding and use of formative assessments to guide their science instruction.

Students were engaged in many outreach programs, and as a result, became more interested in science and significantly increased their science knowledge.

The results of the kindergarten interviews demonstrated that the students of the participating kindergarten teachers significantly increased their science knowledge as a result of engaging in the project activities. In addition, teachers commented that their students were more engaged and interested in science as a result of the project.

Several recommendations were made to assist the project staff with future planning and decision making. The recommendations are based on the knowledge of the project's implementation and impact, as well as the teachers' comments regarding the project.

Recommendation 1: Make the vision of project clear to all participants, including teachers, facilitators, and informal educators.

Some aspects of the project were not implemented as intended. The project would likely be improved by making expectations exceedingly clear at the beginning of the project. It may be helpful to create a document for each participant that outlines the ways in which the project is intended to be implemented, and periodically review the document throughout the duration of the project.

Recommendation 2: Remove or revise the distance learning aspect of the project.

Many teachers reported having trouble with the distance learning technology. Many teachers either did not have access to the technology, or experienced connectivity issues when trying to use the technology. In order for distance learning to be a meaningful part of the project, the staff should make sure that 1) most teachers have access to distance learning technology in their schools, and 2) the teachers or the information technology staff at the teachers' schools are familiar with and knowledgeable about distance learning technology.

Recommendation 3: Develop outreach programs to more closely align with grade-specific curricula.

Many teachers felt as though the outreach programs did not specifically address the science standards they were expected to teach during the year. This problem may be alleviated by following the first recommendation and improving the communication between teachers and informal educators. Also, the staff could collaborate with the informal educators to modify their outreach programs to more closely align to specific science standards.

Recommendation 4: Schedule more time during the project for teachers to share and discuss their thoughts, stories, and experiences regarding the project activities.

A common recommendation from teachers was to set aside discussion time, where teachers could share and discuss the things that have been happening in their classrooms during the project. This may help teachers to be consciously reflective about the project's activities, and to gain new ideas and insights as a result of the other teachers' thought and anecdotes.

INTRODUCTION

This report summarizes the activities and results of Project Pi r^2 (Partners in Inquiry Resources and Research) that took place from June 2009 to September 2010. After an overview of the project, this report will describe the evaluation design, including a description of the instruments and procedures used for data collection. This report will then describe the implementation and impact of Project Pi r^2 on the participating teachers and their students. The project's activities will be briefly described as well as the participant and staff's perceptions of how successfully the activities were implemented. The project's impact will be described regarding the outcomes outlined in the evaluation plan, namely teachers' awareness and use of community resources, science content knowledge, and attitudes and beliefs toward inquiry-based teaching, as well as students' science content knowledge. This report will conclude with a summary of the major findings as well as recommendations for the future implementation of project activities.

OVERVIEW OF PROJECT PI R^2

Project Pi r^2 was a science teacher professional development project designed and implemented by the Northwest Ohio Center of Excellence in Science and Mathematics Education (NWO) and funded by the Ohio Board of Regents. Additional funding for some components of the project, namely Science in the Park, was provided by Square One Education Network, BP-Husky LLC, and the Bowling Green Community Foundation. The focus of Project Pi r^2 was to provide science teachers with high-quality professional development and outreach services from community partners. As a result, the project aimed to improve the overall quality of the participating teachers' science lessons and thus increase the quantity and quality of the science learning done by the participating teachers' students. Project Pi r^2 was designed to meet five goals:

1. Help retain and support teachers in science and technology
2. Expose teachers to effective models in science instruction
3. Integrate educational resources in the region's classrooms to model inquiry and increase class time spent on STEM subjects
4. Improve student inquiry science process skills and science achievement
5. Promote the use of research-based best practices in science teaching in northwest Ohio classrooms consistent with local, state, and national standards

The teachers who participated in this project were kindergarten through high school science teachers from several districts in northwest Ohio. Beginning in June of 2009 and ending in September of 2010, the teachers participated in several activities – the Community Resources Workshop, NWO Inquiry Series, NWO Symposium, classroom outreach lessons provided by community partners, and Science in the Park.

OVERVIEW OF THE EVALUATION DESIGN

The evaluation of Project Pi r^2 was designed to measure the implementation and impact of the project's activities on the participating teachers and their students. The evaluation questions are listed below, accompanied by the general process by which each question was addressed.

1. **How successful was the implementation of the Project Pi r^2 activities?**

   Project activities were monitored throughout the school year to measure the extent to which they were being implemented as planned. In addition, teachers' perceptions of project activities were measured several times during the course of the project.

2. **What impact did Project Pi r^2 have on teachers' science content knowledge?**

   A test of science knowledge was administered to the participating teachers at the beginning and end of their professional development. The teachers' pretest and posttest scores were statistically analyzed to determine whether the changes in science content knowledge were significant.

3. **What impact did Project Pi r^2 have on teachers' attitudes and beliefs toward and use of inquiry-based science teaching strategies?**

   The Teacher Beliefs Instrument (TBI) was administered to the participating teachers at the beginning and end of their professional development. The teachers' presurvey and postsurvey scores were statistically analyzed to determine whether the changes in attitudes, beliefs, and use of inquiry-based teaching strategies were significant. In addition, classroom observations and monthly worksheets completed by teachers provided further evidence regarding the teachers' use of inquiry-based teaching strategies (including formative assessment).

4. **What impact did Project Pi r^2 have on teachers' awareness and use of community resources in their classrooms?**

   A survey was administered after the teachers had completed the Community Resources Workshop in June 2009. In addition, a survey was administered to teachers once a month from October to April to provide further evidence regarding their use of community resources in their classrooms.

5. **What impact did Project Pi r^2 have on students' science content knowledge?**

   The evaluation of student content knowledge was conducted with kindergarten students since there were more kindergarten teachers participating in the project than teachers from any other single grade level. An interview protocol that utilized picture cards was developed to measure kindergarten students' science content knowledge. Student interviews were conducted in Fall 2009 and Spring 2010.

In the following sections, the instruments and procedures briefly described above will be explained in greater detail.

DATA COLLECTION INSTRUMENTS AND PROCEDURES

NWO Inquiry Series Evaluation Survey

Since the Project Pi r^2 professional development sessions occurred during the NWO Inquiry Series, the participating teachers were asked to complete the NWO Inquiry Series Evaluation Survey each month (from September to April) in order to measure their perceptions of the Project Pi r^2 professional development activities. The NWO Inquiry Series Evaluation Survey is an online survey that includes several demographic questions (e.g., subjects taught, grade level, teaching status) and seven questions regarding the perceived quality and value of the professional development session. The seven "quality and value" questions were 4-point Likert style questions with an open-ended section where teachers could choose to leave comments. Teachers who attended the NWO Inquiry Series were entered into a prize raffle if they completed the evaluation survey. The NWO Inquiry Series Evaluation Survey can be found in Appendix A.

Teacher Science Content Knowledge Test

The teacher science content knowledge test was designed in alignment with the science content that was addressed during the professional development. Therefore, the changes in scores from pretest to posttest could more accurately be attributed to the professional development provided by Project Pi r^2. The test includes 20 items: 16 multiple-choice questions and 4 open-ended questions that yield a potential maximum score of 24. Most of the items were selected from existing content instruments, such as the instruments developed by MOSART[1], the Ohio Achievement and Graduation Tests, and the National Assessment of Educational Progress. The remaining items were developed by the project evaluator. A content specialist confirmed the scientific accuracy of the test before it was administered. The test was administered to the teachers in September 2009, before they had received any professional development, and also in April 2010. The teacher science content knowledge test can be found in Appendix B.

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[1] MOSART (Misconceptions-Oriented Standards-based Assessment Resources for Teachers) is an NSF-funded RETA (Research, Evaluation, and Technical Assistance) grant that has developed several multiple-choice instruments designed to measure K-12 students' science content knowledge.

Teacher Beliefs Instrument

The Teacher Beliefs Instrument (TBI) consists of two major sections: a modified version of the Science Teaching Efficacy Belief Instrument (STEBI[2]) and the Instructional Practices Inventory (IPI). In addition, the TBI also includes several demographic questions. The STEBI consists of 23 items that measure teachers' self-efficacy and outcome expectancy regarding science teaching. An example of a self-efficacy item is, "I know the steps necessary to teach science concepts effectively". An example of an outcome expectancy item is, "The inadequacy of a student's science background can be overcome by good teaching". The IPI consists of 31 items that measure teachers' perceived preparedness, importance, and use of reform-based teaching strategies. Some examples of reform-based teaching strategies are, "Have students investigate real-world problems", "Develop students' conceptual understanding vs. memorization of facts", and "Take students' prior knowledge into account when planning lessons". The TBI has been used by NWO for many years, and has consistently produced results that are valid and reliable. The TBI was administered to the teachers online, once in September 2009 and again in March 2010. The Teacher Belief Instrument can be found in Appendix C.

Community Resources Workshop Survey and Monthly Follow-up Surveys

The Community Resources Workshop Survey was administered to the teachers on the last day of the Community Resources Workshop in June 2009. The survey consists of 15 items that measure teachers' perceptions of the quality of the workshop as well as the impact the workshop had on the teachers' awareness of and attitudes toward community resources. The "impact" questions asked teachers to rate their opinions as they were when taking the survey (after the workshop), as well as what they were before the survey. In addition, the survey asked teachers to estimate their monthly use of community resources during the last school year (2008-2009), and then to estimate their monthly use of community resources for the following school year (2009-2010). In order to keep track of the teachers' monthly use of community resources in their classrooms, the teachers completed an online survey every month (from October 2009 to April 2010) that asked for the number of times the teachers had used community resources and which community resources they had used. The Community Resources Workshop Survey and Monthly Follow-up Survey can be found in Appendix D.

Outreach Worksheet

During the 2009-2010 school year, teachers received (in their classrooms) seven outreach programs from the Project Pi r^2 community partners (e.g., Toledo Zoo, Toledo Metroparks, Toledo Botanical Garden). In order to maximize the effectiveness of the outreach programs, the teachers were to administer a formative assessment to their students before receiving the outreach program. The assessment measured students' previous knowledge regarding

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[2] Riggs, I.M. & Enochs, L.G. (1990). Toward the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education, 74*(6), 625-637.

the content addressed by the outreach program. The teachers were then to report their findings to the outreach provider (one of the community partners) and discuss ways in which the outreach program could be tailored to meet the needs of the teacher's students. After the outreach programs, teachers were to administer another formative assessment to their students, and facilitate an extension activity that built upon the concepts addressed during the outreach program. In order to measure the extent to which these steps were taken, teachers were asked to complete an Outreach Worksheet for every outreach program they received. The Outreach Worksheet can be found in Appendix E.

Classroom Observation Instrument

The Classroom Observation Instrument was developed to measure the extent to which teachers use effective science instruction strategies in their classrooms. The instrument includes 11 items, some examples of which are, "Teacher asked students to provide evidence to support their claims or explain their reasoning when giving an answer" and "Teacher encouraged active student-student interactions (students worked collaboratively or cooperatively)". The items are scored based on the frequency with which the teacher demonstrates the behavior stated in the item. For example, a "0" is recorded for a particular item if the specified behavior is not observed during a lesson; a "1" is recorded if the behavior is infrequently observed, and a "2" is recorded if the behavior is frequently observed. The teachers participating in Project Pi r^2 were observed[3] during each of the outreach programs delivered by the community partners. The teachers were expected to co-facilitate the outreach programs, so the teaching strategies included in the observation instrument could potentially be observed during the programs. The Classroom Observation Instrument can be found in Appendix F.

Kindergarten Picture Card Interview Protocol

Eight to ten random students of each participating kindergarten teacher were interviewed for the evaluation of their science content knowledge. The interview protocol was developed to align with the science concepts that were addressed by the Project Pi r^2 professional development as well as the Ohio Academic Science Standards for kindergarten. The interview consisted of four tasks during which the students were asked a number of questions about a set of picture cards. The students' performance on the four tasks measured the students' knowledge of the day and night sky, living and non-living things, heredity, and observable features of animals. The students were interviewed in a quiet place in their classroom or school, away from the other students in the classroom. The students of the participating teachers were interviewed once in October and again in May. The kindergarten interview protocol along with the pictures that were used can be found in Appendix G.

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[3] The teachers were observed by the community partners who delivered the outreach programs as well as scientists from Bowling Green State University, The University of Toledo, Lourdes College, Owens Community College, and The University of Findlay.

Teacher Reflection Survey

The participating teachers were asked to reflect on how successfully the project activities were implemented as well as the impact the project had on their content knowledge, attitudes and beliefs, and their students' interest and knowledge about science.

Informal Educator Reflection Survey

The informal educators who facilitated the Inquiry Series professional development sessions and provided outreach programs to teachers' classrooms were asked to reflect on how the successfully the project activities were implemented as well as the impact the project had on their organization.

THE IMPLEMENTATION OF PROJECT PI R^2

In this section, I will briefly describe the three major activities of Project Pi r^2 – the Community Resources Workshop, the Inquiry Series professional development sessions, and the outreach programs – and the extent to which those activities were successfully implemented. First, however, a description will be given of the teachers who participated in Project Pi r^2.

TEACHER PARTICIPANTS

A total of 30 teachers from northwest Ohio were recruited to participate in Project Pi r^2. Of the original 30 teachers, 29 regularly attended and completed the major project activities. Most of the participants were female, white (non-Hispanic), primary (K-3) teachers from urban or suburban school districts. Most of the teachers (21) had never participated in a professional development program offered by NWO. The participating teachers represented 14 different school districts from northwest Ohio, 10 of which were public. Of the 10 public districts, 6 had a district effectiveness rating of "Excellent", 3 had a rating of "Effective", and 1 had a rating of "Continuous Improvement". Table 1 summarizes the demographic information obtained from the Teacher Belief Instrument and the Ohio Board of Regents Preliminary Participant Survey.

Table 1. Demographic information for Project Pi r^2 teachers

Demographic Variable	Values	N	%
Gender	Female	28	97%
	Male	1	3%
Racial/Ethnic Background	White, non-Hispanic	28	97%
	Hispanic	1	3%
Grade Level	K-3	18	62%
	4-6	4	14%
	7-8	5	17%
	9-12	2	7%
Subjects Taught	Science	5	17%
	Math	2	7%
	Both	22	76%
Highest Degree Earned	Bachelor's	6	21%
	Specialist's	1	3%
	Master's	22	76%
Type of School	Public	25	86%
	Private	4	14%
Teaching Experience (in years)	Minimum	4	-
	Maximum	40	-
	Average	19	-

COMMUNITY RESOURCES WORKSHOP

The Community Resources Workshop (CRW) is a one-week summer professional development program that has been implemented in Toledo since 1998. Teachers who attend the CRW become more aware of and familiar with local educational resources by visiting several community organizations and hearing presentations from several additional organizations.

The 2009 CRW ran from June 15-19, and was the first major component of Project Pi r^2. Although Project Pi r^2 and the CRW are separate programs, most of the teachers who attended the 2009 CRW were Project Pi r^2 participants. In fact, a few teachers who were not originally enrolled in Project Pi r^2 were recruited by the end of the CRW. During the 2009 CRW, teachers visited the Franciscan Center at Lourdes College, Wildwood Metropark, The Blade, The Toledo Museum of Art, WGTE Public Media, The Toledo Zoo, the

Challenger Learning Center of Lucas County, Fifth Third Field (of the Toledo Mud Hens), and the Toledo Public Library. In addition, the teachers were engaged in presentations by organizations such as the Wolcott House, Nature's Nursery, and Toledo Botanical Garden.

A total of 37 teachers completed the CRW Evaluation Survey, 20 of which were also Project Pi r^2 teachers. Based on the teachers' survey responses, it can be concluded that the CRW was successfully implemented. The teachers demonstrated positive attitudes toward the CRW, and seemed to believe the activities and information provided by CRW were valuable and important. Table 2 presents the results from a portion of the CRW Evaluation Survey.

Table 2. Participants' attitudes regarding the implementation and personal impact of the CRW

Survey Items	**% of responses in each category***				
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
4. I learned new things about local resources	0%	0%	0%	14%	86%
5. I will use the information I learned in my classroom	0%	0%	0%	19%	81%
6. This workshop met my expectations	0%	0%	3%	16%	81%
7. I would recommend this workshop to others	0%	0%	0%	8%	92%

* n = 36

The comments provided by the teachers were also positive and further demonstrated the successful implementation of the CRW. Some examples of teachers' comments include:

The week was well planned. I can't wait to start preparing for the new school year.

It was the most valuable, applicable workshop I've taken in many years!

INQUIRY SERIES PROFESSIONAL DEVELOPMENT SESSIONS

During the school year, the teachers participating in Project Pi r^2 attended monthly professional development sessions that were held in conjunction with the NWO Inquiry Series, a free professional development opportunity for K-12 STEM (Science, Technology, Engineering, and Mathematics) teachers, administrators, and undergraduate students in northwest Ohio. The Inquiry Series includes several sessions regarding STEM teaching and learning that participants can choose to attend (see Appendix H for the 2009-2010 Inquiry Series brochure).

Project Pi r^2 teachers participated in professional development activities each month (from September 2009 to April 2010) that were designed to improve the teachers' knowledge of science content and effective teaching strategies. Each month, the professional development addressed a different science concept such as animal adaptations, heredity, the universe, and soil. The content addressed in each session was aligned with the Ohio Academic Science Standards for Kindergarten through 8th grade, thus making the professional development relevant for all of the teachers in attendance. Table 3 describes the science content that was addressed each month.

Table 3. Science content addressed during the Pi r^2 sessions of the NWO Inquiry Series

Month	Science Content	Community Organization that Facilitated the Session
September	Animal Adaptations	The Toledo Zoo
October	Heredity	Sauder Village
November	Native Plant and Animal Species Profiling Plants and Animals	The Toledo Metroparks Toledo Botanical Garden
December	The Universe	Challenger Learning Center of Lucas County
January	Soil	Toledo Botanical Garden
February	Geology (via distance learning)	LEARNco (Northcentral Ohio Educational Service Center)
March	Renewable and Non-renewable Resources	Seven Eagles Historical Society

The professional development sessions were co-facilitated by a K-12 teacher leader, a scientist, and an informal educator (from a community organization such as the Toledo Zoo). The general format of the professional development sessions went as follows:

1. The teachers participated in a formative assessment activity, which allowed the session facilitators to see what the teachers already knew about the science concept that was going to be addressed during the session. The activity also introduced the teachers to the science concept they would explore during the professional development session.
2. The teachers explored the science concept through a short inquiry-based activity facilitated by the K-12 teacher leader and scientist.
3. The informal educator facilitated a one-hour activity about the science concept. These activities were modified versions of the activities the informal educators delivered to the teachers' students during the outreach phase of the project. The "teacher version" was more comprehensive and complex regarding the science content.
4. The K-12 teacher leader, scientist, and informal educator facilitated a wrap-up activity that extended the content addressed earlier in the session.

The teachers' perceptions of the sessions were evaluated by analyzing the teachers' responses to the monthly Inquiry Series Evaluation surveys. In particular, teachers' responses to three questions from the Inquiry Series Evaluation survey ("The session met my expectations", "The session was engaging", "The content/information presented during the session was valuable to me") were analyzed to determine the extent to which teachers perceived the implementation of the sessions successful. The survey results demonstrated that Project Pi r^2 sessions consistently met teachers' expectations, and that teachers perceived the Project Pi r^2 sessions to be highly engaging and valuable. Table 4 includes a summary of the teachers' responses for the three questions used to determine the extent to which the sessions were successfully implemented.

Table 4. Summary of teachers' perceptions regarding the implementation of Project Pi r^2

Survey Question: The [Project Pi r^2] session met my expectations					
Month	Responses				n
	Disagree	Somewhat Disagree	Somewhat Agree	Agree	
October	0	1	9	13	23
November*	-	-	-	-	-
December	0	3	9	12	24
January	0	0	1	22	23
February	0	0	2	16	18
March	0	2	2	14	18
Total	0	6	23	77	106
Survey Question: The [Project Pi r^2] session was engaging					
Month	Responses				n
	Disagree	Somewhat Disagree	Somewhat Agree	Agree	
October	0	1	7	15	23
November	0	0	1	22	23
December	1	2	8	13	24
January	0	0	1	22	23
February	0	0	2	15	17
March	0	2	3	13	18
Total	1	5	22	100	128
Survey Question: The content/information presented during the [Project Pi r^2] session was valuable to me					
Month	Responses				n
	Disagree	Somewhat Disagree	Somewhat Agree	Agree	
October	0	2	6	15	23
November	0	0	2	21	23
December	1	3	9	11	24
January	0	0	2	21	23
February	0	1	2	15	18
March	0	1	5	12	18
Total	1	7	26	95	129

* The November session was held at the NWO Symposium, which was evaluated with a different survey. Teachers were not asked if the sessions met their expectations.

The Inquiry Series Evaluation surveys also gave teachers opportunities to provide comments about the survey questions and their responses to the questions. The comments that were provided by the teachers regarding the three evaluation questions above further illustrated the successful implementation of Project Pi r^2. Many of the teachers' comments addressed the capacity of the project and its facilitators to apply science lesson ideas to multiple grade levels. Some examples include:

> *Loved how the [facilitators] met many grade levels and interspersed different grade levels throughout the evening!*

> *The presenters tried to bring the information to all levels.*

The comments also reflected teachers' intentions to use the instructional strategies and curricular materials in their classroom. Some examples include:

> *I look forward to this community resource coming into my classroom.*

> *I will be using the container that was made for us in my classroom. I can't wait to see the reaction of my students.*

CLASSROOM OUTREACH PROGRAMS

As part of their participation in Project Pi r^2, teachers were given nine outreach programs throughout the school year. The outreach programs were inquiry-based "traveling programs" conducted in the teachers' classrooms by one or more informal educators from community science organizations such as The Toledo Zoo and Toledo Botanical Garden. Table 5 includes descriptions of several of the outreach programs provided by the informal educators. Teachers and informal educators were expected to follow the format outlined in Figure 1 regarding the implementation of the outreach programs.

Figure 1. Intended format for the implementation of outreach programs during Project Pi r^2

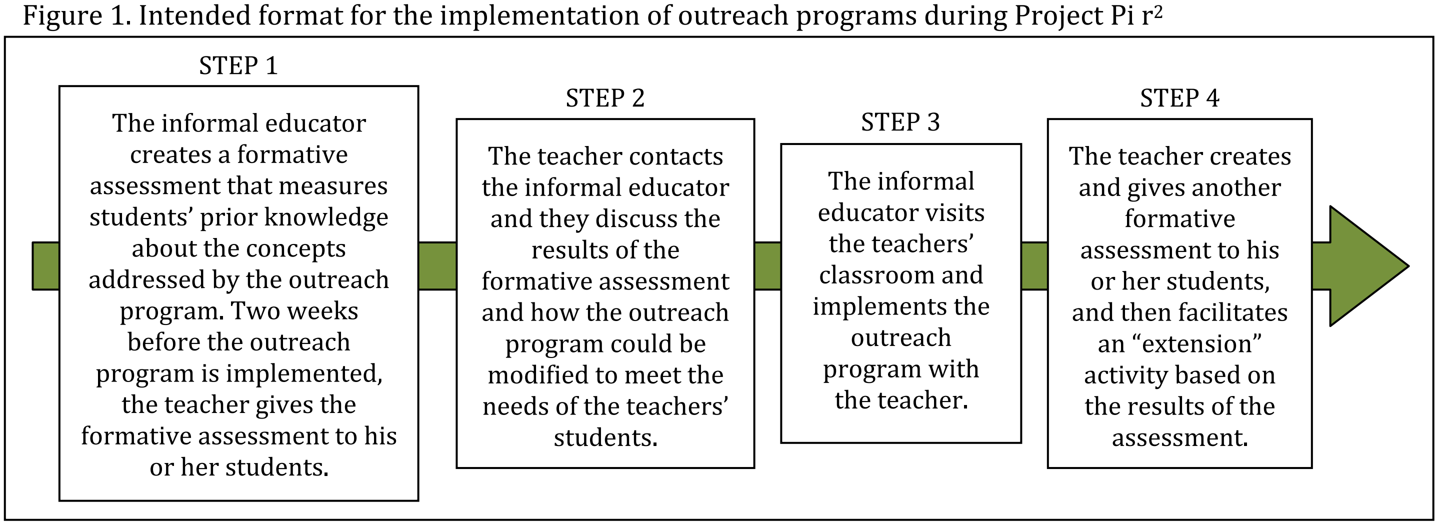


Table 5. Outreach programs provided by community science organizations for Project Pi r^2

Community Science Organization	Outreach Program	Program Description
The Toledo Zoo	Reptiles and Amphibians: Defense Mechanisms	To introduce the topic of defense mechanisms, specifically camouflage, the students played a relay race and worked in groups to find paper snakes in their "habitat," (the snakes that were the same color as the "habitat" were harder to find). Students explored other defense mechanisms by feeling and guessing the identity of several biofacts that were hidden from the students' view. Students looked at pictures of reptiles and amphibians to determine different defense mechanisms that the creatures use to protect themselves from predators. The students also observed a live reptile & amphibian and determined their defense mechanisms.
	Animal Adaptations	This program looked into the "tools" or "adaptations" that animals have to help them survive in their environments. The students started off by drawing an animal in groups and discussing the different parts the animals have on their bodies. The students then helped the lucky teacher "dress for success" by adding accessories like camouflage, a tail, claws, and more! To wrap up the lesson, the students looked at some live animals and pointed out their adaptations.
Sauder Village	Heredity	Using Heritage Varieties of Vegetables and Heritage breeds of animals, this program walked students through the basics of how characteristics are passed on from "parents" to offspring, how variations in characteristics can occur either naturally or be design and reasons why we sometimes 'breed' for certain characteristics depending on our needs. Graphing and prediction were also used in this program.
	Spinning	Incorporating the storybook "Woolbur" this program provided students the opportunity to learn how wool is transformed into yarn and then clothing. Science focus included simple machines, variations among members of the same species, where items come from (nature made vs. machine made) and how simple processes can transform one product into another.
	History's Mysteries	This program used the theme of history detectives to sharpen students' inquisitive thinking skills using the scientific method of learning. Students learned about artifacts (man vs. nature made) and were tasked with taking an unknown artifact and using various research methods to first hypothesize what the item might be and then determine through research what it really was and then compare their results.

Table 5 continued

Community Science Organization	Outreach Program	Program Description
Toledo Botanical Garden	Profiling Plants and Animals	The goal of this program was to have students gain an appreciation for how and why plants and animals are grouped and classified. Students sorted artificial fruits and vegetables into 2 groups using such characteristics as (Fruit/Vegetable, Grows on a Tree/Does Not Grow on a Tree, Grows in Ohio/Does Not Grow in Ohio, etc.). The students then used their categories to determine the identity of a "mystery fruit". For the second activity each group of students received a set of "beaks" representing an imaginary bird, and a set of containers representing different types of "bird food". Students then experimented with each type of bird beak and determined which food would be easiest for that imaginary bird to eat.
	D.I.R.T.	We began by having students simply investigate a sample of soil using magnifying glasses and microscopes. Next we used a pot containing many of the components of soil (weathered rock, sand, silt, clay, air, water, plant material and small animals). We discussed the different components of soil and took time to discuss how rocks break down to smaller pieces. Then we gave students pure samples of sand, silt and clay to look at with the microscopes. We talked about how soil is a mixture of these three particle sizes and asked them to make a prediction, based on their observations, about whether their soil contained mostly sand, silt or clay. Then we had students set up a sedimentation experiment with their soil sample to test their prediction. We ended the presentation with a short activity to experiment with 3 different agents of weathering: wind, friction/gravity, and water.
	Introduction to a Garden	We asked the students what they knew about a garden and discussed the fact that besides plants you can also find animals in a garden. Each student then chose a puppet out of a bag and we talked about what the animal was and why it would live in the garden. Next we read the book The Tiny Seed and discussed how seeds travel. Each student received a clear plastic container of seeds and a magnifying glass to look at their seeds more closely. We then asked the students to decide how their seeds might travel based on our four categories: Fly on the wind, Hitchhiker, Carried and Buried, or Eaten and Expelled.

Table 5 continued

Community Science Organization	Outreach Program	Program Description
Toledo Metroparks	Heredity	Students investigated animals and their parents by examining photographs of our native species. Students used a "Think, Pair, Share" strategy for developing an awareness of the similarities and differences between the adult animals and their offspring. Attention was paid to the differences in body structures and coverings and how these are inherited from the parent. Animal pelts and turtle shells were used demonstrate the variety of physical characteristics within the same kind of animals.
	Native Species	The diverse native species found within the Toledo park system were the focus of this program. Kindergarten and first grade students developed rules for defining living and non-living things, second graders investigated how our native species face loss of habitat and third through high school students identified mammal skulls to discover how our native species survive in different environments and interact with other organisms. While photographs were used in place of actual animals, all students were given opportunities to handle biofacts (e.g., skins, skulls, shells and feathers).

The teacher and informal educator reflections, along with the teacher outreach worksheets, provide some evidence regarding the extent to which the outreach programs were implemented as intended (see Figure 1).

Since communication between the teachers and informal educators was an important part of the project, the teachers and informal educators were asked to reflect on the communication that occurred between them regarding the outreach programs. The responses indicated that some teachers and informal educators communicated more than others. While most of the teachers reported receiving a pre-assessment from the informal educators before the outreach program (see Step 1 in Figure 1), some noted that the results of the assessment were not discussed with the informal educator (see Step 2 in Figure 1). Similarly, most the informal educators mentioned that, although pre-assessments were sent to the teachers ahead of time, very few teachers contacted the informal educators to discuss the results of the assessment. Some teachers, according to the informal educators, summarized the results of the assessment when the informal educators arrived at the teachers' classroom to teach the outreach program.

The informal educators were also asked to reflect on the extent of the teachers' involvement during the outreach programs. This prompt was included in the informal educator reflection survey because one objective of the project was to encourage teachers and informal educators to co-facilitate the outreach programs (see Step 3 in Figure 1). The responses from the informal educators indicated there was a large range of teacher involvement, from teachers passively watching the program or grading papers to facilitating activities and interacting with students. Data from the classroom observations supported this finding. Future iterations of this project would likely be improved by clarifying the project's expectations regarding communication and outreach implementation.

Since many of the teachers were not involved or minimally involved in the facilitation of the outreach programs, the classroom observations conducted by the university scientists (n=23) did not provide much information regarding the teaching strategies employed by the teachers. Instead, many of the scientists observed the teaching strategies of the informal educators, and thus provided information regarding the quality of the outreach programs. Overall, the scientists' observations indicate that the outreach programs were successfully implemented. The scientists reported that the informal educators kept the students engaged and provided appropriate guiding. One scientist wrote:

> *[The informal educator] kept the students' attention and easily led and controlled the discussion in a manner that was open-ended, non-threatening, yet challenging for all participants. The nature of the presentation, to distribute historical artifacts and challenge students to use reasoning to determine their use, proved to be an effective way of engaging students in scientific exploration and analysis.*

The outreach worksheets completed by the teachers[4] demonstrated that, after the outreach programs had been taught in their classrooms, most of the teachers created and administered a formative assessment to their students, and facilitated an extension activity based on the assessment (see Step 4 in Figure 1).

As part of the overall project reflection, the teachers were asked to respond to the prompt, "Describe your experiences with the outreach programs. Were they successful? Was it hard to fit them into your teaching schedule? What challenges did you face?". The teachers reported having positive experiences with the outreach programs, and many teachers mentioned that their students enjoyed and were engaged in the outreach programs. One challenge commonly found in the teachers' responses to the prompt was the timing of the outreach programs. Many teachers mentioned that it was difficult to schedule the outreach programs to fit with what they were teaching during a particular time of the year. Often, the outreach programs would be delivered before or after the teacher had taught the concepts that were addressed by the outreach program. Examples of these responses include:

> *The only problem I had with outreach programs was timing. Obviously, we had to schedule in advance, but there were programs that would have worked better at different times of the school year.*

> *I think [the outreach programs] would have been more effective had I been teaching some of the topics at the time the presenters came.*

Regardless of this issue, teachers seemed to be grateful for the opportunity to have outreach programs in their classrooms. One teacher wrote:

> *[The outreach programs] didn't always fit with my timing of a unit, but I didn't care. It could always be intro, extension, or review at any time of the year.*

IMPACT OF PROJECT PI R^2 ON TEACHERS

This section will include information regarding the impact of Project Pi r^2 on teachers' awareness and use of community resources, science content knowledge, and attitudes and use of reform-based teaching strategies.

AWARENESS AND USE OF COMMUNITY RESOURCES

Teachers' responses to the Community Resources Workshop (CRW) survey were analyzed in order to measure the impact of the project on teachers' awareness and use of community resources. There were 20 usable responses from the survey. A Wilcoxon test was conducted to evaluate whether the participants' attitudes significantly changed as a result of the CRW. The results indicated significant changes in the positive direction (more

[4] About 70% of the teachers completed and returned outreach worksheets for each of the outreach programs that were taught in their classrooms.

agreement) for each item. For Item 8, 19 teachers gave more positive responses after the CRW (Z=-3.867, p<.001); for Item 9, 18 participants gave more positive responses after the CRW (Z=-3.782, p<.001); and for Item 10, 11 participants gave more positive responses after the CRW (Z=-3.017, p<.001). See Table 6 for the percentage of responses chosen for each item.

Teachers were also asked to approximate the number of times per month they used community resources in their classroom during the last year (2008-2009), and the number of times per month they planned on using community resources in their classroom the following year (2009-2010). A Wilcoxon test was conducted to see if the number of times predicted for the following year were significantly different from the number of times approximated for the last year. The results indicated that the number of times predicted for the following year was significantly higher than the number of times approximated for the last year (Z=-3.879, p<.001). Thirty participants predicted they would use community resources more the following year than they did the previous year. See Table 7 for the percentage of responses given for each category.

Table 6. Participants' responses regarding their awareness and attitudes about community resources

Survey Items	% of responses in each category*									
	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
8. I am aware of the educational resources/services that are offered by local organizations**	5%	0%	30%	0%	30%	0%	35%	10%	0%	90%
9. I can confidently integrate community resources into my lesson plans**	5%	0%	30%	0%	20%	0%	40%	20%	5%	80%
10. Using community resources in my lesson plans can get my students excited to learn**	0%	0%	0%	0%	30%	0%	25%	5%	45%	95%

* n=20
** The results of the Wilcoxon test indicated that participants' responses were significantly more positive after the workshop (Z=-3.867, p<.001; Z=-3.782, p<.001; Z=-3.017, p<.001; respectively for Items 8, 9 and 10)

Table 7. Participants' responses regarding their prior and future use of community resources

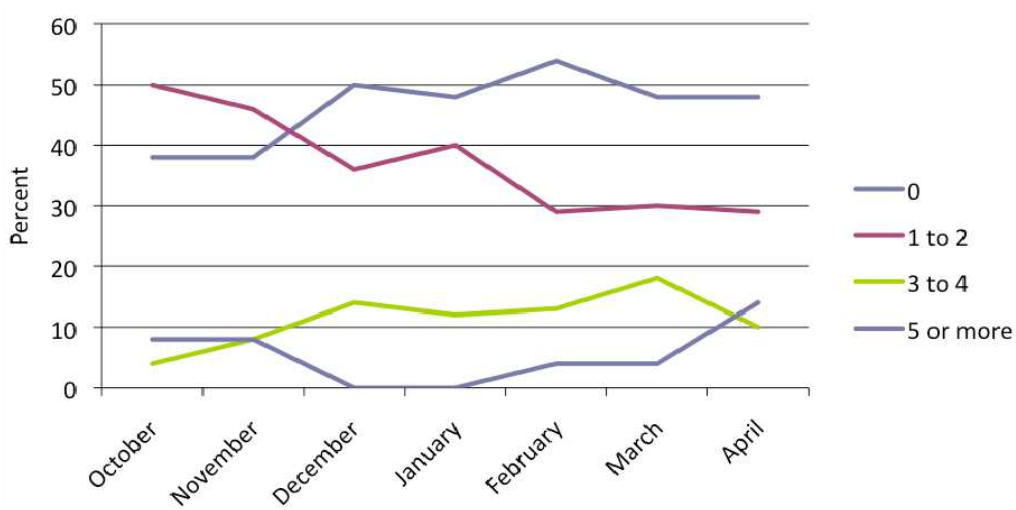
Survey Item	% of responses in each category*							
	0 times		1-2 times		3-4 times		5+ times	
	Last	Next	Last	Next	Last	Next	Last	Next
11 (12). How many times per month did you (do you plan to) use community resources in your classroom last (next) year?**	35%	0%	65%	50%	0%	35%	0%	15%

* n=20
** The results of the Wilcoxon test indicated that participants anticipated a significant increase in their use of community resources for the following year compared to last year (Z=-3.879, p<.001)

Throughout the school year, teachers completed monthly surveys that documented their use of community resources. The responses to these surveys were used to measure the accuracy of the teachers' predictions regarding the use of community resources in their classroom. At the beginning of each month, teachers were asked to reflect on the past month and report how many community resources they had used. Figure 2 illustrates the percentage of teachers who chose each category (0, 1 to 2, 3 to 4, 5 or more) for each month. The response pattern looks more similar to their use of community resources during the previous year (2008-09) than their predictions for the 2009-10 year. For most months, the majority of teachers reportedly used zero community resources in their classrooms.

It is important to note that teachers were asked to *not* include the outreach programs that were paid for by the project. Therefore, it's likely that teachers were using more community resources per month than what is reflected by the results of the follow-up surveys. Furthermore, it's quite possible that teachers were not using extra community resources in their classrooms because they already felt pressure to schedule and facilitate the outreach programs. Had the teachers not been provided with free outreach programs, their monthly use of community resources may have been closer to their predictions.

Figure 2. Teachers' monthly use of community resources in their classroom



SCIENCE CONTENT KNOWLEDGE

Science content knowledge tests were administered in October 2009 and April 2010, before and after the teachers' engaged in professional development focused on science content. The teachers' content test scores demonstrated that the test was fairly difficult. The multiple-choice items on the pretest ranged in difficulty from .17 to .83, with a mean item difficulty of .52[5]. The multiple-choice items on the posttest ranged in difficulty from .33 to .92 with a mean item difficulty of .61. Reliability analyses were conducted with both pre and posttest scores, and the alpha coefficient values[6] indicated that both sets of data were less reliable than what it typically deemed "acceptable" (> 0.70). One explanation for the low observed reliability is that the test measured teachers' knowledge regarding multiple science topics and domains (some life science topics, some earth science topics, and some space science topics). Therefore, although the test is a measure of "science knowledge", items that measure knowledge about different science domains may not be highly correlated if teachers have more knowledge about one of the domains. Since the teachers completed the test twice (fall and spring), the test reliability also can be measured using the test-retest method, which is based on the correlation between the two test scores. The correlation between the pre and posttest scores was .67, a strong positive correlation, which indicates that the test is sufficiently reliable. A dependent t-test demonstrated that teachers' post-test scores were significantly greater than the pre-test scores, meaning that teachers significantly increased their science content knowledge during Project Pi r^2. Table 8 includes a summary of the science content test analyses, including mean test scores, standard deviations, t score, effect size, and reliability coefficients.

Table 8. Summary of science content test analyses

N	Mean pretest score (S.D.)	Mean posttest score (S.D.)	t	Effect size (Cohen's d)	Pretest Reliability (α)	Posttest Reliability (α)
22	11.9 (3. 6)	13.9 (4.0)	3.07**	.52	.59	.64

Note: ** p < .01
Note: Conventionally, effect sizes around 0.5 are considered to be "medium" while those larger than 0.8 are considered to be "large"

The impact of Project Pi r^2 on teachers' science content knowledge was also determined by analyzing the teachers' responses to the prompt, "Describe how Project Pi r^2 affected your science content knowledge and your attitudes/confidence regarding inquiry-based science teaching", on the Teacher Reflection Survey. In general, the responses demonstrated that teachers felt more knowledgeable about science as a result of the project. Specifically, a few teachers mentioned the monthly professional development sessions and one teacher mentioned the outreach programs as reasons for their increase in science knowledge.

> *The monthly meetings helped to introduce me to the science content and made me more confident in teaching the concepts that were being introduced.*

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[5] The item difficulty is simply the percentage of test-takers who answered the item correctly. Therefore, low item difficulties actually represent more difficult items.
[6] Alpha coefficient values indicate the internal consistency of the test, which is a measure based on the correlations between the items on the test. If the test purports to measure a single underlying construct, then the items on the test should be correlated, the alpha coefficient value should be fairly high.

The monthly meetings that focused on different science content helped me to grow in my knowledge.

The way that Pi r^2 affected my science content knowledge was that the presenters that came to our room are experts in their field. Listening to them talk with my students, I also learned.

BELIEFS AND BEHAVIORS REGARDING SCIENCE TEACHING

Teachers' beliefs about behaviors regarding science teaching were measured with the Teacher Beliefs Instrument, Outreach Worksheet, Classroom Observation Instrument, and Teacher Reflection Survey.

The TBI was administered online to teachers in October 2009 and April 2010. The TBI measured teachers' self-efficacy and outcome expectancy beliefs about science teaching[7]. The self-efficacy section of the TBI consists of 13 items with a five-point scale (5=Strongly Agree, 4=Agree, 3=Neutral, 2=Disagree, 1=Strongly Disagree). The outcome expectancy section of the TBI consists of 10 items and uses the same five-point scale. The TBI also includes an Instructional Practices Inventory, which lists 31 reform-based teaching strategies for which teachers are asked to rate a) how frequently they use the strategy in their classroom, b) how important the strategy is for effective teaching, and c) how prepared they feel to use the strategy. Examples of reform-based strategies are, "ask students to explain concepts to one another", "allow students to construct their own understandings", and "take students' prior knowledge into account when planning lessons". All items are measured on a four-point scale, which is defined below:

Frequency

1=Never, 2=Rarely, 3=Sometimes, 4=Frequently

Importance

1=Not Important, 2= Somewhat Important, 3=Important, 4=Very Important

Preparedness

1=Not Prepared, 2= Somewhat Prepared, 3=Prepared, and 4=Very Prepared

[7] For this survey, self-efficacy reflects teachers' confidence in their ability to teach science effectively, and outcome expectancy reflects teachers' belief that effective science teaching will result in student learning.

The results of the TBI demonstrated that, after participating in Project Pi r^2, teachers 1) were significantly more self-efficacious about teaching science, 2) used reform-based teaching strategies more frequently, 3) perceived reform-based teaching strategies to be more important, and 4) were significantly more prepared to use reform-based teaching strategies. Teachers' outcome expectancy beliefs did not significantly improve. Table 9 includes a summary of the TBI analyses, including the mean presurvey and postsurvey scores, standard deviations, t score, effect size, and reliability coefficients for each scale.

Teachers were also asked to report the number of hours per week they teach science; one objective for Project Pi r^2 was to increase this number. The results of a dependent t-test, however, demonstrate that teachers did not significantly increase the number of hours per week they teach science (see Table 9). It may be unreasonable to expect teachers (especially elementary teachers who are self-contained) to dramatically shift their teaching schedule over the course of one year. Many of the schools at which the teachers work have instructional pacing guides that may have made it difficult to increase the amount of time science was taught.

The Outreach Worksheets demonstrated that teachers facilitated extension activities with their students that included many reform-based science teaching strategies, including cooperative learning and student-led experimentation. Also, many of the activities were cross-disciplinary in nature, using Reading and Art to further learn about science.

The Outreach Worksheets also demonstrated that teachers generally created and utilized their formative assessments to guide/modify further instruction. One teacher wrote the following in one of his/her outreach worksheets:

> *The results [of the formative assessment] were very different than what I was expecting. Only half the students understood that the ability to run fast couldn't be an inherited trait. They were just as confused at whether or not black hair and green eyes could be passed down. I could also see their confusion during the moth activity [done during the outreach program] as well. Since the formative assessment showed me that students did not understand the concept of inherited versus acquired traits, I had to change the original extension activity I had planned.*

The Outreach Worksheets and Teacher Reflection surveys illustrated that most of the teachers increased their knowledge regarding formative assessment and its applications for science teaching and learning. Responses on the Teacher Reflection survey illustrated that teachers learned that formative assessments can be administered in dozens of ways, not just in paper and pencil format. Also, many of the teachers reported (on the Outreach Worksheets) using the formative assessment ideas from the book they received by Page Keeley[8].

[8] Keeley, P. (2008). *Science formative assessment: 75 strategies for linking assessment, instruction, and learning*. Thousand Oaks, CA: Corwin Press.

Table 9. Summary of TBI analyses

Scale	N	Pre-survey Mean (S.D.)	Post-survey Mean (S.D.)	t	Effect Size (Cohen's d)	Pre-survey Reliability (α)	Post-survey Reliability (α)
Self-efficacy	25	49.0 (6.7)	51.6 (4.6)	2.28*	.45	.91	.87
Outcome Expectancy	25	36.9 (4.1)	37.3 (3.8)	.53	.10	.78	.76
Frequency	25	92.5 (10.7)	100.0 (10.2)	4.08***	1.90	.85	.90
Importance	25	98.2 (11.0)	104.0 (11.6)	4.01**	.51	.92	.93
Preparedness	25	80.4 (15.2)	91.6 (14.2)	4.00**	.76	.94	.95
No. of hours per week	22	5.6 (8.7)	6.7 (9.4)	.75	.12	-	-

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Note: Conventionally, effect sizes around 0.5 are considered to be "medium" while those larger than 0.8 are considered to be "large"

The Classroom Observation Instrument was intended to measure teachers' use of reform-based science teaching methods, such as asking higher order questions, allowing students to construct their own knowledge, and encouraging student-student interactions. However, the methodology for collecting the observation data was not effectively implemented, thus resulting in two outcomes: 1) less observations were done than was intended, and 2) the nature of the collected data was different than was intended. An average of four observations were conducted for each teacher, as opposed to seven, which was the original intention. Therefore, the number of observations for each teacher was not enough to detect a change in teaching strategies during the course of the project. In addition, since many teachers were not involved or minimally involved with the facilitation of the outreach programs, the classroom observations (done by the informal educators and scientists) did not provide much information regarding the teaching strategies employed by the teachers. In fact, many of the strategies that were supposed to be observed were given the rating "N/A" due to the teachers' minimal involvement. Even when the teachers were involved, some of the informal educators reported being too busy with the program facilitation to pay attention to the teachers' teaching strategies. Teachers' involvement in the outreach programs generally consisted of managing classroom behavior and encouraging students to participate.

Regardless of the data collection issues, the classroom observations did provide some information about the teachers' behaviors regarding science teaching. First, the observations indicated that most of the teachers' classrooms appeared as though students regularly engaged in inquiry-based science. For example, plants, animals, and science books were observed to be in many of the classrooms. In addition, student desks were often observed to be in clusters, and student work was often posted on the classroom walls. Second, the observations indicated that, during the outreach programs, the students were not afraid to share their ideas and answer questions. This finding demonstrates that teachers have created a learning environment where students feel free to express their ideas. Third, the observations indicated that teachers "encouraged active student-student interactions". This teaching strategy was the most commonly rated (as a 1 or 2), and was often rated even if most of the other teaching strategies were given the rating of "N/A".

THE IMPACT OF PI R^2 ON STUDENTS

Interviews were conducted with the kindergarten students in Fall 2009 and Spring 2010 in order to measure the impact of Project Pi r^2 on student science knowledge. Kindergarten was chosen as the target grade for student science knowledge because it was the most represented by the teachers in the project (almost 30% of the teachers taught kindergarten). The sample of students included an equal number of boys and girls, and a fairly equal number of high and low ability students. Before the interviews, most teachers were specifically asked to choose an equal number of boys and girls and high and low ability students. For four or five of the classrooms, the interviewer randomly chose an equal number of boys and girls from the class roster. It's likely that this method also resulted in a fairly equal number of high and low ability students. Most of the interviews were conducted in a quiet place away from the rest of the class (in the hallway or the library). An interview protocol was followed in which students were shown pictures of objects and organisms, and then were asked several questions regarding the pictures. For one task, students were shown eleven pictures of living and non-living things, and were asked to sort them and explain their reasons the sorting the pictures the way they did. For another task, students were shown a picture of a polar bear, and were asked to identify physical features that help the polar bear survive. For all tasks, the students' responses were documented and scored for correctness. A scoring rubric was created and followed to ensure that the scoring was uniform for all interviews. For most tasks, students received one point for each correct response. For example, students received one point for each correctly sorted picture in the "living and non-living" task. A maximum score was applied to some tasks that had a large number of possible correct responses. For example, when asked about the similarities between a baby and adult deer, students could have potentially given five or six correct responses. A maximum score of three allowed for adequate variability among the students. After the interviews had been scored, an independent t-test demonstrated that student science knowledge significantly increased during the project. Table 10 includes a summary of the interview analysis. An independent t-test was conducted instead of a dependant t-test because the pre-project and post-project interview groups mostly consisted of different students. However, since students in each classroom were randomly selected for the interviews, there were instances where the same student was selected for both pre- and post-project interviews.

Table 10. Summary of kindergarten student interview analysis

N (Pre)	N (Post)	Mean pre score (S.D.)	Mean post score (S.D.)	t	Effect size (Cohen's d)	Pre Reliability (α)	Post Reliability (α)
52	48	26.0 (3. 7)	33.8 (4.3)	7.24***	1.9	.67	.57

Note: ** p < .01

Note: Conventionally, effect sizes around 0.5 are considered to be "medium" while those larger than 0.8 are considered to be "large"

The interviews indicated that many students retained knowledge gained from the outreach programs. For example, during the post-project interviews, several students mentioned that the stars were still in the sky during the day, but they can't be seen because of the sun's light – this concept was directly addressed by the Challenger Learning Center's STAR Lab program.

One teacher wrote the following in his/her reflection survey:

> *I was amazed at various comments from the children that showed me they were retaining the concepts that were taught. One little boy said as the Sauder program ["Spinning", see Table 5] was going on "I think this wool would be an adaptation, [a]m I right?". When Lightfoot [from Seven Eagles] was talking to the children about different animal coverings, he mentioned the word camouflage. Many of my children said "We know that word!" The Toledo Botanical Garden did the Soil program. They brought worms along for the children to observe. A while after ... we had a bug unit in our reading program. There was also information about worms. The children*

reminded us of some of the things they had learned about worms from the [Toledo Botanical Garden] presentation.

Many teachers mentioned on the Teacher Reflection Survey that their students benefited from the hands-on nature of the outreach programs, and became more engaged and interested in science as a result of the project. One teacher commented (in an outreach worksheet) about his/her students' interest in science:

> *One of the things that came out during the formative assessment is the students concern for the environment/Earth. I had originally thought of just having the students make Earth Day posters. We talked about things we could do at home and school to help cut down on our consumption of those non-renewable resources. As we continued to talk the idea started to evolve. Students wanted to make others aware of the problem, especially in our school. So we decided to make posters to remind others to recycle and take care of the Earth, as well as to remind them of Earth Day. The students also wanted to start a recycling program since our school currently does not have one. The students have starting putting together a proposal to create one at our school.*

EVALUATION SUMMARY AND RECOMMENDATIONS

The Project Pi r^2 evaluation used several quantitative and qualitative methods to measure the implementation and impact of the project on 30 science teachers from northwest Ohio and their students. The project's three major activities – the Community Resources Workshop, the monthly professional development sessions, and the outreach programs – were successfully implemented, but not without a few obstacles. The outreach programs in particular were not always implemented in the way that was originally intended. Nonetheless, the project positively impacted the teachers and their students. Here is a summary of the project's impacts on teachers and students:

- The project increased teachers' awareness of and confidence using community resources in their classrooms.
- Teachers' science content knowledge significantly improved as a result of participating in the project.
- The project increased teachers' positive beliefs and behaviors regarding science teaching.
- The teachers' students were engaged in many outreach programs during the school year, and as a result, became more interested in science and significantly increased their science knowledge.

Embracing the formative nature of the evaluation data, I will make several recommendations to assist the project staff with future planning and decision making. The recommendations are based on my observations and insights regarding the project's implementation and impact, as well as the teachers' comments regarding the project. Each recommendation will be followed by a brief explanation.

1. **Make the vision of project clear to all participants, including teachers, facilitators, and informal educators.**

   Some aspects of the project were not implemented as intended. For example, many teachers did not co-facilitate the outreach programs with the informal educators. Also, many informal educators and teachers reported having little communication with each other and not discussing the results of the formative assessments before the outreach programs. The project would likely be improved by making expectations exceedingly clear at the beginning of the project. It may be helpful to create a document for each participant that outlines the ways in which the project is intended to be implemented, and periodically review the document throughout the duration of the project. One teacher recommended that a small binder with all of the formative assessment probes and contact information be distributed at the beginning of the year.

2. **Remove or revise the distance learning aspect of the project.**

   Many teachers reported having trouble with the distance learning technology. Many teachers either did not have access to the technology, or experienced connectivity issues when trying to use the technology. In order for distance learning to be a meaningful part of the project, the staff should make sure that 1) most teachers have access to distance learning technology in their schools, and 2) the teachers or the information technology staff at the teachers' schools are familiar with and knowledgeable about distance learning technology.

3. **Develop outreach programs to more closely align with grade-specific curricula.**

   One common recommendation that teachers gave on the Teacher Reflection Survey was to more closely align the outreach programs to their grade's curriculum. Many teachers felt as though the outreach programs did not specifically address the science standards they were expected to teach during the year. This problem may be alleviated by following the first recommendation and improving the communication between teachers and informal educators. Also, the staff could collaborate with the informal educators to modify their outreach programs to more closely align to specific science standards.

4. **Schedule more time during the project for teachers to share and discuss their thoughts, stories, and experiences regarding the project activities.**

   Another common recommendation was to set aside discussion time, where teachers could share and discuss the things that have been happening in their classrooms during the project. This may help teachers to be consciously reflective about the project's activities, and to gain new ideas and insights as a result of the other teachers' thought and anecdotes.

Appendix A: NWO Inquiry Series Evaluation Survey

February 18 Inquiry Series Evaluation

Default Section

In order to plan better for future NWO activities, we would be grateful to receive your comments on the February 18 NWO Inquiry Series. Kindly complete this short questionnaire to share your views with us. At the end of the survey, you can provide your name and email address to enter the drawing for a DOOR PRIZE! You can also request a contact hour (CEU) certificate. Your information is required if you want to enter the drawing and/or receive a certificate.

NWO
Northwest Ohio Center of Excellence in Science and Mathematics Education

BGSU COSMOS

1. What NWO project are you enrolled in?
Please note: the Inquiry Series is not considered an "NWO project".

- DREAMS
- Project Pi r2(squared)
- USE-IT
- I'm not enrolled in an NWO project
- Other (please specify)

2. Which of the following best describes your current status?

- Undergraduate student
- PreK-12 teacher
- University/College faculty
- School administrator
- Other (please specify)

3. If you are a student, please tell us your major and concentration.

What is your major?

What is your concentration?

4. What STEM subjects do you teach? Choose all that apply.

- Science
- Math
- Technology
- None of these

5. Do you teach special education?

- Yes
- No

6. How many years have you been teaching? If you are a student, you can enter "0".

Please enter numbers only.

7. Please choose the category that best represents the grade level(s) you teach.

If you cannot fit yourself into one of the categories, please choose "other" and tell us the grade levels you teach.

If you currently do no teach, please choose N/A.

- Pre-Kindergarten to 4th grade
- 5th grade to 8th grade
- 9th grade to 12th grade
- N/A
- Other (please specify)

February 18 Inquiry Series Evaluation

8. Which session did you attend?

- USE-IT (3-8) [Presenters: Betsy Hood; Charlene Patten]
- Technology Integration in STEM Education (K-12) [Presenter: Carrie Rathsack] Technology Integration in STEM Education (K-12) [Presenter: Carrie Rathsack]
- Using Community Resources (K-12) [Presenters: Varies by month]
- Physical Sciences Modeling (9-12) [Presenters: Ash; Hafemann]
- Exploring Inquiry in High School Biology (9-12) [Presenter: Underwood]
- Exploring Elementary Math Topics (K-6) [Presenter: Amy Boros]
- What is a Number? (9-12) [Presenter: David Meel]
- Experiencing Engineering is Elementary (K-6) [Presenters: Cherie Pilatowski; Julie Campbell]
- Project pi r2 (K-8)

February 18 Inquiry Series Evaluation

For each of the statements below regarding the session you attended, please choose the category that best describes your level of agreement/disagreement with the statement.

9. The session met my expectations.

- Disagree
- Somewhat Disagree
- Somewhat Agree
- Agree

Comments:

10. The session was engaging.

- Disagree
- Somewhat Disagree
- Somewhat Agree
- Agree

Comments:

11. The content/information presented during the session was valuable to me.

- Disagree
- Somewhat Disagree
- Somewhat Agree
- Agree

Comments:

12. I learned something new from the session.

- Disagree
- Somewhat Disagree
- Somewhat Agree
- Agree

Comments:

13. I will incorporate the content/information from the session into my classroom lessons. If you do not teach, please choose N/A.

- Disagree
- Somewhat Disagree
- Somewhat Agree
- Agree
- N/A

Comments:

14. Attending the session made me feel more <u>confident</u> about teaching science, technology, engineering, and/or math. If you do not teach, please choose N/A.

- Disagree
- Somewhat Disagree
- Somewhat Agree
- Agree
- N/A

Comments:

15. Attending the session made me feel more <u>excited</u> about teaching science, technology, engineering, and/or math. If you do not teach, please choose N/A.

- Disagree
- Somewhat Disagree
- Somewhat Agree
- Agree
- N/A

Comments:

16. If you would like to be entered into the door prize raffle AND/OR receive a contact hour (CEU) certificate, please provide the following information.

First name:

Last name:

Email Address:

**17. Would you like to be entered in the door prize raffle?
Please remember, you must enter your information above if you choose "yes".**

- Yes
- No

**18. Would you like to receive a contact hour (CEU) certificate?
Please remember, you must enter your information above if you choose "yes".**

- Yes
- No

Thank you! Your responses will help NWO continue to provide valuable resources to the educational community!

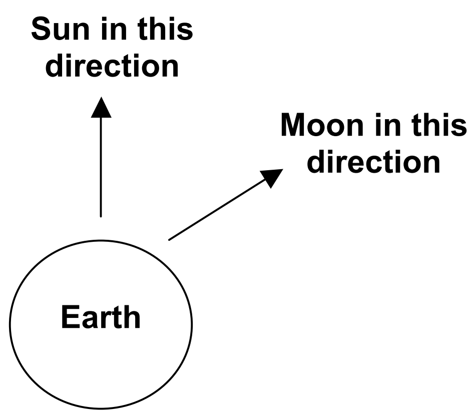
Appendix B: Teacher Science Content Knowledge Test

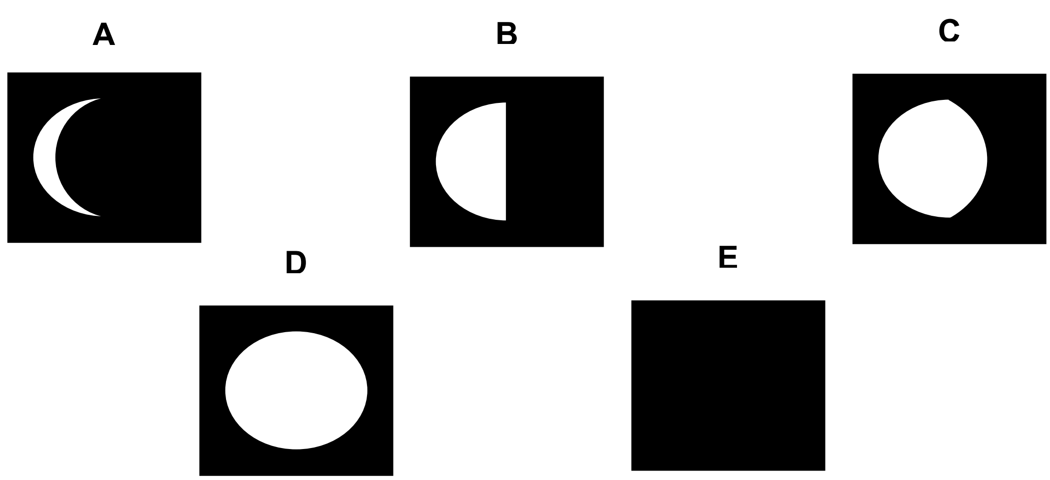
Project Pi r^2
Teacher Science Content Knowledge
Pretest 2009 – 2010

Unique Code	First 2 Letters of Mother's Maiden Name		Your Birth Month (2 digits)		Your Birth Day (2 digits)	
EXAMPLE	D	E	0	7	1	8
YOUR ID						

Directions: This test contains multiple choice and constructed response questions about your knowledge of science content. Circle the correct answer (A, B, C etc.) for multiple-choice questions. Use the space provided for extended response questions. Carefully read and follow the directions for each question.

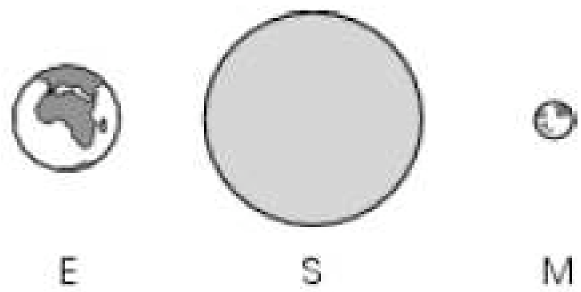
1. If you could look down from space at Earth from far above its north pole, the Sun and Moon would be in the directions shown by the arrows in the picture below. What would the Moon look like to a person on Earth facing the Moon?



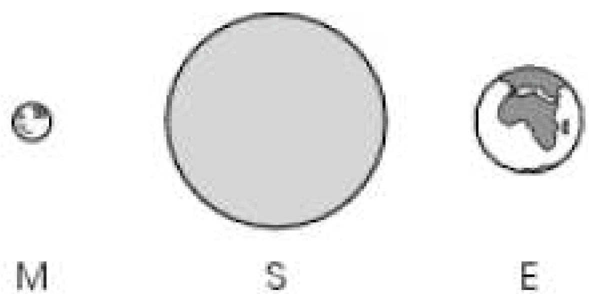


2. **Which diagram shows the relative positions of Earth (E), the sun (S) and the moon (M) during a full moon?**

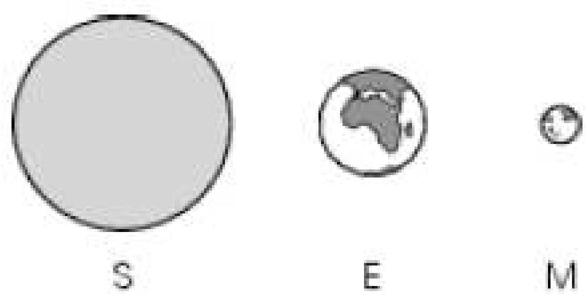
A



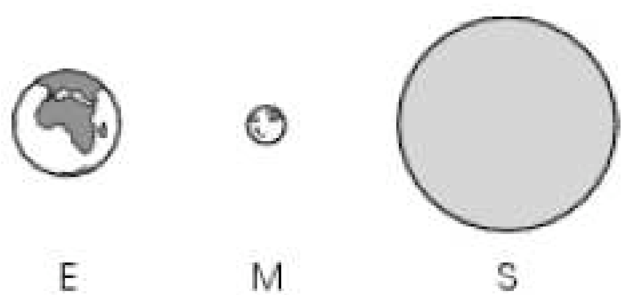
B



C



D



3. **Imagine the following scenario. In a solar system many light years from our own is a planet called Staylar that is orbited by a small moon. If the moon orbits Staylar once every 200 days, and Staylar orbits its sun once every 50 days, how often would Staylar inhabitants observe a full moon?**

A. 4 times every year

B. Once every 4 days

C. 4 times every day

D. Once every 4 years

4. What change would occur if Earth's rate of rotation significantly increased?

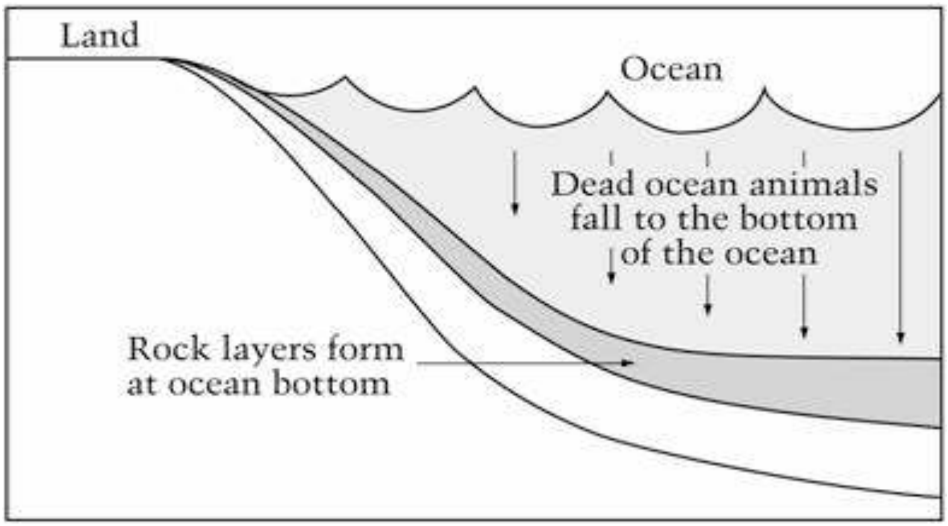
A. The year would be shorter

B. The year would be longer

C. The day would be shorter

D. The day would be longer

5. The picture below shows how a type of rock forms at the bottom of the ocean. What type of rock is this?



A. Igneous rock

B. Metamorphic rock

C. Sedimentary rock

6. Explain how igneous rock can be transformed into sedimentary rock.

7. According to scientists, the tall mountains in the western U.S. are younger than the low mountains in the eastern U.S. How can the younger mountains be taller?

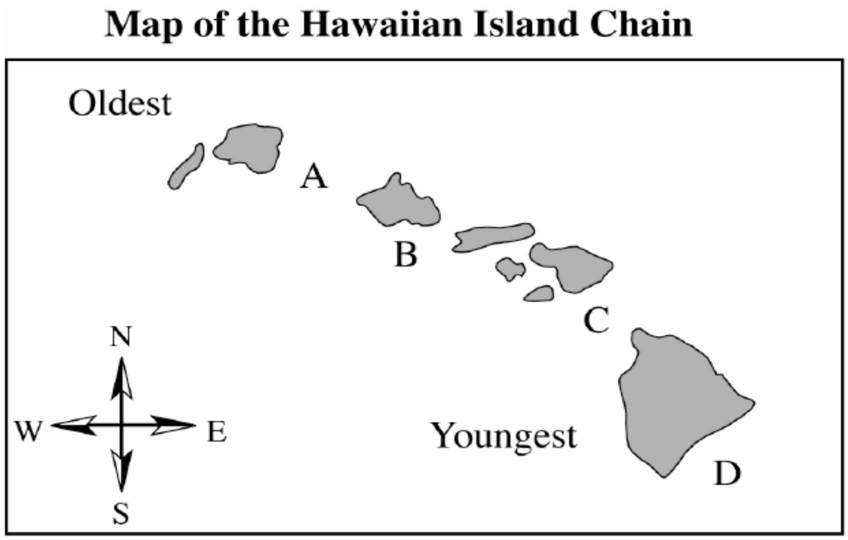
A. The volcanoes in the eastern mountains erupted long ago

B. There are more earthquakes in the western U.S

C. There are more landslides in the eastern U.S

D. The eastern mountains in the eastern U.S. have been eroding longer

8.



The Hawaiian Islands are riding on the Pacific Plate as it moves northwestward. They are being formed as the plate moves over a hot spot in the mantle. Where is the next volcano likely to form?

A. A

B. B

C. C

D. D

9. Which of the following occurs if two of Earth's plates move alongside each other?

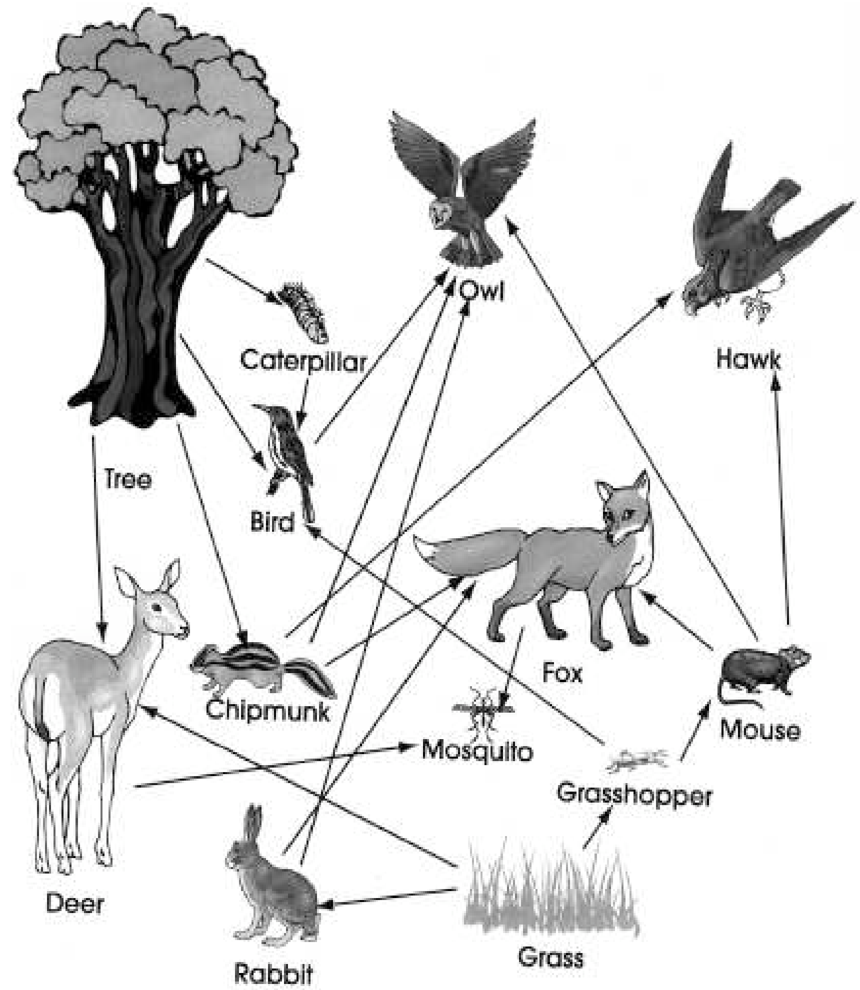
A. Volcanic eruptions

B. Earthquakes

C. Mountain formation

D. Ridge formation

The diagram below illustrates the relationships in a forest food web.



10. Based on this diagram, an ecologist would most likely conclude that a decrease in the fox population would result in a(n):

A. Increase in the owl population

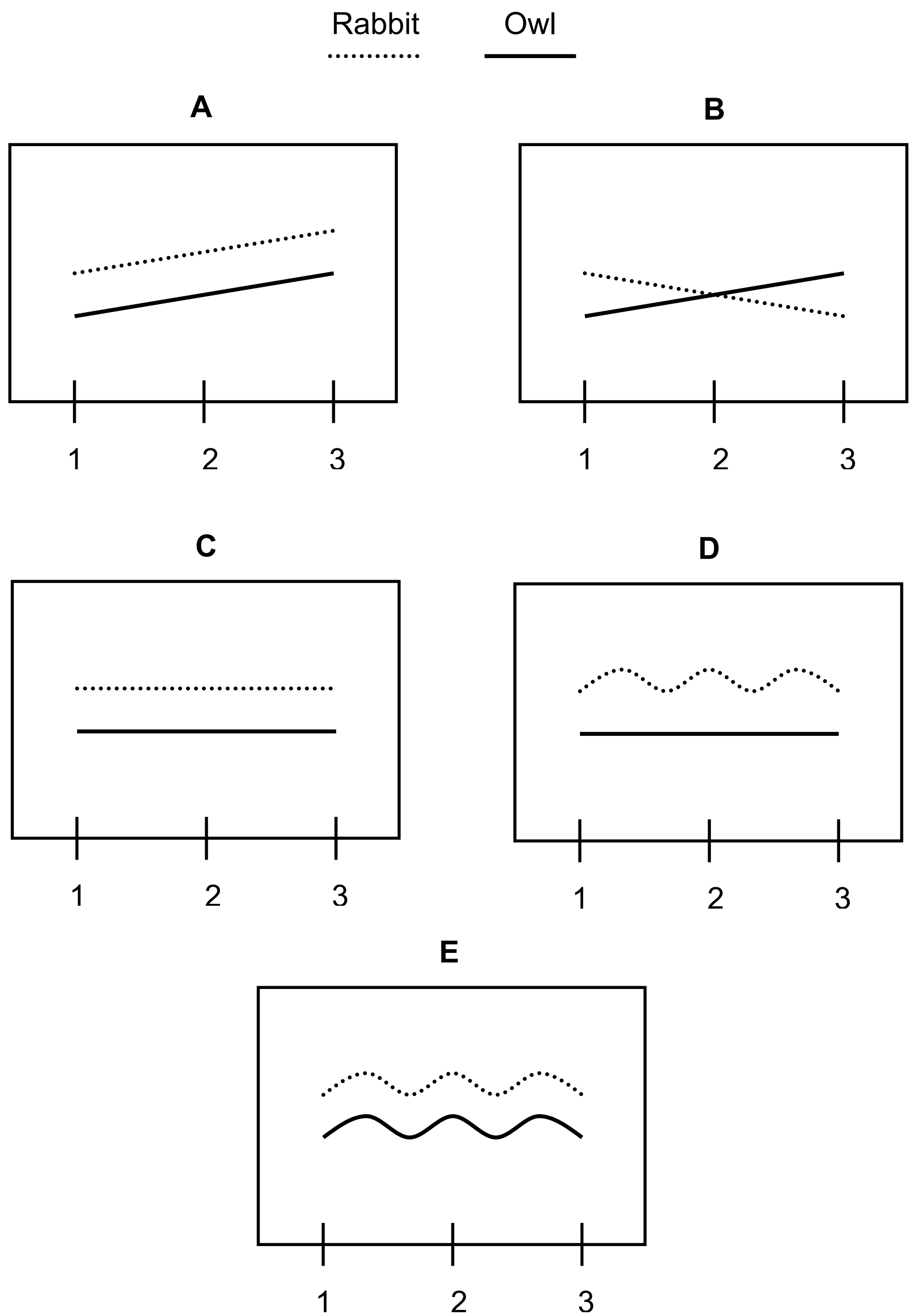
B. Decrease in the rabbit population

C. Decrease in the chipmunk population

D. Increase in the grasshopper population

11. Name two consequences that would result from a significant decrease in the mouse population. Give an explanation for each consequence.

12. **If you measured the sizes of the owl and rabbit populations over the course of three years, what would you expect to find? Choose the graph that best represents what would happen to the population sizes.**



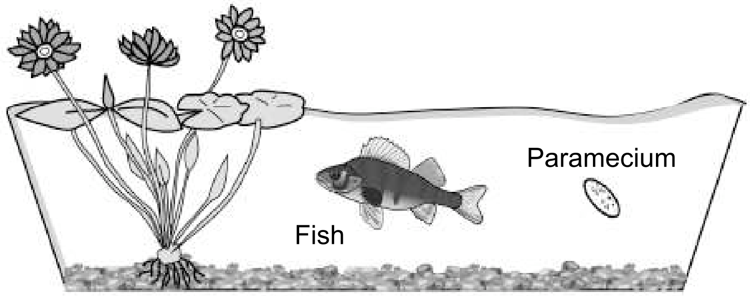
13. **Differences between the members of a population will most likely be passed to future generations if they are**

A. Due to genetic changes and result in unfavorable variations

B. Due to genetic changes and result in favorable variations

C. Not due to genetic changes and result in unfavorable variations

D. Not due to genetic changes and result in favorable variations



14. Paramecia usually reproduce asexually. Fish reproduce sexually. Describe how these two methods of reproduction differ with respect to the genetic makeup of the offspring produced.

15. Suppose the environmental conditions of a lagoon containing fish and paramecia change. Why would the fish population have an advantage over the paramecium population?

A. Multi-cellular organisms are more resilient than single-celled organisms

B. It is easier for the fish population to migrate to a different area

C. There is more genetic variability in the fish population

D. It is less common for fish to inherit harmful traits from their parents

16. There are many types of finches that live in the Galapagos Islands. For one year on one of the islands, the insect population drastically decreased and the number of flower and seed producing plants drastically increased.

What happened to the population of insect-eating finches during that year?

A. They migrated to an area where insects were more abundant

B. They decreased in number due to the lack of food sources

C. They evolved to eat flowers and seeds

D. They did not survive the change

17. Which action by humans has had the most positive ecological impact on the environment?

A. Use of pesticides to regulate insect populations

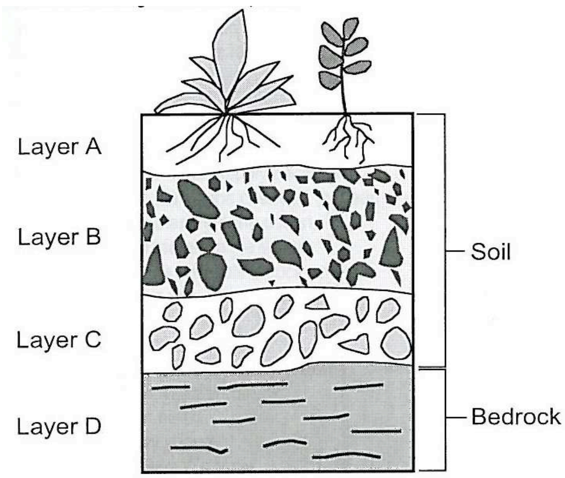
B. Importation of organisms such as the Japanese beetle and the zebra mussel into the United States

C. Overhunting of many predators to prevent the death of prey animals

D. Reforestation and overcropping to prevent soil erosion

18. Imagine a world where trees take thousands of years to grow. Would they be considered a renewable resource or a non-renewable resource? Explain your answer.

19. Below is a diagram of a soil profile.



Which layer contains the most organic material?

A. A

B. B

C. C

D. D

E. They all have the same amount of organic material

20. You take a core sample of soil in order to determine the ground composition before you pour the foundation for an extension to your house. What are you most likely to observe within the core sample?

A. The physical appearance and chemical composition of the soil remains the same until you reach rock

B. The chemical composition of the soil changes until you reach rock, but the physical appearance does not

C. The physical appearance and chemical composition of the soil appear to change until you reach rock

D. The physical appearance of the soil seems to change until you reach rock, but the chemical composition does not

Appendix C: Teacher Beliefs Instrument

Teacher Belief Instrument

Your Unique Code

What NWO project are you enrolled in?

- DREAMS
- PI R2 (squared)
- I'm not enrolled in an NWO project
- I'm not sure
- Other (please specify)

Please use the drop-down menus to enter your unique code, which will be used to keep track of your responses during the analysis of these evaluation data.

	First letter of your mother's maiden name	Second letter of your mother's maiden name	Your Birth Month	Your Birth Day
My Unique Code				

Teacher Belief Instrument

Part A: Self-Efficacy Beliefs About Teaching

(Enochs & Riggs, 1990; modified Haney, 2005)

Directions: Please indicate the degree to which you agree or disagree with each statement below by checking the appropriate category for each statement.

As you can see below, science and mathematics are both included in the statements. We understand that your beliefs may differ (sometimes greatly) between science and mathematics teaching, so we ask that you answer the statements based on your beliefs about science *OR* math, not both.

If you teach only science or only mathematics, please answer the statements based on your beliefs about that subject. If you teach both science and math, please choose one or the other.

Project pi r-squared participants: Please answer based on your beliefs about science.
DREAMS participants: Please answer based on the MAT degree you are pursuing

Please indicate how you will answer the statements.

- Based on my beliefs about **SCIENCE** teaching
- Based on my beliefs about **MATHEMATICS** teaching

1. I am continually finding better ways to teach SCIENCE/MATHEMATICS topics.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

2. Even when I try very hard, I do not teach SCIENCE/MATHEMATICS topics as well as I do most subjects.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

3. When the grades of students improve, it is often due to their teacher having found a more effective SCIENCE/MATHEMATICS teaching approach.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

Teacher Belief Instrument

4. I know the steps necessary to teach SCIENCE/MATHEMATICS concepts effectively.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

5. I am not very effective in monitoring SCIENCE/MATHEMATICS experiences.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

6. If students are underachieving in SCIENCE/MATHEMATICS, it is most likely due to ineffective teaching.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

7. I generally teach SCIENCE/MATHEMATICS topics ineffectively.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

8. The inadequacy of a student's SCIENCE/MATHEMATICS background can be overcome by good teaching.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

9. When a low-achieving child progresses when studying SCIENCE/MATHEMATICS, it is usually due to extra attention given by the teacher.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

10. I understand SCIENCE/MATHEMATICS concepts well enough to be an effective SCIENCE/MATHEMATICS teacher.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

11. Increased effort in SCIENCE/MATHEMATICS teaching produces change in students' SCIENCE/MATHEMATICS achievement.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

12. The teacher is generally responsible for the achievement of students in SCIENCE/MATHEMATICS topics.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

Teacher Belief Instrument

13. Students' achievement in SCIENCE/MATHEMATICS is directly related to their teacher's effectiveness in teaching SCIENCE/MATHEMATICS.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

14. If parents comment that their child is showing more interest in SCIENCE/MATHEMATICS at school, it is probably due to the performance of the child's teacher.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

15. I find it difficult to explain to students why SCIENCE/MATHEMATICS investigations turn out as they do.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

16. I am typically able to answer students' SCIENCE/MATHEMATICS questions.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

17. I wonder if I have the necessary skills to teach SCIENCE/MATHEMATICS.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

18. Effectiveness in SCIENCE/MATHEMATICS teaching can impact the achievement of students with low motivation.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

19. Given a choice, I would not invite the principal (or other) to evaluate my SCIENCE/MATHEMATICS teaching.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

20. When a student has difficulty understanding a SCIENCE/MATHEMATICS concept, I am usually at a loss as to how to help the student understand the concept better.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:					

Teacher Belief Instrument

21. When teaching SCIENCE/MATHEMATICS topics, I usually welcome student questions.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

22. I do not know what to do to turn students on to SCIENCE/MATHEMATICS topics.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

23. Even teachers with good SCIENCE/MATHEMATICS teaching abilities cannot help certain kids learn.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MY RESPONSE TODAY:	jn	jn	jn	jn	jn

Teacher Belief Instrument

Part B: Instructional Practices Inventory

Directions: For each of the instructional strategies below, please rate from 1 to 5 how ...

FREQUENTLY you use each of the strategies

IMPORTANT you feel each strategy is to effective teaching

PREPARED you feel in using each strategy

24. Have students investigate real-world problems.

24a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:	jn	jn	jn	jn

24b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:	jn	jn	jn	jn

24c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:	jn	jn	jn	jn

25. Have students make connections between science/mathematics and other disciplines.

25a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:	jn	jn	jn	jn

25b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:	jn	jn	jn	jn

25c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:	jn	jn	jn	jn

26. Require students to supply evidence to support their claims or explain their reasoning when giving an answer.

26a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

26b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

26c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

27. Ask students to discuss alternative conclusions or consider alternative methods for solutions.

27a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

27b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

27c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

28. Have students write to learn science/mathematics.

28a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

28b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

28c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

29. Engage the whole class in discussions based on science/mathematics concepts.

29a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

29b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

29c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

30. Ask students to explain concepts to one another.

30a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

30b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

30c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

31. Use reflections written by students to guide instruction.

31a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

31b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

31c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

32. Differentiate classroom instruction to meet students' learning needs.

32a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

32b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

32c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

33. Allow students to work at their own pace.

33a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

33b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

33c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

34. Ask students to use multiple representations (e.g. numeric, graphic, symbolic).

34a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

34b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

34c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

35. Work collaboratively with other teachers to plan or teach a unit.

35a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

35b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

35c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

36. Provide opportunities for students to pursue issues/ ideas/ topics of personal interest.

36a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

36b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

36c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

37. Assess student learning via performances and projects (performance-based assessments).

37a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

37b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

37c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

38. Assess student learning via writing.

38a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

38b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

38c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

Part B: Instructional Practices Inventory (continued)

Directions: For each of the instructional strategies below, please choose the response that best represents how ...

FREQUENTLY you use each of the strategies

IMPORTANT you feel each strategy is to effective teaching

PREPARED you feel in using each strategy

39. Use the community setting, or local environment, as a context for learning.

39a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

39b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

39c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

40. Allow students to construct their own understandings.

40a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

40b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

40c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

41. Provide students with concrete experience before abstract concepts.

41a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:	jn	jn	jn	jn

41b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:	jn	jn	jn	jn

41c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:	jn	jn	jn	jn

42. Develop students' conceptual understanding vs. memorization of facts.

42a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:	jn	jn	jn	jn

42b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:	jn	jn	jn	jn

42c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:	jn	jn	jn	jn

43. Take students' prior knowledge into account when planning lessons.

43a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:	jn	jn	jn	jn

43b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:	jn	jn	jn	jn

43c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

44. Have students work in cooperate/ collaborative learning groups.

44a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

44b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

44c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

45. Have students develop, implement and revise a design process.

45a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

45b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

45c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

46. Engage students in inquiry and/ or problem-solving activities.

46a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

46b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

46c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

47. Have students prepare project/lab/research reports.

47a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

47b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

47c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

48. Have students use appropriate educational technology (e.g., calculators, computers, electronic probes, Internet-based scientific data sets).

48a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

48b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

48c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

49. Have students use science/mathematics instructional manipulatives, supplies and/or equipment.

49a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

49b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

49c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

50. Ask students to apply science/mathematics in a variety of contexts.

50a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

50b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

50c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

51. Use informal questioning to assess student understanding.

51a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

51b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

51c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

52. Have students use feedback to revise their work.

52a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

52b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

52c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

53. Have students keep a notebook to organize their learning (summarize main ideas, record/analyze data, etc.).

53a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

53b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:				

53c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:				

54. Plan classroom instruction and/or assessment using the state or national standards for science/mathematics.

54a. Frequency

	Never	Rarely	Sometimes	Frequently
MY RESPONSE TODAY:				

54b. Importance

	Not Important	Somewhat Important	Important	Very Important
MY RESPONSE TODAY:	jn	jn	jn	jn

54c. Preparedness

	Not Prepared	Somewhat Prepared	Prepared	Very Prepared
MY RESPONSE TODAY:	jn	jn	jn	jn

Teacher Belief Instrument

Demographic Information

Please indicate your gender.

- Male
- Female

Which of the following best describes your teaching status?

- In-service teacher
- Pre-service teacher
- Substitute teacher
- School administrator

What subjects do you teach?

- Science
- Mathematics
- Both

What grade level(s) do you teach?

- Kindergarten
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- N/A

Please enter the name of your:

School Building ______________________

School District ______________________

How many years have you taught?

____

Approximately how many students are you teaching this year?

____

Teacher Belief Instrument

Approximately how many hours per week do you spend teaching:

Science?

Mathematics?

What is the highest degree you have earned?

- Bachelor's
- Specialist's
- Master's
- Doctorate
- Other (please specify)

What was your undergraduate degree major?

- Early Childhood/Elementary Education
- Middle Childhood Education
- AYA/Secondary Education
- Special Education
- Other (please specify)

What was your concentration for your undergraduate degree?

- Science
- Mathematics
- Social Studies
- Language Arts/Reading
- Other (please specify)

Teacher Belief Instrument

How many NWO/ COSMOS events have you attended this year?

- This is the first
- Two to three
- Four to six
- Seven or more

What NWO/COSMOS events did you attend?

How many years have you attended NWO/ COSMOS events?

- This is my first year
- Two years
- Three years
- Four or more years

Please indicate OTHER professional development in which you've participated.

Appendix D: Community Resources Workshop Survey and Monthly Follow-up Survey

2009 Community Resources Workshop Evaluation

Unique Code	First 2 Letters of Mother's Maiden Name		Your Birth Month (2 digits)		Your Birth Day (2 digits)	
EXAMPLE	D	E	0	7	1	8
YOUR ID						

1. I am a (circle one):

Counselor Media Specialist Administrator Teacher

If you are a teacher: Grade(s) ____________ Subject(s) ____________________

2. I learned about this workshop from:

3. The reason(s) I am taking this workshop is (are):

Contact Hours Professional Growth Undergraduate/Graduate Credit Other

If other, please explain ___________________________

Please rank the statements in items 4-10 using the following scale:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
SD	D	N	A	SA

4. I learned new things about local resources

SD D N A SA

Comments:

5. I will use the information I learned in my classroom

SD D N A SA

Comments:

6. This workshop met my expectations

SD D N A SA

Comments:

7. I would recommend this workshop to others

SD D N A SA

Comments:

Please continue on the back.

For the following statements, choose the category that represents your opinion TODAY, and then choose the category that represented your opinion BEFORE THE WORKSHOP.

8. I am aware of the educational resources/services that are offered by local organizations

TODAY	SD	D	N	A	SA
BEFORE WORKSHOP	SD	D	N	A	SA

Comments:

9. I can confidently integrate community resources into my lesson plans

TODAY	SD	D	N	A	SA
BEFORE WORKSHOP	SD	D	N	A	SA

Comments:

10. Using community resources in my lessons can get my students excited to learn

TODAY	SD	D	N	A	SA
BEFORE WORKSHOP	SD	D	N	A	SA

Comments:

11. Approximately how many times per month did you use community resources in your classroom last year?

0
1-2
3-4
5+

12. How many times per month do you plan on using community resources in you classroom next year?

0
1-2
3-4
5+

13. What are the obstacles to using CRW resources in your classroom?

14. How can we improve/modify the content of this workshop?

15. Other comments?

April Community Resource Usage Survey

ID Code and Date

Below, please enter your unique ID code and today's date.

Please use the drop-down menus to enter your unique ID code. Remember, your code is the first two letters of your mothers' maiden name, your birth month and your birth day.

For example,
AL1129

	First letter of your mothers' maiden name	Second letter of your mothers' maiden name	Your birth month	Your birth day
Your Unique Code				

Please enter today's date.

	MM		DD		YYYY
Today's date is		/		/	

April Community Resource Usage Survey

Community Resources

Please think about the community resources that you used in April.

DO NOT COUNT THE OUTREACH PROGRAM(S) THAT YOU RECEIVED AS PART OF PI R-SQUARED.

How many times did you use community resources in your classroom during the month of April?

- 0
- 1 to 2
- 3 to 4
- 5 or more

Now, please scroll down and check the resources that you used in April. If you used a particular resource more than one time, say so in the corresponding text box.

The Blade

- Special Sections, Kids Newspapers, new E-version of the Blade
- Speaker's Bureau

Please indicate here if you used a particular resource more than once.

The Challenger Learning Center

- Field Trip to Challenger Learning Center
- "Mission to the Moon" simulator
- Outreach (Starlab, others)

Please indicate here if you used a particular resource more than once.

Discover Downtown Walking Tours

- Downtown walking tour for Historic use or Architectural use

Please indicate here if you used a particular resource more than once.

Franciscan Center of Lourdes College/TheaterVISION

- Participated in a TheaterVISION Day
- Theatre; attended a play/musical

Please indicate here if you used a particular resource more than once.

April Community Resource Usage Survey

Imagination Station (formerly COSI)

- Field trip visit to the center
- Educational resources online/science experiments/curriculum
- Distance Learning programs
- Outreach programming in your school

Please indicate here if you used a particular resource more than once.

Johnson's Island

- Pre-field trip visit
- Archaeological experiential learning program/field trip to island

Please indicate here if you used a particular resource more than once.

Lourdes Appold Planetarium

- Field trip to Planetarium

Please indicate here if you used a particular resource more than once.

Lourdes Life Lab

- Field trip to Life Lab
- Resources from Life Lab
- Outreach programs in your school

Please indicate here if you used a particular resource more than once.

Metroparks of Toledo

- Participated in a Historical Program (Canal Experience, Manor House, Schoolhouse. etc.)
- Participated in a Nature/Environment Program (example: Nature Walks, Hands-on programs)
- Program/Presentation in classroom or assembly

Please indicate here if you used a particular resource more than once.

April Community Resource Usage Survey

Sauder Village

- Field Trip to Village
- Presenter in classroom (example: One Room School, Story of the Quilts)

Please indicate here if you used a particular resource more than once.

Solar House

- Solar House at your school

Please indicate here if you used a particular resource more than once.

Toledo Botanical Garden

- Field trip to Toledo Botanical Garden (Early Sprouts, Pioneer Living, etc.)
- In-class visits (A Wealth of Water, Resource Pizza, etc.)
- Education programs at the garden

Please indicate here if you used a particular resource more than once.

Toledo Lucas County Public Library

- Visit to Local History Center at Main Library or Tatum Center
- Children's programs at Library
- Use of Catalog or Kids Place website
- Pre-ordering books

Please indicate here if you used a particular resource more than once.

Toledo Mud Hens

- School days at the Mud Hens

Please indicate here if you used a particular resource more than once.

Toledo Museum of Art

- Field Trip to Museum (Glass Pavilion, Museum Tours, etc.)
- Use of Resource Center for Educators (RCE) (Discovery boxes, Poster Packets, Curriculum binders, etc.)

Please indicate here if you used a particular resource more than once.

April Community Resource Usage Survey

Toledo Symphony Orchestra

- Field trip to see Toledo Symphony Orchestra
- Outreach program at your school

Please indicate here if you used a particular resource more than once.

Toledo Zoo

- Field trip to Zoo
- Hands-on education programs during your zoo visit
- Distance Learning
- Discovery Boxes
- Outreach Programs; a classroom visit from the Zoo

Please indicate here if you used a particular resource more than once.

Valentine Theatre

- Field trip to Theatre for Historical Tour
- Field trip to theatre for Theatrical shows/musicals/plays
- Kids' Concerts
- Special Events- Special Discounts for Students

Please indicate here if you used a particular resource more than once.

WGTE- Public Media

- Borrowing Educational Resource Center Materials (ERC)
- Website accounts
- Watch Instructional Television during the school day or recording of programs for later classroom use

Please indicate here if you used a particular resource more than once.

April Community Resource Usage Survey

The Wolcott House Museum

- Field trips to the Museum
- Pre- or Post-Field trip visit from Museum
- Use of Resource Guide to Native Americans within classroom

Please indicate here if you used a particular resource more than once.

Are there other programs from the Community Resources Workshop you utilized this month that are not listed above? If so, please describe them here.

Thank you for completing this survey!

Appendix E: Outreach Worksheet

Outreach Lesson Worksheet

Your Name:

Outreach Provider:

Name of Outreach Lesson:

Date of Lesson:

1. What were the results of the outreach pre-assessment you gave to your students before the outreach lesson?

2. How was the outreach lesson modified based on the results of the pre-assessment?

3. Describe the formative assessment you created (you may attach documents if appropriate).

4. What were the results of the formative assessment?

5. Describe the extension activity you created for the outreach lesson (you may attach documents if appropriate).

6. How was the extension activity modified based on the results of the formative assessment?

Appendix F: Classroom Observation Instrument

Project Pi r^2 Teaching Observation Protocol

Observation Date: ______________________ Observer: ____

Teacher: ____

Duration of lesson: ____________________ Number of students in classroom: _________________

1. Did the physical environment of the classroom (walls, centers, other spaces) suggest that students are regularly engaged in inquiry-based science? **Circle one.**

No	Yes – Somewhat	Yes - Strongly

What evidence is there to support your answer? ____

____

2. Did the teacher create a risk-free environment so that students could express ideas, opinions, and questions (about concepts and/or reasons for learning specific topics)? **Circle one.**

No	Yes – Somewhat	Yes - Strongly

What evidence is there to support your answer? ____

____

Using the following scale, indicate how often during the lesson you observed each of the teaching behaviors below. **If appropriate, provide examples of the observed behavior.**

N/A	The teacher did not have the opportunity to demonstrate the behavior during the lesson.
0	The behavior was **not observed** during the lesson, but the teacher did have opportunities to demonstrate the behavior.
1	The behavior was **observed infrequently** – the teacher demonstrated the behavior some times but not others (i.e., given several opportunities to do so, the teacher only demonstrated the behavior twice).
2	The behavior was **observed frequently** – the teacher demonstrated the behavior consistently throughout the lesson (i.e., given several opportunities to do so, the teacher demonstrated the behavior every or almost every time).

3. ________ Teacher asked students open-ended "probing" questions.
Example(s):

4. ________ Teacher asked students higher order questions.
Example(s):

5. ________ Teacher appropriately used "wait time".
Example(s):

6. ________ Teacher asked students to provide evidence to support their claims or explain their reasoning when giving an answer.
Example(s):

7. ________ Teacher asked students follow up questions (i.e., after asking one student a question, the teacher asked other students for alternative explanations).
Example(s):

8. ________ Teacher allowed students to construct their own knowledge (i.e., students were not "given" the answers).
Example(s):

9. ________ Teacher encouraged students to think about and ask questions regarding science concepts.
Example(s):

10. ________ Teacher provided opportunities for students to record observations and/or write predictions, questions, ideas, etc.
Example(s):

11. ________ Teacher encouraged active student-student interactions (students worked collaboratively or cooperatively).
Example(s):

What other comments would you like to mention regarding the behaviors above, the teacher's participation in the lesson, or any other relevant issue?

____

____

____

____

____

____

Explanations of Desired Behaviors

1. A physical environment that suggests regular engagement in inquiry-based science would look something like this:
   - Students' desks are arranged in a way that promotes interaction (i.e., clusters)
   - Science materials (i.e., hand lenses, thermometers, living materials [plants, aquarium], measurement tools) are visible and easily accessible to students
   - Student-generated responses, observations or questions are posted around the room (i.e., chart paper)
   - Non-fiction science literature resources are visible and accessible to students

2. In order for teachers to create a risk-free environment, they should have a positive rapport with their students and be welcoming and non-judgmental of students' questions and ideas, regardless of the students' ability level.

3. Open-ended questions are those that require students to answer with more than a "yes" or "no". The questions should "probe" the students' understanding of the content. The purpose of asking these probing questions is to informally assess the students' understanding of the science concept.

4. Higher order questions are more cognitively demanding than other questions that only require students to remember or recall facts or principles. Higher order questions require students to *use* and *apply* their knowledge, rather than just restating their knowledge. Please note, depending on the context, asking students to restate or recall knowledge is necessary. But asking higher order questions encourages students to think more scientifically, which is why it is evaluated on this protocol.

5. After a teacher asks a question, they should not request an answer from the student(s) until the teacher has waited for the student(s) to gather their thoughts and formulate a response. Usually, 3 to 5 seconds is appropriate. Also, *after* a student gives a response, the teachers should wait another 3 to 5 seconds before moving on or asking another question. This encourages the student who gave the response to elaborate on his or her answer, and for other students to reflect on the answer that was just given.

6. Asking the students to explain their answer or provide support for their claims gives the teacher an idea of how the students are thinking about a particular concept. Knowing *why* a student gave a particular response is in most cases more informative than just knowing the student's response.

7. Follow up questions could be asked in a couple of ways. First, the teacher could ask one student a question, and if that student answers incorrectly or incompletely, the teacher could ask that student one or more follow up questions. Second, the teacher could ask one student a question, and then ask one or more follow up questions to the whole class to gather alternative explanations or ideas. Regardless, teachers should ask multiple questions to gain the greatest insight into student thinking.

8. Students often have more meaningful learning experiences when they can connect their prior ideas to new ideas and construct knowledge themselves. The teacher should facilitate the students' construction of knowledge by encouraging the students to reflect on what they already know and emphasizing certain components of the activity that would assist students in organizing their knowledge.

9. Teachers should encourage students to be reflective about what they are learning so that students can generate questions. Also, every so often, teachers should give the students the opportunity to ask those questions before moving on to something else.

10. Students should be encouraged to write their predictions, observations, thoughts and ideas, whether it is in a notebook, on a piece of chart paper, or something else.

11. Encouraging student-student interactions includes behaviors like facilitating discussions among the students, having the students work in groups (where each student has a specific responsibility), and having students present results to each other.

Appendix G: Kindergarten Picture Card Interview Protocol

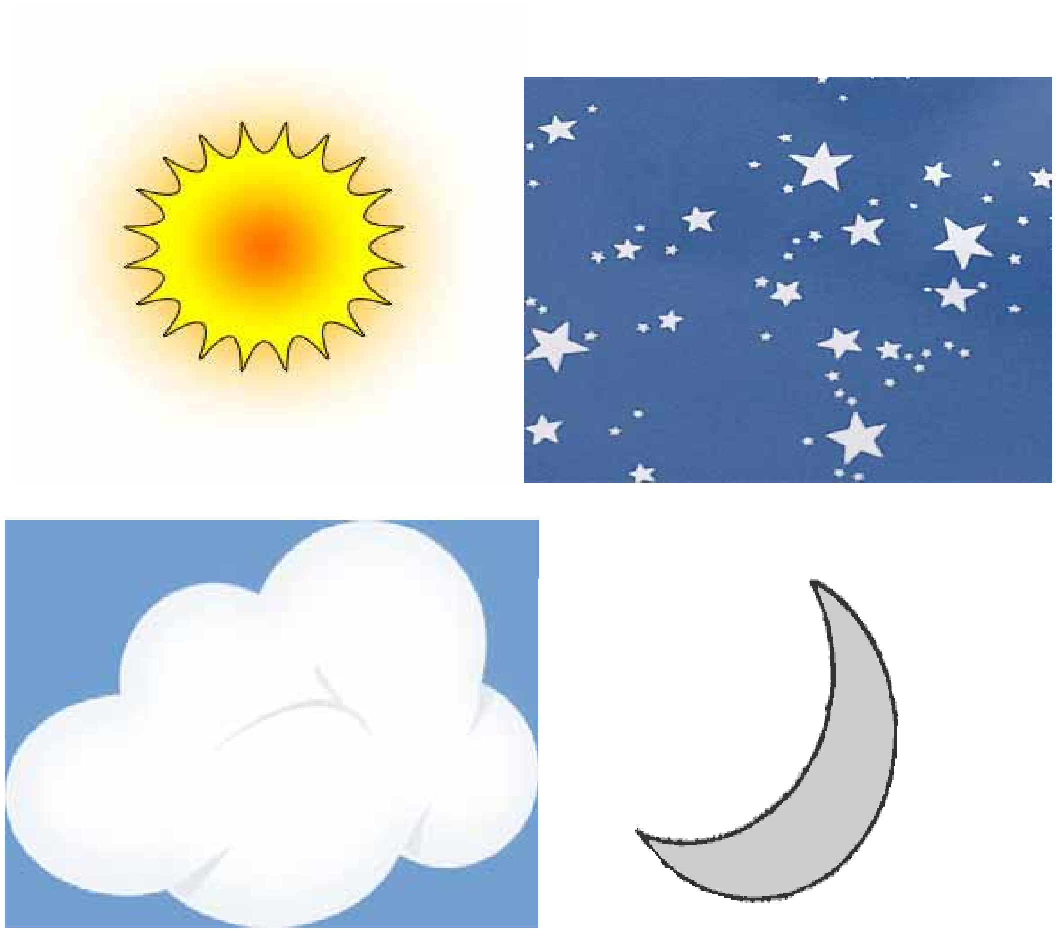
Kindergarten Assessment

1. **Look at the pictures on the table. They are pictures of things you can see in the sky.**

   Which of those things can you sometimes see during the night?

   Which of those things can you sometimes see during the day?

   Pictures:



2. **Look at the pictures on the table. They are pictures of living and non-living things. I want you to make two groups of pictures. Put the things that are living here, and put the things that are non-living here.**

   Why did you say that these (the living group) things are living?

   Pictures:






Pictures for #2 (continued):





3. **Look at the pictures on the table. They are pictures of adult animals and baby animals. What about the baby and the adult is the same? What about the baby and adult is different?**

   Pictures:



4. **Look at the pictures on the table. They are pictures of animals that live in different places around the world.**

   What do you notice on the polar bear that helps it to live?

   What do you notice on the hummingbird that helps it to live?

   What do you notice on the shark that helps it to live?

   Pictures:



Appendix H: 2009-2010 NWO Inquiry Series Flyer

NWO

Northwest Ohio Center of Excellence in Science and Mathematics Education

Advancing STEM Education for the 21st Century

IDEAS

NWO STEM Education Inquiry Series 2009~10

Blast-Off Keynote Speaker

21st Century Learning...It's More Than Just Technology!

Betsy Hood, Director of the Educational Resource Center at WGTE Public Media

How do these much talked about 21st century skills apply to your classroom? This informal presentation will explore current trends in tech integration as well as student outcomes and support systems that produce a framework for classroom learning in the 21st century.

Monthly Interdisciplinary Opportunities

Using Community Resources (Grades K-12) *(This section can be taken for credit.)*

Facilitators: October - Toledo Zoo; December - Toledo Museum of Art; January - Lucas County Soil and Water Conservation; February - Lourdes College Theater Vision & Life Lab; March - The Blade Newspapers in Education

Discover new resources, meet education specialists, and experience new ideas to energize your classroom science, mathematics, and technology lessons. *Because each monthly session is unique, this course is an excellent choice for teachers and pre-service teachers who cannot regularly attend.*

Monthly Engineering Opportunities

Experiencing Engineering is Elementary (EiE) (Grades K-6)

Facilitators: Cherie Pilatowski and Julie Campbell, Toledo Public Schools Science Support Specialists

Learn more by doing with the research-based, standards-driven, and classroom-tested curriculum from Engineering is Elementary (EiE). These investigations will help elementary school educators enhance their understanding of engineering concepts and pedagogy while fostering engineering and technological literacy among children.

Monthly Mathematics Opportunities

Exploring Elementary Math Topics (Grades K-6)

Facilitator: Amy Boros, Frank Elementary School, Perrysburg

Join us for lively discussions, hands-on, ready-to-use activities, and new ideas that can quickly and easily be incorporated into your elementary classroom. The sessions will focus on early elementary mathematics, but will include topics and discussions for all levels of elementary math teachers.

What Is a Number? (Grades 9-12)

Facilitator: Dr. David Meel, Mathematics & Statistics Dept., BGSU

These sessions will look at numbers and number sense from the natural to the complex and beyond. Be prepared to consider the infinite and to work through ideas that have perplexed mathematicians for years. Bring a graphing calculator and an open mind to these sessions.

Register online at: http://nwocenter.org/inquiryseries

Monthly Science Opportunities

Physical Sciences Modeling (Grades 9-12)

Facilitators: Nate Ash, Perrysburg High School, and Mary Kate Hafemann, Ottawa Hills High School ***(This section can be taken for credit.)***

Physics, chemistry, and physical science teachers will learn how the modeling method gives students the opportunity to confront their misconceptions about physical science head on, analyze their data in an in-depth, consistent way in order to construct appropriate models, and develop the skills and confidence needed to interpret results in a scientifically critical way.

Exploring Inquiry in High School Biology (Grades 9-12)

Facilitator: Dr. Eileen Underwood, Biological Sciences Dept., BGSU ***(This section can be taken for credit.)***

Expand your professional network and join area biology teachers as they explore topics of interest and investigate current knowledge about the best ways to instruct students in the life sciences.

Monthly Technology Opportunities

USE-IT (Uniting Science Education, Inquiry and Technology) (Grades 3-8)

Facilitators: Betsy Hood and Charlene Patten, WGTE Public Media

Gain strategies and classroom-ready resources that model effective applications of 21st century skills. Interact with new technology and/or sharpen your skills with the technology you already have. Walk away with learning tools (and technology!) designed for immediate adoption in the classroom and engage in best practice discussions to identify 21st century methodologies that promote active, process-oriented student learning.

USE-IT is funded by the Martha Holden Jennings Foundation. *This program is limited to 24 participants; please contact NWO at nwo@bgsu.edu to register.*

Technology Integration in STEM Education (Grades K-12)

Facilitator: Carrie Rathsack, Integrations Specialist, Rossford Public Schools

These sessions will focus on a number of topics in 21st century technology education. STEM integration and the latest tools and resources will be discussed to help teachers effectively meet the needs of all students.

October/December – Internet Tools for Teaching STEM; **January/February** – SMART Board for Elementary Math;
March – Integrating 21st Century Skills and Tools into the Secondary Science Classroom

Monthly Project pi r^2 Opportunities

Project pi r^2 (Grades K-8) *(This session is currently filled)*

Facilitators: Aimee Mendelsohn, Summit Academy School for Alternative Learning; Dr. Rick Worch, School of Teaching & Learning, BGSU; Robyne Kramp, Bowling Green City Schools; Deb Wickerham, Findlay City Schools; and Berry Cobb, Professor Emeritus, BGSU

Project pi r^2, Partners in Inquiry Resources and Research, is an exciting program offering 100 contact hours of high-quality teacher professional development for teachers in grades K-8 which brings science outreach into the classroom. *Please email mklinge@bgsu.edu for information on future opportunities.*

2009 -10 Inquiry Series Dates

DATE		TIME	PLACE
Sept. 26 [Sat]	**Blast-Off** – Betsy Hood, WGTE Public Media	8:30-12:30	BGSU Student Union (Lenhart Grand Ballroom)
Oct. 22 [Thurs]	Monthly Evening Session	5:00-8:00	Rossford High School (701 Superior St., Rossford, OH)
Nov. 7 [Sat]	**NWO Symposium**	7:45-4:00	Penta Career Center (9301 Buck Road Perrysburg, OH)
Dec. 3 [Thurs]	Monthly Evening Session	5:00-8:00	Rossford High School (701 Superior St., Rossford, OH)
Jan. 21 [Thurs]	Monthly Evening Session	5:00-8:00	Rossford High School (701 Superior St., Rossford, OH)
Feb. 18 [Thurs]	Monthly Evening Session	5:00-8:00	Rossford High School (701 Superior St., Rossford, OH)
Mar. 25 [Thurs]	Monthly Evening Session	5:00-8:00	Rossford High School (701 Superior St., Rossford, OH)
Apr. 22 [Thurs]	**Summit**	4:30-8:30	Rossford High School (701 Superior St., Rossford, OH)

The Inquiry Series is free to all educators and school administrators. Meals are provided free of charge. CEUs (Contact Hours) are available for this event.
Partial scholarships available for graduate credit. For more information contact nwo@bgsu.edu.

Supporting grant sponsors: Martha Holden Jennings Foundation, Ohio Board of Regents, Ohio Department of Education

The Northwest Ohio Center of Excellence in Science and Mathematics Education is a partnership between Bowling Green State University, University of Toledo, Lourdes College, Owens State Community College, University of Findlay, local school districts, educational service centers, businesses and non-profit organizations.