At the January 24th Launch, teams of teachers, scientists, and staff gathered at tables to investigate fundamental properties of matter, mass and volume. The first activity began with questions on how to measure the mass and volume of common everyday objects. Pockets and purses were searched, and cell phones, car keys, lip-gloss and other objects appeared. Discovering that the available measuring tools had limitations (deliberately), the challenge became to devise strategies for estimating and measuring mass and volume, and to understand appropriate precision of measurements. As people worked with objects and instruments, the room resounded with questions, debates, and expressions of surprise, puzzlement, and triumph! This first day of scientific investigation laid some important groundwork for understanding more about our physical world.

Scientific inquiry includes formulating questions, predicting, measuring, modeling, and talking. Talk may seem out of place in a list of scientific actions, but it is essential if our experiences (and those of the scientist) are to result in new understanding. Science is a process of building public knowledge which can only happen if ideas are shared and debated.

In scientific discussion, claims made are based on, and justified with, evidence; argumentation and critique are encouraged; questions are raised; multiple theories are debated. Building knowledge through discussion is not always comfortable; this collective meaning-making process takes time and effort to develop.

In Fulcrum, face-to-face and online discussions are the centerpiece of our work as it is through the making-meaning process that learning advances. Discussions take place online within small study groups, and with time are characterized by:

- Listening to and building on others’ ideas
- Justifying and explaining ideas with evidence
- Asking for clarification and raising questions
- Noting commonalities and discrepancies

While discussions advance learning in Fulcrum, there are implications for the classroom, too. When these same strategies are encouraged and supported in the classroom, students have opportunities to formulate ideas and hear the ideas of others. A culture of listening is established, conversation is more productive, and learning deepens. After honing their own science discussion skills, Fulcrum participants will turn their attention to science talk in their own classrooms.

**Something to Think About**

The other day at the Fulcrum launch, many of you were busy learning about mass and volume benchmarks. In the course of that activity, some of you weighed your cell phones.

You probably found that when you put your cell phone on the scale, the scale read somewhere between 50 and 100 grams. What do you think the scale would read if the phone started to ring? Is the cell phone heavier when it is ringing? Is it lighter? Does the ringing make any difference in the scale reading? Why do you think so?
Dear Principals,

Since 2004, the Fulcrum Institute has been preparing PreK-8 teachers to implement and lead research-centered science learning and teaching in their schools and districts. The Fulcrum Institute participants advance their knowledge of science concepts, research methods, data collection, and effective inquiry-based science teaching, through three graduate level courses. The courses are an effective blend of on-line learning and face-to-face experiences that bring scientists, researchers, and classroom teachers together to ponder some of the most profound issues in science, such as, Where does the heat from my coffee go as it cools on my desk?

On Saturday, January 24th, we welcomed the third cohort of teachers to join the Fulcrum Institute. Fifty-six teachers from 22 school districts across Massachusetts convened on the Tufts campus to work in small groups to investigate how we calculate and understand the masses and volumes of stuff in our everyday world. The investigations the participants did together, as well as the discussions of data and concepts, provided a preview of the work they will do in the first Fulcrum course, Some of What Matters About Matter. At the close of the day, the teachers were ready to begin their investigations in course one. Each teacher received a kit of materials for their investigations and three science pedagogy books to use as resources for their work in Fulcrum as well as their work with colleagues:

Those of you who are fortunate enough to have teachers engaged in the Fulcrum Institute, whether they are beginning their Fulcrum experience or they are Fulcrum graduates sharing their Fulcrum expertise with colleagues, have a special resource for science teaching and learning in your building. Your Fulcrum Institute teachers are not only furthering their own science learning, but they are learning how children and scientists develop their scientific ideas. They understand why inquiry must be at the heart of all science teaching, learning, and assessment. Experienced Fulcrum Institute principals know how much it means to their participating teachers to stay in touch with how the teachers are doing in the course. Some principals have a Fulcrum Bulletin Board in the office, inviting the Fulcrum participants to post investigations, interesting science questions, and ideas for curriculum. When a Fulcrum Institute teacher is in the building, conversations about science naturally emerge!

We urge you to take a look at the Fulcrum Institute website and preview the material in course one as well as video clips of the launch and Fulcrum Institute grads. Your teachers are deeply engaged in learning how to conduct investigations, how to participate in interactive discussions of data and phenomena, and how to reflect on each stage of their own intellectual development as scientists. The Fulcrum Institute participants provide an essential contribution to your school’s development as a lively science community, a place where scientific ideas matter and where literacy for the 21st century begins to flourish.

Linda Beardsley
Director of Teacher Education and School Partnerships

Math/Science Partnerships in D.C.

The day after our exciting and exhausting Launch, a team of Fulcrum Folks (Judah, Linda, Roger, Sara, Sue, and Claudette, one of our evaluation researchers) were on their way to Washington DC (still abuzz from the inauguration) to share experiences, results and ideas with representatives of other MSP programs. MSP (Math-Science Partnership) is the name of the National Science Foundation’s program to promote teachers’ professional development in math and science education through partnerships between school districts, colleges and universities, and non-profits like TERC. There are about 65 of them scattered all around the country. Every year the NSF calls them together for a two-day conference.

Our Fulcrum team took turns presenting our philosophy, goals, methods and results, including video, to an audience of interested colleagues. One of our goals is to disseminate what we’ve learned, what works, what doesn’t, and what lessons others could take from our experience. Several groups expressed interest, and we’ll be following up with them in coming months, trying to spread Fulcrum Fever far and wide.

We heard talks on the state of science and math education (bad), the state of research about how to improve it (not as solid as we’d like), and prospects for financial support in the next year or two (good, as long as we’re “shovel-ready”).

This was the first of these conferences I’ve attended, and I was struck by how unusual Fulcrum is, even among this crowd of like-minded projects. Math projects are a lot more common than science ones, far more projects focus on high school teachers than on earlier grades, and few programs ask as much of their participants as we expect of ours. Our Fulcrum participants are not alone, but they are in the vanguard.

Roger Tobin
Tufts Professor of Physics
Words of Wisdom From Cohort Two

Here is our bit of wisdom for you before you begin. The computer is your friend. Learn to love it. You will be on it every day. To make the workload easy, which will seem overwhelming at first, follow the weekly schedule. Be prepared to turn your kitchen into a lab every weekend. Weekends will be filled with experiments and reports, but having a colleague in the same school to share results with makes it so much easier. If you’re lucky enough to have young children, they may even become your lab assistance. Using the online chat rooms, created by the faculty, you will make connections with different members of your group. This helps you discuss the topics and learn the personalities and abilities of your peers in order to ask questions in a less threatening environment. Remember, the only stupid question is the one not asked. We found that many of our peers had the same questions or unexpected results during our investigations.

The science we learned was challenging and we were able to implement the model of inquiry-based learning into our classrooms. This type of learning made it easier for us to learn the concepts, and therefore we were able to utilize this model with our students. This type of teaching is beneficial in every subject area, not just science. Please take this opportunity to learn all you can and take advantage of all the great minds that are there to help you through the process. Most of all, have fun!

Renee Gately and Cindy Nugent
Timony Grammar School, Methuen

Without a doubt, stick with the program. The Fulcrum Institute teaches you to think differently, and that doesn’t happen overnight (no matter how short some nights may feel when you are in the program!) You will think about the world, your students, and their thoughts differently. Most importantly, you will think differently about how you teach science. It is a process, and it takes time, but only if you give it time. You will learn more about who you are as a learner, and this is especially valuable as you begin to apply this to the learners that you teach each day.

Do what you can each week. Some weeks that will be more than others, and that will be okay. Learn to accept this. Discuss what you are doing with others. You have a great support if there are others in your district or school doing the program too. If not, find a colleague or friend whom you can share the experiments with.

Don’t be intimidated by those who seem to know “more science” than you! Your “real world” constructed ideas will sometimes trump their science ideas! The beauty of the program, everyone is learning.

You will see the world, personally and educationally, quite differently once you have completed the program.

Jen Delorme
Dawson School, Holden

Congratulations on taking the step to increasing your understanding of science, how you teach science, and improving yourself as a learner! My time tackling the challenge of The Fulcrum Institute to be one of the most frustrating, challenging, and most importantly, rewarding and empowering experiences that I have participated in as a teacher. There are so many levels of learning that it is like reading a really rich book; you keep remembering favorite parts and mulling over challenges in assumptions and understanding. Also, as with childbirth, given enough time, the negative aspects subside and one cherishes the positive outcome.

That said, what I gained through my participation with Fulcrum permeates my classroom and teaching style. I am more cognizant of the “big picture” ideas and concepts that I want my students to understand. I think about different ways to present and challenge that understanding. I have enjoyed trying to bring a little more attention to the importance of science education. I now have the confidence to stretch the curriculum. I understand that it is good for both me and my students if we are entering into areas where we are all learning.

I am constantly trying to improve my lessons so that the students can actively engage prior knowledge, record their observations, develop some understanding, and actively engage in discussion with their peers, defending their thoughts with data collected.

Although I am a far cry from being truly skillful at teaching for understanding, I now have a clearer idea of where I am trying to go. I think my students are benefitting from being more actively engaged in the journey.

So enjoy this terrific experience.

Nancy Wilce
Bagnall Elementary, Groveland
When I signed up for the Fulcrum Institute course, I was nervous, excited, and hesitant. I knew that it would be a lot of work, and it came at a time when I had many new initiatives.

I have NO regrets, as I found the Fulcrum course to be one of the few high quality classes that I have taken. This class is the perfect balance between face-to-face contact and online discussions. I never felt that I was alone. I found it helpful, on occasion, to work with another participant as we asked each other questions and shared our observations. We enhanced our learning.

In essence, you get out of the class what you put into it. Many science educators are naturally inquisitive; we ask questions, make observations, make "real life" connections, and look for patterns. We all have the ability to learn from this class, regardless of our background.

Even during the most challenging times, the Fulcrum staff and peers supported me. During the course, I implemented many strategies from the course and now, a year later, I continue to refine my skills. I miss my classes! I wish you well!

Varsha Desai
Oak Middle School, Shrewsbury

What motivated me to stick with the Fulcrum Institute, even when it was tough and there were a million other things going on, was the personal satisfaction and reward I felt. I allowed myself the time to still the rest of my life and focus on teaching science. We all have great ideas about our teaching, but lack the time occasionally to follow through (okay, more often than occasionally!) and bring those great ideas to fruition. Fulcrum forced me to make the time because I never wanted to disappoint my team members and leave them "hanging" in the forums. TRULY there was not a single week when I didn't learn something new, have a new suggestion to try, think about something in a different light, and/or connect to a colleague over a shared experience or idea. It was amazingly rewarding and worthwhile. At times, I was immediately able to apply what I had learned.

Cady Harrington
Atlantis Charter School, Fall River

Doing the Fulcrum program is a lot of work. It takes time away from family. It requires that you prioritize your school duties so you can put in the effort required. Yes, it is worth the time and effort.

To see what a difference actually doing experiments and activities has on one's understanding of the processes validates the use of inquiry-based instruction in our classrooms. One can read the research about the effect it has on student learning, but experiencing the transformative impact ourselves is better.

As I was progressing through the Fulcrum program I found myself becoming more reflective of my practice. It forced me to step outside myself and view what I was doing from a higher level. Sometimes I liked what I saw. Other times it was difficult to justify what was going on in my teaching, which led to changes. This is a practice I will continue.

Were there times I was frustrated? Sure. Was it worth working through the frustrations? Definitely. The value of colleagues is that they are there to share both frustrations and triumphs.

Mike Hansen
Linden School, Malden

Start doing the work early. It takes some time to read through everything, and it helps to start as soon as you get the assignment. Know that your students are going to benefit greatly from what you learn, and you will become a better teacher. It is well worth the struggles. Do not give up. Great teachers never give up!!!

Enjoy!

Jessica Sanchez
Kuss Middle School, Fall River
Roxane Sails to other Shores
Roxane Johnson, the Program Manager of the Fulcrum Institute, has been hired as the Assistant Science Coordinator for the Massachusetts Department of Education, Office for Mathematics, Science, and Technology Engineering (OMSTE).

The Office for Mathematics, Science, and Technology/Engineering (OMSTE) is responsible for writing and updating curriculum frameworks in mathematics, science, and technology/engineering. It manages related initiatives in curriculum and instruction, such as professional development, content institutes, mathematics and science partnerships, and advisory councils.

Roxane will specifically be a liaison with high needs districts, to increase the number of highly qualified science teachers, and to improve science education.

“I have learned so much in my position as the Fulcrum Program Manager. My teaching experience and my years with the Fulcrum Project made me a strong candidate for my new position. It has truly been a pleasure working with the Fulcrum staff and teachers. I’ll especially miss the wonderful people and the relaxed environment of the Tufts University Department of Education.”

Roxane’s last day will be February 27, 2009. She can be reached at roxanejj@yahoo.com

Please Welcome George Collison and Carole Bersani to the Fulcrum Family.

George comes to Fulcrum through a long career path that includes 20 years in a public school in Western Mass, teaching at the University of Massachusetts Dartmouth, and work with the Concord Consortium in online courses in math and science. George’s undergraduate and graduate work included studies in mathematics and physics, a masters in physics, and a doctorate in science education. George is the lead author of Facilitating Online Learning, a guidebook for online facilitators. His passion is equity through mathematics and science education. Recently, through USAID, he helped design curricula in physics and mathematics for Ethiopia and South Africa. He is delighted at the opportunity to work with the wonderful collection of creative teachers and staff in the Fulcrum Project.

Carole comes to us with a varied background in the field of education. She spent over 15 years teaching at the elementary, middle, and adult school levels. She also has been a teacher trainer and workshop facilitator. Most recently, Carole was a Peace Corps Volunteer in Paraguay, South America, where she developed curricula, demonstrated model lessons, and helped local teachers to incorporate alternative methods of instruction.

A large portion of Carole’s focus will be on planning the structure of the Fellows program. Once the Fellows are selected, Carole will serve as liaison between the University and the Fellows. She looks forward to providing support and guidance to the Fellows as they fulfill their very important role as mentors.
In the last issue, we gave you

**Something to Think About...**

Below are views of the starting sections of two roller coasters next to each other in an amusement park. On each roller coaster a car (yellow dot) starts moving to the right at the same time and at the same speed.

On which roller coaster does the car arrive at the right end earlier?

How do you know?

![Roller coaster A](image1)

![Roller coaster B](image2)

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**Resolving the Puzzle**

Assuming no friction, the total energy – kinetic plus potential – of each car remains the same. Each car starts with the same total energy. They move at the same rate until A gets to the dip and B gets to the rise.

At that time:

* A’s kinetic energy increases and its potential energy decreases [the sum of the kinetic & potential energies does not change].

* B’s kinetic energy decreases and its potential energy increases [the sum of the kinetic & potential energies does not change].

At any given distance in the dip A’s kinetic energy is greater than B’s kinetic energy at that distance in the rise. This means that at any given distance from the start A is moving faster in the dip than B is moving on the rise. This means that A will get to the flat region on the right before B does. When they get there A and B will be moving at the same speed.