University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

Project Fulcrum Materials | Project Fulcrum

8-1-2006

Project Fulcrum 2006-2007 Handbook

Follow this and additional works at: http://digitalcommons.unl.edu/projectfulcrummaterials

Part of the Science and Mathematics Education Commons

"Project Fulcrum 2006-2007 Handbook" (2006). *Project Fulcrum Materials.* Paper 1.
http://digitalcommons.unl.edu/projectfulcrummaterials/1

This Article is brought to you for free and open access by the Project Fulcrum at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Project Fulcrum Materials by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Project Fulcrum 2006-2007 Handbook

Project Fulcrum is supported by the National Science Foundation and the University of Nebraska, in partnership with Lincoln Public Schools

Table of Contents

1. About Project Fulcrum 6

1.1. Mission and Goals 6

1.2. About This Handbook 6

1.3. The Role of Resident Scientists/Mathematicians/Engineers in the Schools 6

1.3.1. Terminology 6

1.3.2. What Resident Scientists/Mathematicians/Engineers Are: 7

1.3.3. What RSEMs Are NOT: 7

1.3.4. The Role of RSEMs in the Classroom. 8

1.4. Expectations of RSEMs 8

1.4.1. Appearance and Responsibilities 8

1.4.2. Where Can RSEMs Work? 8

1.4.3. Time Requirements/Availability 9

1.4.4. Serious Offenses 11

1.4.5. Resident Scientist/Mathematician/Engineer Appointments 11

1.5. Teachers 11

1.5.1. Definitions 11

1.5.2. Facilitate the Resident Scientist's/Mathematician's Work in the School 12

1.5.3. Keep Project Management Updated 12

1.5.4. Lead Teacher Stipends 12

1.5.5. For Resident Scientists, Mathematicians & Engineers: What is it Like Being a Middle or Elementary School Teacher? 12

2. Logistics 13

2.1. Who to Contact 13

2.1.1. General Information about Project Fulcrum 13

2.1.2. Graduate Student Appointments, Stipends, Health Insurance, etc. 14

2.1.3. Travel & Ordering (Money in General) 14

2.1.4. Project Fulcrum Mailing Address, Website, E-Mail 14

2.1.5. Listservs 14

2.1.6. Other Contact Information 14

2.2. Ordering Procedures 14

2.3. Conferences 15

3. PF 15
3.1. Breaking The Ice 15
3.2. Scientist/Mathematician/Engineer Responsibilities 16
3.2.1. Nuggets 16
3.2.2. Resident Scientist/Mathematician/Engineer Group Meetings 17
3.2.3. Unit Workshops 17
4. Assessment and Research 17
4.1. Why Are You Asking Me So Many Questions? 17
4.1.1. National Science Foundation Requirements 17
4.1.2. NSF Annual Report 17
4.1.3. UNL Requirements 18
4.1.4. Internal Program Assessment 18
4.2. Why the Permission Slips? 20
4.3. Student Permission Slips 20
4.4. Pre/Post Surveys 20
4.4.1. Some of the questions we are asked related to our personal lives – Why? 21
4.4.2. Do I have to answer questions that I think are too personal? 21
5. For Scientists: Working in K-12 Schools 22
5.1. Schools and Teachers 22
5.1.1. Schools (and teachers) are not autonomous 22
5.1.2. Teachers feel pressure from all sides 22
5.1.3. Schools have limited funding for equipment 22
5.1.4. Some Teachers do not want to be involved. 22
5.1.5. Teachers do not have a lot of time. 22
5.1.6. K-12 schools have politics. 23
5.1.7. Other Resources 23
5.2. Students: How They've Changed Since You Were in School 23
5.2.1. Developmental Level 23
5.2.2. Relevance and Interest 24
5.2.3. Learning Styles and Levels 25
6. Working in the Lincoln Public Schools 26
6.1. Building-Wide Concerns 26

6.1.1. Your School's Building Map/Emergency Procedures 26
6.1.2. Your School's Policies 26
6.1.3. Prohibited Items 26
6.1.4. Your School's Culture 26
6.1.5. Working with Substitute Teachers 27
6.1.6. Picture Taking 27
6.1.7. Parent-Teacher Conferences 27
7. Misc Information 27
7.1. Room 301 Ferguson 27
7.2. File Naming Convention 27
7.3. Website 27
7.3.1. Location. 27
7.3.2. Photos 28
7.4. Lincoln Public Schools Science Units 28
7.4.3. Science Scope and Sequence 28
7.5. Advice 28
7.5.1. Teachers: Introduce the Resident Scientist/Mathematician/Engineer to Everyone at Your School 28
7.5.2. Teachers: Introduce the Resident Scientist/Mathematician/Engineer to Your Kids and Their Circumstances 29
7.5.3. Involve Parents 29
7.5.4. Get to Know Each Other's Personalities. 29
7.5.5. Keep Communication Lines Open 29
7.5.6. Plan 29
7.5.7. Use Everyone Else as Resources 29
7.5.8. Don't Make Assumptions 30
7.5.9. Scientists/Mathematicians: Be Flexible 30
7.5.10. Scientists/Mathematicians: Communicate Your Enthusiasm 30
7.5.11. Have Goals 30
7.5.12. People are Different 30
7.6. Most Common Problems 30
7.6.1. Problems with Resident Scientists/Mathematicians 30
7.6.2. Problems with Teachers 31

8. Resources *33*

8.1. Developing Your Activities 33

8.1.1. Goal Statement 33

8.1.2. Time Available 33

8.1.3. Finding Out What The Students Already Know 33

8.1.4. How will you accomplish the activity? 33

8.1.5. Formative Assessment 34

8.1.6. How will you know if the students learned what they were supposed to learn? 34

8.2. Inquiry 34

1. About Project Fulcrum

1.1. Mission and Goals

The education of K-12 students in science, technology, engineering, and math (STEM) is of critical importance. Project Fulcrum (PF) unites students, teachers, and scientists to promote math and science education.

The goals of Project Fulcrum are:

1) Enhance students' opportunities to learn science by increasing access to inquiry-driven experiences in content areas that satisfy national and state science and math standards;
2) Assist teachers in gaining more science knowledge and increase their confidence about teaching science and math;
3) Provide students with diverse role models;
4) Improve student attitudes regarding their involvement in science and math;
5) Help GK-12 Resident Scientists/Mathematicians/Engineers improve pedagogical, communication and teamwork skills, thus enhancing future employment opportunities;
6) Assess the short-term and long-term impacts of the program on the schools, the teachers at those schools, and the GK-12 Resident Scientists/Mathematicians;
7) Facilitate long-term interactions between teachers, teacher educators and scientists/mathematicians; and,
8) Promote long-term cooperation between Scientists/Mathematicians/Engineers and teacher educators at UNL to stimulate additional joint activities promoting K-12 education.

This program is **NOT** intended to turn science, math, and engineering students into teachers. Our goal is to ensure that the next generation of researchers in academia, industry, and government are aware of and sympathetic to the need for quality education in public schools and capable of communicating with schools and teachers to determine how they can best assist in achieving the goal of 'science for all'.

1.2. About This Handbook

This handbook will guide you throughout the coming year. Much of the information you need is maintained on the PF website so that it can be as current as possible. Lists of participants, contact information, the calendar, etc. are there and will be regularly updated. For this reason, we do not include printouts of, for example, contact information. If you would like a hardcopy of this information, you may print out a copy; however, make sure you check periodically to ensure that the information has not changed.

1.3. The Role of Resident Scientists/Mathematicians/Engineers in the Schools

1.3.1. Terminology

All of the graduate students participating in the program are called 'Resident Scientists' 'Resident Mathematicians' or 'Resident Engineers'. It is important not to refer to yourself (or to let others refer to you) as a grad student, graduate student, student and especially ***not*** as a student teacher. We will provide you with a badge with your name and title on it to remind people that you are a scientist, mathematician or engineer.

1.3.2. What Resident Scientists/Mathematicians/Engineers Are:

Resident Scientists/Mathematicians/Engineers (RSEMs) are full-time graduate students pursuing degrees in math, science or engineering. They are taking 9-12 credits of graduate courses, doing research, or both. RSEMs are selected in part because of their potential to be future leaders in their fields: they are not planning to become K-12 teachers nor is it our intent to encourage them to do so. In ten years, they will University faculty, managers in industry, entrepreneurs, and government employees who will know how to work effectively with teachers, are interested in doing so, and encourage others to join them.

RSEMs work with teachers and their students. RSEMs must be **school-wide resources** so that they can affect as many students and teachers as possible. RSEMs bring real-life experience in science, problem solving skills and excitement about science to the classroom.

For teachers:

Resident Scientist/Mathematician/Engineer stipends cover more than just the time they spend in schools. Most graduate students easily average 50 hours per week and many work more than that. Although the PF workload is approximately 17 hours per week, part of the Project Fulcrum graduate assistantship is for making progress toward graduate degrees in the form of coursework or research. It is standard for STEM disciplines to support future scientists through assistantships.

In most disciplines, the first 1-3 years consist of 9-12 hours of coursework. In some disciplines, students start research while they are taking courses. Almost all disciplines have comprehensive exams, although the name differs discipline to discipline (i.e. 'comps', 'prelims', 'qualifiers', etc.). All have the following in common: students have a fixed number of attempts to pass each exam. If they do not pass the exam, they must leave the department.

Because of the consequences, your Scientist/Mathematician/Engineer probably will be more stressed than usual if he or she is taking these exams. Some departments have more than one set of exams. As an example, physics has an elementary qualifier, which tests knowledge of undergraduate physics, an advanced qualifier (one part is necessary to earn an M.S. and the second part is necessary to be admitted to the Ph.D. program). This is followed by a comprehensive exam during which they have one to two weeks to develop a research proposal on a topic assigned by their supervisor. Finally, there is a thesis defense. Studying to pass these exams is part of what we pay graduate students to do. These hoops are critical, stressful times in the lives of STEM graduate students and your patience is much appreciated.

1.3.3. What RSEMs Are NOT:

- RSEMs are NOT student teachers. Most RSEMs have no formal training for teaching or working with children – nor is it a goal of this program to make them teachers.
- RSEMs are not just an extra set of hands in the classroom.
- RSEMs are not supposed to 'take over' a class; they must be partners with the teachers in planning *and* execution of activities.
- RSEMs are not certified by the state and they cannot be left with children unless there is a state-certified teacher present. The potential for legal action in case of injury or accusations of harassment is enormous. Violation of this rule is cause for removal of the Resident Scientist/Mathematicians from your classroom.

1.3.4. The Role of RSEMs in the Classroom.

RSEMs are in the classroom to help improve math and science education for students in ways deemed appropriate by their teachers. RSEMs are to avoid:

- **Giving lectures**. A five-minute overview of an upcoming activity is fine, but students don't learn by listening. If you have to talk, work in plenty of opportunities for students to participate. Ask them a question and let them discuss it with a partner, and then ask for volunteers to share their answers.
- **Focusing more on you than the students.** Teaching is facilitating the learning process for your students. The focus is and should always be on the student, ***not the teacher***. If you are teaching because you like to be in front of an audience, Project Fulcrum is the wrong program for you.

1.4. Expectations of RSEMs

1.4.1. Appearance and Responsibilities

RSEMs represent the University and Project Fulcrum to the school and the school district, so it is important that they be professional. RSEMs are expected to follow all of the requirements of their schools in terms of their dress and behavior. Lead Teachers should ensure that RSEMs are aware of the standards in their particular schools. Regardless of school policy, all PF RSEMs must obey the following requirements:

- RSEMs are expected to be punctual to all PF activities and to provide as much advance notice as possible when unexpected circumstances require a change of plans.
- Dress in a professional manner at all times.
  - No hats may be worn in the building.
  - Clean jeans may be worn as long as they are not ragged or torn. Sagging jeans and jeans that allow underwear to be seen should not be worn.
  - T-shirts must be clean, may not have a commercial logo or advertise a product and should not promote unacceptable behavior.
  - No clothing that shows skin on backs, stomachs, or midriffs is allowed. Short shorts and short skirts are not permitted.
  - Your dress is independent of what teachers at your school wear. You are representing the university and the program.
  - Shorts are permitted when it is very warm in the classroom, but they should be clean and not overly short.
- Cell phones, pagers, etc. should be kept turned off and out of view at all times. Personal electronic devices are not to be used during instructional time.
- Do not eat in front of students unless you are joining them for a meal, snack, etc.

1.4.2. Where Can RSEMs Work?

Resident Scientists must work with students on **math, science, or technology**. They should NOT be involved in spelling, social studies or anything else unless the program is integrated with science and/or math. For example, a social studies unit on Lewis and Clark in which the

Resident Scientist introduced contour maps, the geology of the area, and navigation by the stars would be an acceptable project.

RSEMs also may be involved in family math and science activities, after-school science clubs, and science fairs. We encourage you to find ways to work with students and their parents on these types of efforts. RSEMs may not count going on field trips as time worked UNLESS there is a substantial science component to the field trip that you helped to originate or execute. Do not forget that any activity involving students must include an LPS teacher. There are no exceptions!

1.4.3. Time Requirements/Availability

RSEMs are required by the conditions of the grant to *average* ten hours per week in a school working with either the students or the teachers. Note that this is an average and you may work more hours one week and fewer hours the next week.

- **8 hours per week** should be student/teacher contact hours during which the Resident Scientist/Mathematician/Engineer is actively engaged with a teacher *and* his or her students. During the first two weeks the Resident Scientist/Mathematician/Engineer is in the school, this may include some observation time – enter this time as student contact.
- **2 hours per week** must be spent planning with teachers.
- **1 hour per week** is spent at the Resident Scientist/Mathematician/Engineer group meeting.
- **Up to four additional hours per week** may be necessary for preparation (alone or with a teacher), plus completing the journal, schedule and activity log.

IMPORTANT

- A full-time graduate student appointment is for 12 months. We try to arrange things so that the 2 summer months are free from any PF duties, during which time you can focus on completing the requirements for your degree. This leaves 10 months of PF activity, which we will count (for the sake of argument) as 40 weeks. UNL considers a full-time graduate appointment a minimum of 15 hours per week, so a full-time Scientist/Mathematician/Engineer will log 600 hours with the project over the course of the year. Note that some departments define a graduate appointment to be 17-20 hours/week, so regard these numbers as the minimum requirements.
- LPS has 18 weeks per semester. NSF requires that you spend 8 hours/week of your appointment working with students and another 2 hours in the schools.
- By the end of the year, a full-time Scientist/Mathematician/Engineer should have spent 288 hours working with students and another 80 hours spent in the schools, either planning with teachers or working with students.
- The table below estimates the time you should spend on each activity. The ten hours in the school are written in stone: there is some flexibility in shifting time between the other categories.

- Full-time students should be close to meeting half of their time requirements after the first semester. Don't get behind and expect to be able to make up a significant amount of time during the second semester.

Activity	Full Time (h)	Half Time (h)
Student Contact (in schools, or extracurricular activity)	288	144
Planning with teachers and other working with students	80	40
Weekly Group Meetings	40	40
Filling out journal/activity log[1]	60	30
Summer Institute	40	40
Preparing and participating in workshops, documenting activities, etc.	50	26
Other	42	0
TOTAL	**600**	**320**[2]

YOU ARE RESPONSIBLE FOR ENSURING THAT YOU MEET THESE REQUIREMENTS. FAILURE TO BE ON TRACK TO DO SO MAY RESULT IN TERMINATION OF YOUR ASSISTANTSHIP.

Special Cases:

- Non-science activities with students (joining them for lunch, for example) must be limited to no more than one hour per week (a total of 36 hours for full-time and 18 hours for half-time).

RSEMs should be available whenever LPS is in session. A calendar with LPS and UNL holidays is available on the PF website. LPS information also is available at: http://www.lps.org/about/calendar/. Each school will have deviations from their normal schedules due to field trips, assemblies, etc. The Lead Teacher is responsible for letting the Resident Scientist/Mathematician/Engineer know as far in advance as possible when these occurrences are.

RSEMs occasionally must be out of town for conferences or fieldwork, or unavailable due to exams. ***It is the Resident Scientist/Mathematician/Engineer's responsibility to plan absences with the Lead Teacher in advance.*** The Lead Teacher should be notified as much in advance as possible.

RSEMs will be encouraged to visit other schools during the course of the year. This time should be counted in the weekly student contact hours. Resident Scientists should ensure that visits to other schools are reciprocated: your school should still have a

[1] 90 minutes are allocated for this task each week, which is generous. You should need that long most weeks.
[2] Half-time scientists/mathematicians are paid slightly more than half the full-time stipend because they are required to come to meetings throughout the year. This is why the number is larger than 300 hours.

Scientist/Mathematician/Engineer working with students for an average of eight hours per week. The exchange visits do not have to take place during the same week: remember that the goal is to meet the cumulative time requirements: how you do that will depend on your specific circumstances.

1.4.4. Serious Offenses

We are guests in the Lincoln Public Schools. This requires that we obey their rules ***to the letter***. RSEMs can be dismissed for any of the following:

- Bringing a weapon – or anything that could be used as a weapon – onto school property. THIS INCLUDES JACKKNIVES. 'School property' includes the parking lot and grounds.
- Swearing or using abusive language with a teacher, student, or administrator.
- Showing up under the influence of drugs or alcohol, or bringing drugs, alcohol, or tobacco onto LPS property. This includes prescription and over-the-counter drugs.
- Repeated failure to turn in documentation materials (journal, activity log and/or schedule).

A Resident Scientist/Mathematician/Engineer breaking these rules could lead to the entire program being thrown out of the LPS system. It is easy to forget that you have a jackknife in your pocket. Please think carefully before you head to a school.

1.4.5. Resident Scientist/Mathematician/Engineer Appointments

Graduate students must be enrolled full-time to hold a Resident Scientist/Mathematician/Engineer appointment. We cannot employ a student who has is taking fewer than the minimum number of credits required for full-time status. Please notify us if anything changes in terms of number of classes taken, your standing in your degree program, etc. RSEMs cannot be paid if they are not registered as full-time students. If you graduate in May and leave the university, we cannot pay your summer stipend.

A full-time Resident Scientist/Mathematician/Engineer appointment covers 12 months. During this time, you may not take additional employment, including over the summer. Scientists on half-time appointments should not accept employment for any more than the other half of their stipend. Being a Project Fulcrum Resident Scientist/Mathematician/Engineer – which includes taking courses and doing research – is a full time job.

1.5. Teachers

1.5.1. Definitions

Every school has one (and in some cases two) Lead Teacher(s). Lead Teachers are mentors, organizers, and facilitators. They are the Resident Scientist/Mathematician/Engineer's entryway into the school and help the Resident Scientist/Mathematician/Engineer work with other teachers. Lead Teachers are an extremely important part of Project Fulcrum. A Cooperating Teacher is a teacher with whom the Resident Scientist/Mathematician/Engineer has substantive interaction (i.e. more than a one-time visit).

1.5.2. Facilitate the Resident Scientist's/Mathematician's Work in the School

The Lead Teacher is a critical resource in determining how the Resident Scientist/Mathematician/Engineer can best aid the school. Different models will work in different schools, so the Resident Scientist/Mathematician/Engineer and Lead Teacher must plan together to make the best use of resources. The Lead Teacher is the key to helping the Resident Scientist/Mathematician/Engineer reach beyond the Lead Teacher's classroom. This may require pleading, begging, and cajoling colleagues to take a chance. Emphasize that the project tries to make teaching easier and more effective.

A couple suggestions from previous participants include offering to have the Resident Scientist/Mathematician/Engineer do a five-minute demonstration or very quick activity in the classroom to show the new teacher how the Resident Scientist/Mathematician/Engineer can help. Joint activities with other classes involving the Resident Scientist/Mathematician/Engineer also are effective ways to ease colleagues into the program. Some teachers are intimidated by Resident Scientist/Mathematician/Engineer, while others are busy and believe that the Resident Scientist/Mathematician/Engineer is likely to take up more time than they will save. Do not take rejections personally.

1.5.3. Keep Project Management Updated

We depend on Lead Teachers to tell us how things are going in their classes. If there is ANY problem or concern regarding the Resident Scientist/Mathematician/Engineer or the program in general, PLEASE, PLEASE let us know as soon as possible. We do not want you to feel uncomfortable or put out because of your participation in the program. Please tell us while we have the chance to do something about it. Feel free to contact the Project Coordinator at fulcrum2@unl.edu or 472-8685 at any time.

1.5.4. Lead Teacher Stipends

Lead Teachers receive a stipend based on an hourly rate for all meetings attended and for submitting complete journals on time. Payment vouchers will be turned into the UNL accounting office when all activities are completed. Checks will be available about three weeks later and will be mailed directly to your home.

You will be asked to sign a consultant form at the initial meeting for each unit in which you participate. We are required by State law to have your social security number for any reimbursement.

One hour is allocated for each journal. Payment for journals is made only if the journal is turned in *on time* and is complete.

1.5.5. For Resident Scientists, Mathematicians & Engineers: What is it Like Being a Middle or Elementary School Teacher?

Teachers have far more responsibilities than just teaching. Their many "hats" include instructor, counselor, nurse, referee, mentor, facilitator, warden, director, and coordinator to name a few. Even in a city like Lincoln, teachers must deal with great diversity—non-English-speaking students, students with abusive parents, high mobility rates, and latchkey children. Many students have learning disabilities, behavior problems, and other special needs. Many of the Lead Teachers for Project Fulcrum have additional leadership responsibilities with LPS, such

as science liaison or team leader. Many also are working on advanced degrees or taking classes to meet state and federal professional growth requirements to renew their teaching certificates.

One teacher said, "Teaching science is not the easiest of subjects to teach. It requires more planning, more materials, and more logistical decisions than other subjects do. Preparation time is lengthy because students have to learn the subject matter by "doing" science. The science objectives are just a small part of each lesson. Knowing how to gather, interpret, and communicate data is a skill that all students have to be taught how to do. "

Another former Lead Teacher explained "Teaching is probably one the most difficult professions to accurately paint a picture of. It is a balancing act like no other. Responsibilities are continually added to their (teachers') already full plates with an entire community expecting results. We (teachers) deal with peoples' children – think of all the expectations they (parents) have for their children's futures. Many parents believe it is the responsibility of the teacher to shape the children."

A teacher's workweek is similar to a graduate student's in that it stretches to include all the things that have to be done. This may include daily or weekly after-school building meetings, monthly district meetings, and meetings with parents. Many teachers must handle lunch duty, playground duty, or early morning duties such as bus supervision or supervising breakfast time. Time is the most precious commodity for a classroom teacher.

Teachers have to work with each student as an individual, which means that there is a lot of paperwork. Teachers must maintain a discipline plan and/or special plan (sometimes called a 504 plan) for students who are unable to operate within a regular school day because of behavior or educational problems. A yearly pacing plan showing approximate dates for completion of units has to be handed in and approved by their principals. Some schools require teachers to make daily lesson plans identifying which standard(s) they are teaching and submit these plans to their principals to prove that every student is getting an opportunity to learn.

The federal "No Child Left Behind" act (aka 'NCLB' or 'nickle-bee') places great pressure on teachers due to its emphasis on high-stakes testing. Testing stresses students and their teachers. All schools must publish their students' test scores in reading, math, writing, and science. There are serious consequences for schools that do not meet federal standards, which can include firing teachers and principals, and allowing students in that area to switch to other schools. The standardized tests in the Lincoln Public Schools are called the Criterion Referenced Tests or CRTs. CRTs constitute one of the primary job stresses for teachers.

2. Logistics

2.1. Who to Contact

2.1.1. General Information about Project Fulcrum

Project Coordinator: (402) 472-8685. The Project Fulcrum office is in room 301 Ferguson Hall. The code for opening the office will be handed out at the first meeting. Any questions regarding Project Fulcrum should start with the Project Coordinator, with the exception of the items noted below. In particular, **please do not ask the LPS District Office, Lois Mayo or Matt Larsen questions before you have talked to us**.

2.1.2. Graduate Student Appointments, Stipends, Health Insurance, etc.

Kay Haley (116 Brace; 472-9221) is the graduate secretary for the Department of Physics & Astronomy. She processes all of the paperwork for Project Fulcrum graduate student appointments and is the person to talk to for any questions regarding your pay, your appointment, health insurance, etc.

2.1.3. Travel & Ordering (Money in General)

The Project Coordinator will handle all travel and ordering. Do not spend money out-of-pocket for anything, as we cannot guarantee that you can be reimbursed.

2.1.4. Project Fulcrum Mailing Address, Website, E-Mail

Project Fulcrum
c/o Department of Physics & Astronomy
University of Nebraska – Lincoln
Lincoln, NE 68588-0111
(402) 472-8685
e-mail: fulcrum2@unl.edu
website: www.physics.unl.edu/~fulcrum

2.1.5. Listservs

To send e-mail to all teachers: PF_TCH_AY06@UNL.EDU

To send e-mail to all Resident Scientists: PF_SCI_AY06@UNL.EDU

Prof. Leslie-Pelecky and the Project Coordinator receive a copy of mail going to any of these lists.

2.1.6. Other Contact Information

The most current contact information for all Resident Scientists and Lead Teachers will always be available on the Project Fulcrum Database. Only Project Fulcrum teachers, Scientists/Mathematicians/Engineers and project management have access to your contact information.

Ask your partner whether he or she can be contacted at school, at home or both. RSEMs should ask teachers when their planning hours are, as this sometimes is the only time during the day that a teacher can take a phone call. Make clear to your partner the times you do NOT want to be contacted (except in case of an emergency). Respect your partner's preferences.

2.2. Ordering Procedures

Project Fulcrum cannot support the purchase of consumables for individual classrooms according to the conditions of our grant. We do periodically make purchase for equipment that can be used in more than one classroom and in more than one year. All purchases stay in the PF office so that all teachers have access to them.

All ordering is done by the Project Coordinator. **We cannot make any reimbursements to individuals for items they purchase on their own.**

2.3. Conferences

Some funding is available for teachers or Resident Scientists/Mathematician to attend conferences at which they give a paper, workshop, or poster about Project Fulcrum. The requirements for receiving funding are:

- You must be presenting a paper, poster or workshop about Project Fulcrum. Abstracts or papers must be reviewed by the PF office prior to submission. You may present a paper on your work in addition to the PF paper.
- We must have 30-day advance notice so that paperwork can be processed.
- You must contact the PF office and have them help you fill out a travel authorization form and send it electronically to papurchasing@unl.edu
- You must file an expense report within three weeks of your return to be reimbursed. Receipts are mandatory for hotels, taxis, rental cars and any other large expenses. Receipts are not required for meals, but you must to keep track of the amount and report actual costs. Each city has a maximum meal cost that can be reimbursed. The Project Coordinator can provide this information.
- Any abstracts or other material submitted must be approved by the PI prior to submission. Please allow at least one-week lead-time.
- You must provide a one-to-two page summary of the conference and your activities there, including the title of your poster, paper or workshop, the names of others involved, the number of people attending your workshop, etc. no later than two weeks after you return. No reimbursements will be approved until this is received.
- Conference registrations and airfare should be charged directly to the grant. Contact the Project Coordinator. A travel authorization must be filled out before this can be done.

3. PF

3.1. Breaking The Ice

Lead Teachers at each school will help the RSEMs determine how they can best assist in the classroom. Planning is a very critical part of the process. Our experience shows that the level and degree of planning can make or break the efficacy of the Resident Scientist/Mathematician/Engineer.

The first quarter is a time of unease. The Resident Scientist/Mathematician/Engineer and the Lead Teacher will be getting used to each other: learning each other's work style, learning how to communicate, and finding the strengths and resources each brings to the partnership. It is common during the first quarter for the participants to wonder what they were thinking when they agreed to participate in this project. We suggest the following:

- Get to know each other personally level. Find time to meet for lunch outside of school. Talk about your background, where you come from, and where you are going. Everyone is busy, but this step can greatly enhance your long-term communication and make working together much easier.

- Establish some ground rules. How much notice should the Lead Teacher give the Resident Scientist/Mathematician/Engineer when he/she needs something from the Resident Scientist/Mathematician/Engineer? Should the Resident Scientist/Mathematician/Engineer feel free to interrupt the teacher during a lesson, or wait until the Resident Scientist/Mathematician/Engineer is asked to contribute? These details will vary depending on the teacher and the scientist. Do not ignore them in the hopes that they will go away – **they will not**. The best strategy is to get everything out in the open and to maintain an open line of communication throughout the year.

RSEMs will receive a formal evaluation after they have been in the school for a few weeks. This evaluation will be based on the teachers' comments, journal/activity log input, and our observations. This is primarily for the Resident Scientist/Mathematician/Engineer's reference. The first evaluation will focus on mechanics: is the Resident Scientist/Mathematician/Engineer dressing appropriately, are they on time, are journal and time card entries on time and filled with enough detail? Input will be solicited from teachers and assessors.

3.2. Scientist/Mathematician/Engineer Responsibilities

In addition to attending all meetings and fulfilling the responsibilities as stated above, Scientists/Mathematicians/Engineers have the following responsibilities.

3.2.1. Nuggets

Each Scientist/Mathematician/Engineer is responsible for submitting one nugget each quarter they are in the schools. A 'nugget' is an NSF-invented term that denotes a one-slide presentation of something notable you have done during the previous quarter. Examples of previous nuggets are on the PF website.

Requirements for content

- Do not show pictures of people giving talks or doing demonstrations. The whole point of this project is for students to learn. Pictures must show students being active and engaged.
- Focus on what is being learned and how Project Fulcrum being in the classroom is improving what or how students learn. Do not just go over what students did. It is easy to do an activity without learning anything.
- Use quotes where possible. Do not tell us that students asked good questions – tell us what questions they asked and let your audience judge for themselves.

A few technical requirements:

- Do not use a lot of words. Do not use a very small font.
- Include a picture, graphic, example of student work, etc. (Make sure you have permission to use the picture or example before you submit it.)
- Use the template provided on the PF website. Do not modify the template.
- In the notes section below the slide, write one to two paragraphs with more details about your project.

- Make sure that your name and your school name are on the slide as shown in the template.

3.2.2. Resident Scientist/Mathematician/Engineer Group Meetings

Resident Scientists and Mathematicians meet once a week to discuss the project, activities and events at their schools. The best sources of information often are other Resident Scientists and Mathematicians. Questions submitted through the journals will be included in the agenda, as well as other topics as they arise. Resident Scientists and Mathematicians will provide schedules to us at the beginning of *each* semester so that we can schedule a time. Group meetings last one hour and are mandatory. They should be recorded in your activity logs.

3.2.3. Unit Workshops

A three-hour meeting that covers the content that is encompassed by the objectives for that unit. Hands-on materials will be discussed. RSEMs are required to participate in planning the workshop. LPS coordinates the workshop registration.

4. Assessment and Research

4.1. Why Are You Asking Me So Many Questions?

Statistics are an integral part of the program. We are required to collect statistics as a condition of our funding. We use these data to improve the program and make the case for additional funding. You will be asked to sign an informed consent form that details the care with which the data will be handled. These statistics are not used to evaluate *you* - they are for evaluating the program as a whole. Results are reported as a group, with no individual identification of people or schools.

4.1.1. National Science Foundation Requirements

The National Science Foundation requires us to provide demographic information on project participants, including racial and ethnic, socio-economic and English Language Learner data. This information is used in aggregate by the National Science Foundation to justify the funding of this program. They are interested in the number of teachers we affect, the number of RSEMs we affect, and the number of minorities and women we affect. NSF has been known to ask for data on short notice, so please help us when we have to scramble to collect information at the last minute.

4.1.2. NSF Annual Report

Each year, we must write an annual report that includes:

- Who worked on the grant and what their roles were.
- Information on who was affected by the grant.
- The primary activities of the grant.
- The primary findings of the grant.

We are also required to submit ‘nuggets’, which are very short summaries of particular projects or results of which we are especially proud. This is the only time that you and your school would be identified and then only with your agreement.

4.1.3. UNL Requirements

If you want to be paid from this grant, UNL must have your:

- Full Name
- Social Security Number
- Home Address
- Home Phone Number

We cannot pay anyone without this information. Social Security Numbers are stored only a locked file cabinet in the PF office – they are not stored on any computer.

4.1.4. Internal Program Assessment

The goals of the program are listed in the front of this handbook. The assessment questionnaires are designed to determine whether the program is meeting these goals. The grid below shows some of the questions we are interested in studying over the course of this program. The information we learn not only helps improve the program, it is disseminated to other GK12 projects throughout the country so that we can come up with a collective model for how to best utilize scientists in the classroom.

Questions	Journals[3]	Science Attitudes[4]	Self-efficacy[5]	Observations[6]	Focus Groups	Student Interviews	Activity Logs	Questionnaires
Do Resident Scientists and Teachers understand what inquiry is and why it is emphasized?								
Are teachers more comfortable using inquiry in the classroom?								
Are students doing more inquiry?								7
Are students learning the scientific method?								5
Are students learning content via inquiry?								8
What are the barriers to using inquiry methods and how can we lower them?								
Have Resident Scientists developed a realistic understanding of the challenges of K-12 education?								

[3] Modified version from the Rocky Mountain Teacher Education Collaborative, University of Northern Colorado. (www.oerl.sri.com/instruments/et/instrTE/rmtec2.html.)

[4] Pre- and Post-Survey using "Image of Science and Scientists Scale" (Krajkovich, J. & Smith, J. (1982); The Development of the Image of Science and Scientists Scale. Journal of Research in Science Teaching, 19(1), 39-44.)

[5] Science Teaching Efficacy Beliefs Instrument for Teachers: (I. Riggs, M. Enochs, and G. Larry, *Science Teaching Efficacy Beliefs Instrument*, Sci. Educ. **74**, 625-637 (1990)).; Student Opinion Survey for students (McMillan, J. (1995). Student Opinion Survey. Princeton, NJ: Educational Testing Services.)

[6] From "User-Friendly Handbook for Project Evaluation: Science, Mathematics, Engineering and Technology Education, NSF, (available at: http://www.ehr.nsf.gov/EHR/RED/EVAL/handbook/handbook.htm).

[7] References 26 and 27 of Section 4 (Bibliography).

[8] LPS has developed a standardized test, the Criterion Reference Test (CRT) that will be used.

Questions	Journals[3]	Science Attitudes[4]	Self-efficacy[5]	Observations[6]	Focus Groups	Student Interviews	Activity Logs	Questionnaires
Have Resident Scientists improved their abilities to work as part of a team and communicate with non-scientists?	■			■	■			9
Does participation affect Fellow's future career choices?		■						10
Were students exposed to diverse images of scientists? Did images of scientists change?	■	■		■		■	■	11
Do Resident Scientists feel they are effective role models?	■	■			■			
Do Resident Scientists affect students from different groups in different ways?	■	■		■		■		
How do students' images of science affect future career plans?		■			■	■		
Does the number of students participating in extra-curricular science change?								12
Do students feel more self-confident in their ability to do science and/or math?			■	■		■		
Do teachers feel more self-confident in their ability to teach science and/or math?	■		■	■				
Do teachers feel more comfortable communicating with scientists and vice-versa?	■			■	■			
Do Resident Scientists join professional education societies? How often do they visit schools, judge science fairs, etc. that are NOT in their school?	■						■	8
Do teachers present papers, workshops or posters at local or national conferences? Have teachers produced materials or led in-services? Hold office in organizations?	■							10
Did participation in PF affect the Resident Scientists' progress toward degree	■							8
Has PF changed the way teachers teach science and/or math?	■			■	■			13
Has the school's investment in science and/or math education changed as a result of the PF experience?								11
How broadly did the Fellow impact the entire school?				■				11
Do faculty/departments previously not involved with K12					■			14

[9] Annual Questionnaire sent to advisors of current Fellows.
[10] Annual Questionnaire sent to current and past Fellows.
[11] Reference 31 of Section 4 (Bibliography)
[12] Annual Questionnaire sent to current and past Lead Teachers
[13] Annual Survey sent to Principals of current and past PF schools
[14] Department chairs, information from database

Questions	Journals[3]	Science Attitudes[4]	Self-efficacy[5]	Observations[6]	Focus Groups	Student Interviews	Activity Logs	Questionnaires
education become involved?					■			
Do departments have education colloquia?								12
Did this experience change how different constituencies think about each other?					■			15
Is the community more aware of the needs of science and math education?								16
Are more joint scientist/educator projects initiated?								12
Do teachers continue to invite UNL scientists to class and what is the nature of the interaction? Do the interactions (nature or number) change?	■			■			■	10

4.2. Why the Permission Slips?

The university must be very careful about what type of information it allows to be gathered and how that information is handled. IRB stands for Institutional Review Board. This organization in the university evaluates any research proposals involving human or animal subjects. Any study must gather data only using procedures that have been approved in advance by the IRB. Once approved, forms and methods of study cannot be changed without resubmitting the changes for approval. Changing even one word requires new approval. Data gathered without the appropriate paperwork cannot be used. The forms that are submitted detail that all data collected will be kept in locked cabinets until its destruction, with a specific time period specified for the destruction. For example, audiotapes, once transcribed, are erased and destroyed.

4.3. Student Permission Slips

Any student participating in the study must have an 'informed consent' form signed by his or her parents. This form lists all of the possible hazards that could come from participating in the survey so that parents can evaluate whether they want their child involved.

4.4. Pre/Post Surveys

You will complete a pre- and a post- survey evaluating your ideas about and attitudes toward the program. The pre-survey will establish your preliminary ideas of what this program is about, your role in the program, etc. This data will be compared to data from a similar post-survey given at the end of the project so that we can compare your expectations with what actually took place. Some questions you might have about the survey are answered below.

[15] Pre/post interviews of PI and senior personnel
[16] Newspaper clippings, Information from UNL Public Relations office, state education budgets.

4.4.1. Some of the questions we are asked related to our personal lives – Why?

One of the goals of this project is to understand what aspects of the GK-12 program could be transferred to graduate education in general to make graduate school a better experience. So questions asked of RSEMs like "Why were you interested in participating in Project Fulcrum?" help us figure out whether there is something missing from traditional graduate education. The expectations of graduate school frequently conflict with home, family and other responsibilities. When people are faced with these conflicts, some opt to leave graduate study. Understanding these pressures and conflicts will help us understand why talented people choose to leave science, math, and engineering programs.

Nationally, the number of women graduate students in GK-12 projects is 55% of the total students, which is *much* higher than their representation in the pool of eligible students. We want to understand what is attractive to women about participating in the GK-program and whether this helps identify what we are missing in the rest of graduate education.

4.4.2. Do I have to answer questions that I think are too personal?

While we want to gather as much data as possible, you are not required to disclose information that you are uncomfortable providing. No information is ever reported in a directly identifiable way. We may use a quote of yours, but the words will not be identified with your name. If you have concerns, please talk to the Project Coordinator.

5. For Scientists: Working in K-12 Schools

5.1. Schools and Teachers

This section summarizes some of the issues prior Scientists/Mathematicians/Engineers have had during the project.

5.1.1. Schools (and teachers) are not autonomous

The state mandates certain competencies for students at each grade level and in each subject area. LPS imposes additional requirements. The principal and teachers do not always agree with the requirements, but they are accountable for meeting each of them. This is especially emphasized with standardized test (CRTs in LPS), and teachers often feel that the limited time available means that they are teaching to the test. Everything you do must help students master these basic competencies.

5.1.2. Teachers feel pressure from all sides

In addition to the principal, the school district and the state and national requirements, teachers often have hundreds of parents and special interest groups that presume to be their bosses. They can be faced with a wide range of competing demands, expectations, and objections from people and groups, each of whom is convinced that their own point of view is correct. You are there to help, not to add to this problem.

5.1.3. Schools have limited funding for equipment

On the positive side, teachers are exceptionally resourceful in finding inexpensive and/or free equipment and supplies. *Project Fulcrum cannot provide money for equipment or supplies;* however, we can help teachers write grants to acquire new equipment or for travel. Help the teachers figure out how to fix a piece of equipment that doesn't work, or identify the giant tub that's been sitting in the back room for so long that no one remembers what it is.

5.1.4. Some Teachers do not want to be involved.

Experienced school principals and teachers are frequently idealistic by nature, but tempered with the reality of years of experience. Those who have maintained their enthusiasm, flexibility, sense of purpose, and love for the students are to be honored and emulated. They usually will be eager for your involvement and a pleasure to work with. Some teachers, however, will have a diminished sense of enthusiasm, flexibility and sense of purpose, often for reasons that are none of your business. You may be able to win over some of these teachers, but others are not going to want anything to do with the program. Treat them courteously and focus on those who welcome your involvement.

Schools get numerous "offers of help," many of which either do not come to fruition, turn out to be very short-lived, or conflict with school priorities. These types of experiences might make them a bit skeptical of you at first. Do not be discouraged. Once you have made good on *your* commitments and demonstrated to them that *you are* in it with them for the long haul, they will warm up.

5.1.5. Teachers do not have a lot of time.

Teachers are pulled in many different directions and are very busy. Try to make their lives simpler, not more complex. Seek to enhance their efforts without imposing extra demands on

their already hectic schedules. Avoid becoming viewed as a time sink or just another person competing for their attention. Be part of the solution, not part of the problem.

5.1.6. K-12 schools have politics.

The same kinds of cliques, power struggles, and honest differences of opinion that you find in most work settings also exist in school staffs. Try to get along with everyone and avoid becoming identified with one group or point of view. Learn the "do's and don'ts" at your school. Do your best to comply with the school's written and unwritten rules.

Do not get involved in school politics. Do not gossip, repeat anything you heard at your school, or get too personally involved with the teachers with whom you work. It is better to leave business relationships as business relationships. Do not criticize teachers, especially in front of their students, their principal or their colleagues.

5.1.7. Other Resources

It is important to realize that teachers and Scientists/Mathematicians/Engineers may use the same word in very different ways. Look at the article by Tanner, *et al.*[1] for a good explanation of the communication divide.

5.2. Students: How They've Changed Since You Were in School

Students come in all sizes, shapes, and levels of emotional and intellectual development. A few of the generalities that you need to know, even if you are working primarily with teachers, are outlined here.

5.2.1. Developmental Level

Children younger than 10-12 years of age base their social values and find their primary security in their family. Puberty produces physical as well as social and emotional changes. Their peer group becomes increasingly significant in their lives at the expense of family, and they begin to question values and try on new behaviors (some of which are strange and others of which are genuinely dangerous). This can be a time of great emotional upheaval for children and parents alike. Some students pass through this stage by l5 and others are still there into their twenties.

An increasing number of children carry heavy personal baggage. Family disputes and break-ups, substance abuse (by themselves or their family members), families with little commitment to the importance of education, inadequate or improper food, clothing, or parental support, self-doubts, and the need to impress peers (particularly in the middle school years) weigh heavily on far more youngsters than you might think, even in a fairly well-off city like Lincoln. In some cases, teachers may have information about students' background that they cannot share with you. Let the teacher be your guide. Do not be judgmental because you may not know the whole story about a situation.

Some previous PF participant suggest that the upper elementary grades (grades 3 to 6) are where most scientists/mathematicians/engineers can have the greatest impact and experience the greatest satisfaction. Students begin learning specific science content in these grades, but perhaps the greatest needs are to encourage positive attitudes toward science and develop science process skills, such as experimenting, measuring, observing, and drawing conclusions from information. Many elementary teachers receive little preparation in science and are eager for

help. Elementary students are curious, exuberant, cute, and relatively unjaded, which means that they may be easier to work with than their older brothers and sisters.

Middle school is where the greatest number of students either catch the spark of excitement for science or intellectually drop out, so there is potentially high impact working with this age group. The primary challenge is to help them associate interesting and relevant applications with science principles. The physical, emotional, and social changes associated with these in-between years, however, make these students less predictable than either elementary or high schoolers, so they have the reputation of being the most challenging to work with. Middle-school teachers vary widely in their training and knowledge of science content. Some have trained as elementary teachers and have little formal science background, whereas others have trained to be secondary teachers and have extensive knowledge in one or more science disciplines.

High schools typically have science teachers well versed in the content they are teaching, but who frequently are eager for help in areas such as science applications and new developments, as well as for loans of or assistance with specialized equipment and experiments. High-school students frequently need help in understanding content, applications, and relationships between science topics and career and college choices. Lower socioeconomic neighborhoods often have highly motivated students whose families are ill prepared to help them with academic and career issues who can benefit enormously from mentoring relationships.

Changes in intellectual development also occur with age. Virtually all elementary school children are concrete thinkers, meaning that they think in relatively simple terms about what they can see, touch, and detect with their other senses. As they mature, most children make the transition to abstract thinking, where they can generalize, project into the future, and deal with less tangible issues. Some people make this intellectual transition around age l1-14, but for many it does not occur until they are 15-20.

Elementary-school-level children require concrete experiences to cement their understanding. For example, a concrete way to represent the effects of water on plant growth is to have plants of varying heights and graduated cylinders filled to show how much water each had received arranged on a table in order of increasing height. One level of abstraction (moving away from the concrete) would showing pictures, rather than real plants and water. Progressively higher levels of abstraction would be numerical data, a graph of the data, and an equation representing the effect of water amount on plant growth. An excellent overview of intellectual development is presented in "A Biological Basis for Thinking and Learning", available in print or videotape from Lawrence Hall of Science.

5.2.2. Relevance and Interest

The old dictum of ‘learn this because you should’ does not work very well today. Decline in interest in science and the development of actively negative attitudes toward science typically occur between the third and eighth grades. These are especially critical times because children can close off pathways by neglecting to take or do well in science.

Applications and hands-on activities generate interest, especially if the application is one that the children find relevant. Anything involving food, for example, is of more interest than a ball rolling down an inclined plane. The traditional approach of teaching theory first and applications later is fundamentally unmotivating. (This applies to college as well as to K-12.) Do not forget

that ‘relevant’ is a relative concept. You may find cells or electrons fundamentally fascinating, but your students may not.

Students involved in *doing* are likely to learn much more than those who watch or listen. The ideal is to have students *discover things for themselves*, although this is not always possible in the day of the standardized test. The idea of internal conflict – where someone sees something that does not make sense in the context of what he or she already knows – is a great stimulator for learning. Teachers often refer to this as the ‘discrepant event’: when you turn a glass full of water upside down and the water does not fall out, for example. This is the same principle that makes magic so engaging.

5.2.3. Learning Styles and Levels

Students who learn science well by listening or reading (auditory and print-oriented learners) typically do well in the traditional education system. Chances are that you were one of these types of learners. Others students learn more effectively by seeing things work (visual learners), by being physically involved in games or activities which simulate scientific phenomena (kinesthetic learners), or by solving problems in groups (group interactive learners). The best learning experiences are those that involve a variety of learning modalities. Do not get caught in the trap of thinking that, just because you are a print-oriented learner, anyone who *really* wants to can learn just by reading books. A problem is that some students have been told ‘you’re a visual learner’ and will try to use this as an excuse not to read or participate in activities. The reality is that most students use one or more learning styles and that a combination of learning styles works best to reach not only groups, but individual learners.

Perhaps the natural inclination of most mathematicians, scientists and engineers is to focus on high achievers. The payoff may be great, as these students will be the next generation’s leaders. In addition, they are typically highly motivated, serious about learning, well behaved, and show their appreciation for your efforts. In short, they are probably very much like you were at that age. Resist the urge to focus only on this group. LPS calls these students ‘differentiated’ or ‘diff’ for short.

At the other extreme are the at-risk students -- those who for a variety of family, peer group, socioeconomic, or other reasons are in danger of becoming adults who cannot function in society. Unless a major portion of this growing group is successfully motivated and enabled to become productive citizens, society itself is in jeopardy. While the challenges are great, the needs are enormous, and those whom you help will remember you forever. There may not be as much of an immediate reward as there is working with higher-achieving students, but the long-term impact is likely to be very important.

Finally, there is the great middle group -- those who are neither gifted nor at-risk. This group will form the bulk of tomorrow's work force and voters, who will be responsible for ensuring our well-being when we are retired. They are perhaps in the most need of developing the tools necessary to work, live, and vote intelligently in an increasingly complex technological world.

6. Working in the Lincoln Public Schools

6.1. Building-Wide Concerns

6.1.1. Your School's Building Map/Emergency Procedures

The first thing a Resident Mathematician/Scientist/Engineer should do when they start working in a new school is ask the Lead Teacher for a school map and list of emergency procedures. Resident Mathematicians/Scientists/Engineers and Lead Teachers should discuss the school's emergency procedures in case of a fire, tornado or other emergency.

6.1.2. Your School's Policies

Different schools have different policies for visitors. Find out whether each school will want the Resident Scientist/Mathematician/Engineer to sign in each day, wear a specific type of nametag, etc. Resident Mathematicians/Scientists/Engineers should ask about other routine procedures: the schedule of when classes (and school) start and end, discipline policy, etc.

6.1.3. Prohibited Items

There are a number of items that MAY NOT be brought onto the property of any LPS school. Included in these items are pocket knives, cellular phones and drugs of any kind, including over-the-counter drugs. Follow the same rules as students: no weapons, alcohol, tobacco, or drugs on campus.

Follow the school's dress code for students, but treat that as the minimum acceptable requirement. Use your own judgment about what is professional and always err on the side of being overdressed rather than underdressed. Resident Mathematicians/Scientists/Engineers should review the school's policies with their Lead Teacher. Each day before leaving for school, do a mental check that you have not accidentally left a jackknife in your pocket or are wearing inappropriate clothing.

6.1.4. Your School's Culture

Lead Teachers, please take some time to talk to your Resident Scientist/Mathematician/Engineer about your school's culture. Do teachers regularly share materials? Does one teacher teach science for the entire grade, or does each teacher teach his or her own class? Are parents involved in activities like math or science nights? Can media, computer, or resource people be called upon to assist in activities? Talk to the Resident Scientist/Mathematician/Engineer about the types of students in your school. Are they primarily affluent? Are they comfortable with English? What grades are being tested in your school this year, and on what subjects? This information will help your Resident Scientist/Mathematician/Engineer adapt to his or her new environment.

Teachers: The disconnect between RSEMs and the students with whom they work is one of the biggest challenges cited by the RSEMs. Remember that most of the RSEMs were the students who paid attention, were in advanced classes, and were engaged most of the time. The RSEMs do not always understand why your students do not just sit down and work. ***Please spend time talking about this***!

6.1.5. Working with Substitute Teachers

Lead Teachers: If you know a substitute teacher is coming in advance, please provide him or her with written instructions about the role of the Scientist/Mathematician/Engineer in your class. RSEMs should keep a copy of the introductory letter at the school so that unanticipated substitutes can be given the information. The Lead Teacher may ask the Resident Scientist/Mathematician/Engineer not to come in when there is a sub. If this is the case, the Lead Teacher should contact the Resident Scientist/Mathematician/Engineer as soon as possible.

6.1.6. Picture Taking

Pictures, audio, etc. can be taken in the classroom only with the consent of the students' parents. Some parents do not want their children to participate in research projects or to have their children's pictures on the web or in a newsletter. The Lead Teacher will distribute permission slips to their students. It is the Resident Scientist/Mathematician/Engineer's responsibility to ensure we have a permission slip on file for any pictures taken. Do not send us any pictures unless you are sure we have permission to use them.

6.1.7. Parent-Teacher Conferences

Parents meet with teachers periodically through the year. RSEMs may be asked to attend these conferences to meet parents and tell them what Project Fulcrum is doing in their school. RSEMs should NOT be involved in discussions between the teacher and the parent about the student because of confidentiality issues. One role that RSEMs have played is to bring activities to the conference that involve students and their siblings while their parents are busy.

7. Misc Information

7.1. Room 301 Ferguson

All of the PF equipment and the PF office are located at 301 Ferguson Hall. Lead Teachers and Resident Scientists are welcome to use any of the equipment, but must reserve the equipment in advance. Sign-out sheets are provided. The code to the door will be provided at the SI.

7.2. File Naming Convention

All files for this year should start with GK12_AY06, followed by the name of the file. Name files such that similar files will show up together in the directory. Remember that other people have to figure out what is in the files and might need to do so when you are not available. We now have five years worth of files: we need your assistance to help us keep them organized.

7.3. Website

7.3.1. Location.

The PF website is at www.physics.unl.edu/~fulcrum and is accessible to anyone. The website helps us disseminate our activities to others. A copy of the handbook will be available on the web. The 'PF Participants' link on the main menu takes you to the database section of the website, which is restricted to PF RSEMs and Teachers. The second part of the handbook describes both in more detail.

7.3.2. Photos

During the Summer Institute, photos will be taken of the RSEMs and their Lead Teachers for use on the website. You will be contacted about a time.

7.4. Lincoln Public Schools Science Units

Each grade in LPS covers four units each year. This list also can be found on the PF webpage under 'Resources'.

7.4.3. Science Scope and Sequence

Grade Levels	Life Science	Physical Science	Space/Earth	Science: Technology & Society
K	Plants	Senses	Seasons	Toys and How They Work
1	Animals and Habitats	Magnets	Soil	Animals and Habitats
2	Life Cycles	Matter	Weather	Recycling
3	Embryology	Energy	Dinosaurs and Fossils	Simple Machines
4	Prairie	Electricity	Space	Ecosystems
5	Water and Wetlands	Chemistry	Rocks and Minerals	Scientific Investigations
6	Human Biology	Electricity and Magnetism	Earth's Changing Surface	Weather and Climate
7	Living Organisms	Chemical Building Blocks	Inside Earth	Environmental Science
8	Cells and Heredity	Chemical Interactions	Astronomy	Light

The units are chosen to comply with the National Science Education Standards and the Nebraska Science Education Standards (both of which are often referred to as 'The Standards'.)

7.5. Advice

RSEMs and Lead Teachers have contributed advice they would like to pass along to you. Here are a few common suggestions.

7.5.1. Teachers: Introduce the Resident Scientist/Mathematician/Engineer to Everyone at Your School

Teachers, librarians, office staff and your principal should know that there is a Project Fulcrum Resident Scientist/Mathematician/Engineer working in your school, and what his or her role is. The Resident Scientist/Mathematician/Engineer is to be a resource for the entire school;

this cannot happen if teachers don't know the resource is there. In this day of heightened security, it is especially important that school faculty and staff know the identify of all adults in the building.

We advise having a formal meeting between the Principal, the Lead Teacher and the Resident Scientist/Mathematician/Engineer shortly after the Resident Scientist/Mathematician/Engineer starts working in the school. Since the Principal has a broad view of the school's needs, he or she may know of places where the Resident Scientist/Mathematician/Engineer can be especially effective.

7.5.2. Teachers: Introduce the Resident Scientist/Mathematician/Engineer to Your Kids and Their Circumstances

For the most part, RSEMs were not like the kids in your classrooms. Talk to the resident scientists about the home life of your students, what the students are likely to know or not know, even what kids at that grade level think is important.

7.5.3. Involve Parents

One partnership had the Resident Scientist set up some activities for open houses and parent-teacher conferences. Siblings who came along had something to do, and since the activities were ones that the students had addressed during school, the students were able to show their siblings what they had learned. The parents had a chance to ask about what the Resident Scientist's role in the classroom was. We got a number of unsolicited comments from parents at this school regarding the impact of the Resident Scientist on their children.

7.5.4. Get to Know Each Other's Personalities.

Do you like to plan everything while your Resident Scientist/Mathematician/Engineer is more the spontaneous sort? You need to talk about it. If your Teacher likes to refer to you as a 'walking encyclopedia' and that really bothers you, you have to say something. RSEMs say that it is important to know the teacher well so that you can be ready for how he or she works, know why he or she does things, etc.

7.5.5. Keep Communication Lines Open

As you will hear over and over (and over), there are significant differences between teachers and scientists. These differences can lead to misunderstandings that, if not confronted, will cause problems. Keep the differences in mind and make sure that you are communicating well. Do not be afraid to ask if you are not sure what your Scientist/Mathematician/Engineer or teacher means.

7.5.6. Plan

It is easy to get busy and neglect plan time. *Do not underestimate the importance of planning*. If you are working with more than one Scientist/Mathematician/Engineer or teacher, make sure that everyone is involved in planning. One group found that meeting just before the bi-monthly teachers' meeting was helpful.

7.5.7. Use Everyone Else as Resources

Get to know your fellow RSEMs and teachers. There is untold wealth of experience, information, and resources out there, but you will not know about it if you do not talk to people.

Scientists suggested a social gathering with other scientists – something informal that allows you to talk about what you do, what you're doing at school, etc.

Make sure you look over all the resources available on the Project Fulcrum website – over five years of activities and experiences are collected there. Do not reinvent things that someone else already has created.

7.5.8. Don't Make Assumptions

Do not assume as a Scientist/Mathematician/Engineer that you can or cannot do something – ask. If it does not fit in with the goals of the teacher, he or she will let you know. Your experience is very different, so you will have ideas that the teacher might never suggest. Planning is a partnership and you both should feel free to make suggestions.

7.5.9. Scientists/Mathematicians: Be Flexible

Remember that things rarely go as planned. Flexibility usually is cited as the number one skill a Scientist/Mathematician/Engineer should have.

7.5.10. Scientists/Mathematicians: Communicate Your Enthusiasm

A large part of your job is to show students and teachers that you are a Scientist/Mathematician/Engineer because you enjoy your field. Students need to seen your enthusiasm and your interest in learning.

7.5.11. Have Goals

Some teacher/scientist pairs found it helpful to have a goal (such as 'graphing' or 'scientific method', for example) that recurs throughout the year.

7.5.12. People are Different

The scientist/teacher difference is a broad generalization. Scientists are each different and teachers and each different. Treat each person as an individual

7.6. Most Common Problems

7.6.1. Problems with Resident Scientists/Mathematicians

1. Promising too much and delivering too little. RSEMs want to be as much help as possible and sometimes they promise more than they can deliver. Be careful when you make a promise and, once made, follow through.

2. Talking down to teachers. The way scientists communicate with each other is different from the way people in schools communicate with each other. It is possible to be condescending without meaning to be. Be respectful of others' opinions and remember that you are a guest in the teachers' classroom.

3. Not paying attention to common courtesies. This means using proper language (no swearing), dressing properly (no t-shirts, no ripped jeans, no dirty clothes), and following all of the rules that the students must follow. Above all, no gossiping about your teacher, other teachers or students in the school or PF. Never criticize your teacher in front of his or her students, colleagues or bosses.

4. Not treating Project Fulcrum as a job. Project Fulcrum is a job and it should be your first priority because Project Fulcrum pays your salary. You are a representative of the university, of

your department and of this program. Because you are working outside the university, the standards are higher than they might be in the comfort of your own department. Just because your professors do something is not a justification for you to do it. We expect you to be professionals in every way.

5. Not turning in journals, activity logs, etc. on time. We have a system for collecting data. Every time we have to treat an individual case, it takes a disproportionate amount of time because it has to be done by hand. Data collection is a large part of the requirements for our grant.

6. Taking over the classroom. Be sensitive to your teachers' plans. Do not spend more time on something than your teacher has allotted. Teachers must plan very tightly if they are to do everything they are asked to do.

7. Getting off on tangents. Sure, it would be great to teach fourth graders about imaginary numbers, but imaginary numbers are not in the fourth-grade math standards and are probably way above the heads of most of the kids.

8. Forgetting that you are teaching ***all*** the students. Do not teach to just the smartest or the most interested kids. Everyone has to learn. This may be frustrating for you at times when you feel you are explaining things as clearly as possible and some of the kids just are not getting it. You will have to adjust how you communicate according to the level of the kids and their abilities.

9. Not establishing a solid communication base with your teacher. You will need to ask for help and your teacher may need to correct you. Be open to suggestions and comments, and be willing to communicate openly with your teacher.

7.6.2. Problems with Teachers

1. Waiting until a problem gets unbearable before telling PF management about it. We want you to be happy and satisfied with your experience. If there is ANYTHING **at all** that is bothering you, contact the Project Coordinator or one of the PIs and tell us. The worst thing is to have something festering for a long time so that when it comes to a head, it is a mess. We want to help.

2. Relinquishing your classroom. If your Resident Scientist/Mathematician/Engineer is dressing inappropriately, you must say something. If he or she is constantly running off on tangents and getting your class off track, the Resident Scientist/Mathematician/Engineer has to be told. Sometimes, the PF participants get excited and forget that it is not about them – they need to be reminded sometimes. Develop a sign language code so your Resident Scientist/Mathematician/Engineer will know when the discussion of special relativity is taking you a little further past the forces and motion unit than you care to go.

3. Not turning in journals, activity logs, etc. on time. We have a system for collecting data. Every time we have to treat an individual case, it takes a disproportionate amount of time because it has to be done by hand. Data collection it is a major requirement of our grant, so we treat it seriously.

4. Letting the Resident Scientist/Mathematician/Engineer become a student teacher. Your Resident Scientist/Mathematician/Engineer should be doing more than just being an extra pair of hands. It doesn't benefit either of you if he or she is just an assistant on your normal activities.

Don’t be afraid to tell the Resident Scientist/Mathematician/Engineer that there isn’t a role for him or her that week. Have your Resident Scientist/Mathematician/Engineer in the classroom only when he or she will really make a difference. On the other extreme, your Resident Scientist/Mathematician/Engineer shouldn’t be expected to develop lessons and teach them by him or her self. They don’t have the training to do that, and it doesn’t make the best use of their talents.

5. Not planning. Grad-student obligations can vary greatly from week to week. If they have an especially heavy week coming up, they may not be able to respond to a brand new idea that needs lots of researching. Give them time.

6. Not checking e-mail frequently enough. All scientists, mathematicians and engineers use e-mail as their main communication method. If you do not read your e-mail for days at a time, you are likely to miss opportunities and frustrate the heck out of your Resident Scientist/Mathematician/Engineer if he or she is trying to get information from you. Please check at least once a day and more if you can.

8. Resources

8.1. Developing Your Activities

Each Resident Scientist/Mathematician/Engineer will be expected to document activities that are developed. The following sections detail the format for this documentation.

8.1.1. Goal Statement

Every activity in which you are involved must have a *goal statement*. A goal statement is a specific statement of what the students will learn or be able to do when they finish. Simply finishing the activity is necessary but not sufficient for learning. Examples of goal statements are shown in the table below.

Weak Statement	Strong Statement
Students will understanding how magnets work differently when they are farther apart.	Students will understand that the force of attraction between two magnets decreases when the magnets are moved further apart from each other.

The goal statement should be developed with the teacher. The goal statement should directly address one of the unit's objectives. Developing a goal statement helps ensure that you and the teacher are on the same page.

8.1.2. Time Available

Clarify with the teachers with whom you are working how much time is available for the activity. Make sure that all the teachers are allotting the same amount of time, if you are working with more than one teacher.

8.1.3. Finding Out What The Students Already Know

Each activity should have some introductory part that allows you and your teacher to ascertain where the students are in terms of the content and skills they already have. Different students will have different levels of readiness for your activities. There are a number of ways to do this and your teacher may have ideas as well.

For example, Ask the students to write (or call out while you write) what they know about a subject and what they would like to learn. Each student can be asked to write three things for each column, or you can do it as a group activity. An advantage to doing it orally as a group is that you can probe the students a little more if they give you incomplete or unclear answers. The disadvantage to doing it as a group is that not all students can contribute. This activity can be done in five minutes or less.

Keep the list of what the students know and want to know so that you can review it at the end of the activity and see if a) there were misconceptions and b) there are things they wanted to know but did not learn from the activity.

8.1.4. How will you accomplish the activity?

Detail what is going to be done and how. Remember that we are trying to keep the focus on the kids learning from things they do. You should spend an absolute minimum amount of time at the front of the room lecturing. Block out how much time you plan to spend on each part of the

activity and check with the teacher to see if he or she agrees that the time is appropriate for his or her students. Students in different classes may require different amounts of time.

8.1.5. Formative Assessment

Formative assessment is the process of gathering data while doing the activity that tells you whether the students are learning what you expect them to learn. Formative assessment is used as a feedback loop. If you find that kids are getting something else out of their lab than you expected, you have an opportunity to address the issue with some or all of them. You will need to think carefully about how you will get your formative assessment data. Asking 'are you understanding this' isn't going to work. You may have a worksheet that asks them to extrapolate what they are doing to a new situation so that you can see if they really understand the concept, or if they are just applying procedures that worked before to a situation in which these procedures do not work.

8.1.6. How will you know if the students learned what they were supposed to learn?

Each activity must include a summative assessment. What are you going to ask the students to do (or write or draw) that will indicate that they understand the goal? Asking them to replicate something they did in the activity will not suffice, as students who are good at pattern matching can do so without really understanding the concept.

8.2. Inquiry

Read the paper by R. Reiff, W. S. Harwood, and T. Phillipson.[2] A copy is included in your manual. The figure below shows the essential features of classroom inquiry. It is important to remember that inquiry is a continuum: some things are conducive to inquiry while others are not as conducive. The chart below goes from more self-direction and less teacher direction on the left-hand-side of the matrix to less self-direction and more teacher direction on the right-hand side of the matrix. The goal is to move toward the left-hand side. You may start with an activity that is truly a 'cookbook lab', meaning that every step is spelled out for the students, and make it less directed. If you rank the materials on a scale of one to ten (one being no inquiry, ten being research), you may be able to move an activity from a one to a four. This should be viewed as a good accomplishment. Not everything is going to be total inquiry. Focus on finding ways to work inquiry into the classroom as much as possible.

Essential Features of Classroom Inquiry and Their Variations

Essential Feature	*Variations*			
1. Learner engages in scientifically oriented questions	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies question provided by teacher, materials, or other source	Learner engages in question provided by teacher, materials, or other source
2. Learner gives priority to evidence in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	Learner given data and told how to analyze
3. Learner formulates explanations from evidence	Learner formulates explanation after summarizing evidence	Learner guided in process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	Learner provided with evidence
4. Learner connects explanations to scientific knowledge	Learner independently examines other resources and forms the links to explanations	Learner directed toward areas and sources of scientific knowledge	Learner given possible connections	
5. Learner communicates and justifies explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to use to sharpen communication	Learner given steps and procedures for communication

More ---------- Amount of Learner Self-Direction ---------- Less
Less ---------- Amount of Direction from Teacher or Material ---------- More

from *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning.* NRC, National Academy Press: Washington, DC, 2000.

Also read the section at :

http://cires.colorado.edu/education/k12/rescipe/collection/inquirystandards.html

for information on how inquiry is used in the state and national science education standards.

Bibliography

1 K. D. Tanner, L. Chatman, and D. Allen, *Approaches to Biology Teaching and Learning: Science Teaching and Learning across the School--University Divide--Cultivating Conversations through Scientist-Teacher Partnerships,* Cell Biol Educ **2**, 195-201 (2003).

2 R. Reiff, W. S. Harwood, and T. Phillipson, *A Scientific Method Based Upon Research Scientists' Conceptions of Scientific Inquiry,* at Proceedings of the 2002 Annual International Conference of the Association for the Education of Teachers in Science,