System-wide Change for All Learners and Educators

Year 4 Implementation Plan

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Introduction

The vision of the SCALE Partnership is to make it the rule, instead of the exception, for every student, every year, to experience high-quality teaching of core mathematics and science concepts and to participate in a scientific investigation of some depth. The partnership brings together mathematicians, scientists, engineers, social scientists, and education practitioners to build a whole new approach to reforming K-12 mathematics and science education. The partnership seeks to improve the mathematics and science achievement of all students at all grade levels in the four partner school districts by engaging them in deep and authentic science and mathematics instructional experiences. The partnership will identify and implement a variety of strategies to reduce the performance gap in mathematics and science K-12 associated with gender, ethnicity and special education students. Simultaneously, the partnership seeks to improve pre-service and in-service mathematics and science professional learning, and improve coordination between them. Finally, the partnership seeks to improve models of collaboration between K-12 and post-secondary institutions in the service of mathematics and science education for all. The partnership is documenting what works and why and will provide information about how to construct such a partnership to a wide audience of policymakers and university and school leaders. These themes were articulated in the original proposal and have been further organized around six goals for SCALE:

Goal 0	Management
Goal 1	Core STEM Instruction System
Goal 2	STEM Immersion Units
Goal 3	Coherent Teacher Preparation and Professional Learning
Goal 4	Equity
Goal 5	Research and Evaluation

At the midpoint of Year 3, the SCALE partnership has grown in almost every aspect. We are now developing, implementing and researching at full capacity in each goal area in terms of funding, resources, and human and social capital. In Years 1 and 2, much of our work centered on Goals 1 and 2. In Year 3, those initiatives have continued to expand and prosper. Also, Goals 3 and 4 have come into their own—engaging additional STEM and education faculty, K-12 educators (both administration and teaching staff)—by working collaboratively across goals, partners and institutions. Goal 5 also has expanded to include the research that is being conducted under Goal 2 in Pittsburgh and Goal 4 in Equity, and has developed a new study directed at IHE participation and change.

In the past year, we have learned that development of the relationships among our core partners takes time, collaboration, and compromise. We have increased our interactions with local Institutes of Higher Education (IHE), STEM and education faculty, creating and renewing connections among K-12 school districts and their local IHEs. More teachers also are involved in participating in the development, training, and implementation of SCALE initiatives. At times, each goal has had to focus on “getting it right” with one district before working with another. We have engaged in numerous pilot and field tests in our development and implementation. While each goal has been forging new ground independently, each goal also has begun to interact with the other goals, blurring the distinctions that were originally set forth in our Strategic Plan. We see this alignment and cross-fertilization as building coherency and capacity in the SCALE enterprise at all levels.

With this expansion in work and participation, the SCALE enterprise has become increasingly more complex and far-reaching. SCALE leadership and partners have followed a strategy of leveraging local commitment, state and federal grants, and assistance from NSF-funded MSPs and Research, Evaluation and Technical Assistance (RETA) projects to expand the enterprise, maintain the momentum of our work, and ensure the quality of our initiatives. We believe these changes are evidence for SCALE emerging as an extended, knowledge-building community of practice. We also believe that these changes will increase the likelihood that SCALE will achieve its ambitious goals.

The implementation planning exercise this year has been both challenging and insightful. It has been challenging in that SCALE is now at its halfway point. All goal areas have grown, are more internally complex, and have complex interaction patterns with the other goals. Now the SCALE goals must confront their own productivity and success as they reach and even exceed the original objectives and benchmarks. In this year's planning session, the Goal leaders were challenged with re-examining priorities and deciding on tradeoffs about the work they plan to accomplish in the next two years. The process leading up to these decisions was insightful for each goal, as they reflected upon what they have accomplished, the lessons they have learned to date, and the new work they would like to conduct.

With these challenges in mind, and the new NSF guidelines for the MSP Annual Progress Report in hand, we instructed each goal to write their section of the SCALE Year 4 Implementation Plan within the context of the five-year Strategic Plan, and to emphasize lessons learned in Year 3, and establish new and emergent work plans and budgets for Year 4. This has resulted in considerable variation in the presentation of each section of the plan, as each Goal has a unique focus, is at a different point of development and success, and interacts with our partners and the other goals in different ways. Each section reflects the different points of development and focus of work within each goal:

- Goal 0 emphasizes the growing importance of communication and distributed leadership across the organization;
- Goal 1 is written to emphasize the work and activities planned with and for each SCALE district in Year 4;
- Goal 2 emphasizes the success of the initial steps to incorporate science immersion units in the LAUSD instructional guides in grades 4-8;
- Goal 3 details new objectives and an expanded direction in building regional K-12 and local postsecondary partnerships, especially to support the Goal 2 work in L.A., and the beginning of the concept of math immersion for middle school teacher professional development;
- Goal 4 is organized around a new approach and the associated new set of benchmarks; and
- Goal 5 details a plan of action for each “line of work” and introduces the new IHE Case Studies.

GOAL 0: Management

The aim of the SCALE management structure is to reflect a highly interactive, collegial system that maintains the clear lines of authority and responsibility necessary to ensure quality, accountability, coherence, direction, and leadership.

The goals and challenges of our ambitious project call for a management structure that facilitates interaction and productivity and is served by modern communication technologies and informed by feedback loops at all levels of the partnership. A key focus of Goal 0 has been to identify points where the SCALE partners need to communicate more effectively, and developing processes and procedures to facilitate collaboration among the partners. Related to this is the challenge of supporting SCALE programs and professionals working from different geographic locations. Another challenge we have identified is managing partnership workflow efficiently by planning and running meetings to optimize efficient use of SCALE participants' time and cognitive capacity, and by planning sufficient time and resources to meet deadlines. All of these challenges involve maximizing communication by managing both the information itself and the flow of that information.

Goal 0 is comprised of the Senior Management Team (SMT); a smaller SCALE leadership team; the UW SCALE Administrative Office (SAO) and technology support; and administrative and technology support at the University of Pittsburgh. To date, key management activities of Goal 0 include:

- Managing daily operation of the project.
- Supporting partnership-wide collaborative work environments, knowledge management and technical resources.
- Leveraging SCALE resources through collaborative development of local and national grants.
- Managing financial awards, sub-contracts, and reports.
- Facilitating SCALE leadership and SMT communication through teleconferences, videoconferences, and regular face-to-face meetings.
- Coordinating with partners' existing/ongoing local projects, other MSPs, and RETAs.
- Supporting production of collaborative documents, reports and publications.
- Producing monthly goal reports and updates to share with SCALE leaders and partners.
- Maintaining and submitting SCALE participation and event data to NSF and the MSP MIS reporting system.
- Planning, organizing, and running meetings and other SCALE events.
- Planning and reimbursing SCALE-related travel.
- Maintaining communications with our NSF Program Officer, Joan Prival.
- Committing to, and supporting, research-based practices.
- Disseminating publications, products and our proven practices.

The ongoing strategies for SCALE Goal 0 in Year 4 include those listed above and the following:

Goal 1–4 Lines of Work: Goal 0 supports the lines of work of the SCALE Goal 1-4 teams by ensuring those teams' members have the tools and support they need to carry out the "on-the-ground" work of SCALE. In particular, the SAO is supporting and coordinating communications, scheduling, publication, purchasing, and delivery of appropriate materials.

Research and Evaluation Team: In addition, Goal 0 supports the Goal 5 Research and Evaluation Team (RET) by providing coordination and resources for transcription, data entry, document production, database tools development, and facilities use. Web-based collaboration and knowledge discovery tools found in SCALE's implementation of SCALEnet also are providing targeted support for team members.

Other Coordination and Support:

- Serving as the front line contact for SCALE from interested parties.
- Producing and submitting NSF and National Advisory Board reports.
- Collecting and submitting SCALE data to the MSP Management Information System (Westat).
- Supporting National Advisory Board activities, NSF visits, meetings and presentations.
- Providing input and advocacy for stakeholders across the partnership.
- Maintaining and further developing a core set of documentation and best practices to serve the partnership and communications.
- Disseminate and publish project reports, journal articles, tools and products to partners, NSF, and to the public.

Technology Expertise and Resources: The role of technology in SCALE is to continue to facilitate communication across the partnership, track and record statistical data, support knowledge transfer, support the coordination of complex tasks, and provide outreach tools to disseminate partnership research and products. Monitoring and support structures include knowledge management and knowledge-sharing resources such as SCALEnet and SCALEbase (a relational database for monitoring and reporting project activities, outputs, and status), and the SCALE Web site. In 2006, technology support for SCALE will focus on the following activities:

SCALEnet

- SCALEnet Training.
- SCALEnet collection development – Continue to build the Reading Room and Commons by moving appropriate materials from workspaces for the SCALE partnership.
- Improve project management tool and workflow – For example, work with Goal 2/Immersion Development Team to develop and refine tools and workflows to solve issues of team coordination, timely and constructive IUAT input, and documenting completed work and workshops. These include a report generator, task lists, and calendaring.
- SCALEnet system maintenance.
- Develop and extend user interface.

SCALE Web site

- Maintain Web site content and features.
- Improve Web site quality with editing, revisions and updates.
- Expand links to related projects such as QED.

SCALEbase

- Continue to develop the database, an individual-level data warehouse for student, teacher, school, and district analysis support.
- Support the research needs of the SCALE Research and Evaluation Team. System needs range from tracking changing roles of individual policy network participants (for the Building a Partnership group) to supporting longitudinal analysis of student test scores in all four districts (Quality Indicator group).
- Support the partnership in its commitment to comply with the MSP Management Information System (Westat) reporting regime.

Challenges and Modifications

In order to facilitate decision-making, strategic priorities, and productive work as well as lessen the burden on the SMT, throughout Year 3 various SCALE leaders have been meeting informally on a regular basis. In May 2005 it was decided to formalize the group and its work. Essential to the operation of this group is direct and regular communication with the SCALE SMT, goal leaders and managers, and our district partners. In May 2005 the following members of the SCALE leadership team were named:

- Eunice Krinsky – California State University Dominguez Hills
- Terry Millar- University of Wisconsin -Madison
- Andy Porter – Vanderbilt University
- Merle Price – Representing IFL and LAUSD
- Lauren Resnick – University of Pittsburgh
- Chris Schunn – University of Pittsburgh

As with previous years, Goal 0 will focus in Year 4 on providing day-to-day management of SCALE with an emphasis on accountability, coherence, direction, and leadership of the partnership. Goal 0 places special emphasis on promoting collaborative work, improving communication and information management, and applying technology solutions. Goal 0 deliverables for Year 4 include:

- Timely completion of the Year 4 Annual Progress Report and Year 5 Implementation Plan.
- Plan and conduct an annual SCALE National Advisory Board Meeting.
- Plan and conduct SMT meetings.
- Plan and conduct the regular SCALE leadership meetings.
- Develop and use processes and tools to support Goal 1–5 leaders, managers, and design teams.
- Align and leverage SCALE activity with related national and regional grants, NSF, and other MSPs and RETAs.
- Identify, publish, and disseminate SCALE-developed resources.

GOAL 1: Core STEM Instructional System

Goal 1 is concerned with mounting a sustainable high quality mathematics and science program for all students, district-wide, in each of the SCALE districts. During the first 2 years of SCALE we developed an explicit theory of action for this work, embodied in the concept paper (*Teaching and Learning Systems: An Analytic Guide for District Planning*) that provides a guidance system for our districts. Our theory of action initially specified four dimensions of the district teaching and learning system: (a) the teaching system (curriculum and instructional programs for use with students); (b) the professional learning system (systems and materials for intensive and sustained professional development of teachers); (c) the monitoring system (systems for assessing student progress on an interim basis, both to guide instruction and to signal which students might need additional support in order to perform well on state accountability tests); (d) the accountability system (systems for using official accountability programs to support productive school and classroom change in the service of enhanced and equitable mathematics and science learning).

As this planning guide has come into use in SCALE districts, several additional elements have been identified as needing targeted attention. These include (a) the design of the district *system as a whole*—that is, the way in which the various dimensions of the teaching and learning system would work together synergistically; (b) the need to monitor professional practice and school functioning as well as student learning; and (c) the need for variants of the teaching, professional learning, monitoring, and accountability systems specifically oriented to high schools (our initial concept paper was based mostly on experience with elementary schools).

Our plans for Year 4 extend our work in each of the dimensions in the original theory of action paper, as well as adding a significant effort focused on district-wide system design. Much of the work that we do in Goal 1 is accomplished through ongoing, intensive coaching of senior district leaders in the design and implementation of their teaching, professional learning, monitoring, and accountability systems.

In Year 4, we will continue to work with each district to assist them in identifying, evaluating and creating policies for their core mathematics and science instructional programs. We will also be working with two districts, Los Angeles Unified School District (LAUSD) and Providence Public School District (PPSD), to guide and support their development of student interim monitoring systems.

Our professional development activities and support will continue and intensify. New work on overall district system design will be introduced. In response to the identified need to monitor system development and functioning, we will intensify our work on rubrics for judging the quality of professional learning, school leadership and teaching quality.

For high schools, we have created a new version of the *Analytic Guide for District Planning*, which will guide our work with districts as they move toward enhanced secondary school mathematics and science programs.

Madison Metropolitan School District (MMSD) is no longer an affiliate member of Institute for Learning (IFL). Consequently, the IFL plays less of a direct role in the implementation of Goal 1 strategies in the district. However, MMSD continues to follow the theory of action of Goal 1,

and work on the Goal 1 objectives and benchmarks in collaboration with the SCALE partnership. In Years 1 and 2, the district received training in the Principles of Learning and Disciplinary Literacy (DL), and continues to incorporate these strategies in their efforts in math and science. In Year 4, MMSD will continue to collaborate with SCALE in addressing Goal 1 benchmarks and objectives. MMSD plans for Year 4, when different from the other SCALE districts, are included below.

Professional Development Activities and Support

In Year 4 the IFL through its DL approach will continue to provide multiple, rigorous professional learning opportunities. These professional development activities focus the attention of mathematics and science teachers, coaches, lead teachers, and principals on supporting students' understanding of mathematics and science concepts (Benchmark 1b-1).

Mathematics. In Year 4 IFL Mathematics Fellows will continue to work directly with district mathematics leaders, coaches, and teachers in three SCALE districts, LAUSD, Denver Public Schools (DPS) and PPSD. In LAUSD, IFL fellows will continue to develop a coaching model for the mathematics coaches in grades 6 and 7, and in Algebra, with a focus on coherence through the use of common frameworks (Mathematical Tasks Framework) and tools (i.e. TTL). LAUSD will explicitly use the professional learning communities among the coach groups to serve as a model for fostering professional learning communities in the schools. The IFL will deliver supplemental mathematics lessons each quarter in grades 1-8.

There will be a national meeting held in Year 4 in Pittsburgh followed by 4-8 additional days of SCALE in-district coaching around mathematics in DPS, LAUSD and PPSD. How these are used will be determined in consultation with the districts. In PPSD, the IFL will continue to work with mathematics coaches as well as supporting the DL work in the district. Finally, a second national meeting, focused exclusively around high school mathematics, will occur.

In Year 4 MMSD will work directly with classroom teachers and ESL and special education teachers who support students in mathematics to enhance their knowledge of mathematics content and pedagogy. Professional development for elementary teachers will emphasize strategies to accelerate the understanding of numbers by first grade students, smoothing the transition to multi-digit operations, and increasing the math content knowledge of intermediate level teachers. Professional development emphasis at middle school will be on enhancing teachers' math content knowledge. At both the middle and high school level, professional development will emphasize pedagogy to challenge all learners in heterogeneous classrooms. MMSD is collaborating with EDC's Lenses on Learning project to offer elementary and middle school principals the tools to support standards-based mathematics instruction in their schools.

Science. In Year 4 the science team will continue to work with three SCALE districts—DPS, PPS and LAUSD —to support district decisions around curriculum implementation and creating an aligned professional development training and coaching system. There will be a national DL meeting that will include the SCALE districts. A second meeting, focusing on curriculum implementation, will also be available. Each of the SCALE districts will have additional days of coaching available to them as part of SCALE. How these will be used will be determined in consultation with the districts.

In Year 4 MMSD science professional developers will continue to work directly with K – 9 science teachers to enhance the implementation of the district's science scope and sequence. In addition to providing teachers with opportunities to learn about the scope and sequence and the materials that support its implementation, the professional development also addresses teachers' content knowledge and issues of equity and access.

Video. In Year 4 we will collect multiple video examples of high-performance, rigorous mathematics and science teaching in DPS, PPSD and LAUSD. Videotaping will be done in at least three of the four SCALE districts and will include sessions in mathematics and science at elementary, middle and high school levels (Benchmark 1b-2).

District Coaching and Coordination
District coaching and coordination teams will continue to work as site liaisons in PPSD, DPS and LAUSD. They will support, mentor and coach district personnel to develop the structures necessary to implement Goal 1 benchmarks.

District and System Design
We have produced a new paper which is an updated, revised version of our theory of action paper, called *Teaching and Learning Systems for Middle and High Schools: An Analytic Guide for District Planning* by Lauren Resnick. The new paper clearly defines a curriculum system theory. We will be using that theory in three of the four SCALE districts to assist them in designing a teaching system, a professional development system and a monitoring system that supports the implementation of a rigorous mathematics and science curriculum in secondary schools. We will also be attentive to how these all connect to the state accountability system.

We will work to put what we are learning into a system-wide SCALE theory. A major component of this theory is the specification of how the district as a whole should be reorganized and how resources may be allocated to support that reorganization. All of these efforts will be closely connected to the Goal 4 equity design work.

Rubrics
In Year 4, Goal 1 will oversee the piloting, implementation and assessment of the professional learning, teaching and school leadership rubrics. We will continue to collect data on school leadership rubrics, as well as to use the rubrics as a professional learning tool for self-assessment and reflection in SCALE districts.

We are in the process of reformatting and expanding upon the Professional Learning rubrics, which were developed by Goal One in Spring 2004. The revised format will build on the successful model of the School Leadership rubrics, following a similar organizational structure and expanding upon the existing Professional Learning tool with added dimensions.

GOAL 2: STEM Immersion Units

General Objectives for the Goal in Year 4

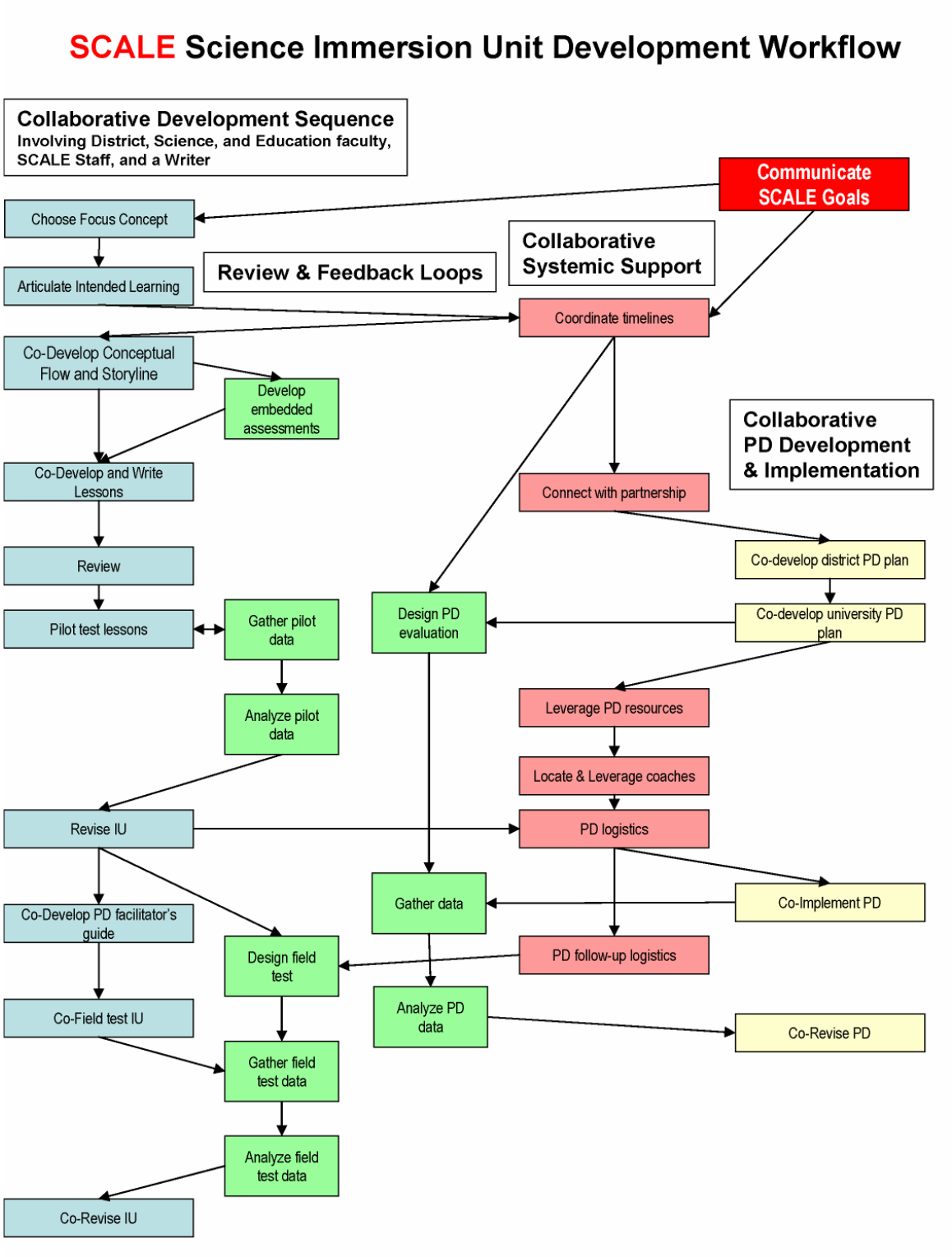
The objectives for the Goal 2 Science Immersion Design Team (IDT) in Year 4 are to:

1. Continue designing and providing high-quality professional development for science immersion units for teachers in SCALE districts (elementary, middle and high school).
2. Produce and implement professional development facilitation guides with identified district leaders and IHE faculty to mentor district immersion unit professional development facilitators.
3. Evaluate student learning from immersion units.
4. Continue to collaborate with districts and local IHEs to identify, develop, field-test and revise immersion units.
5. Evaluate all immersion units by outside qualified reviewers for overall quality and scientific accuracy.

The Year 4 objectives emerge from the work and lessons learned in Year 3. A fundamental piece in science immersion is the addition of the focus on professional development facilitation guides and training for professional development providers within the districts and local IHEs to build capacity for support of widespread and long-term implementation and training.

In addition, during Year 3, the Goal 2 leadership re-examined workflow processes to determine how the work in science immersion is specifically integrated into all the goals for SCALE. As a result, strategic modifications were implemented in the approach in order to explicitly identify how this work integrates into a systemic district approach. The following diagram illustrates the Goal 2 Science Immersion Unit Development workflow and identifies the four areas of work currently in process in LAUSD and Madison Metropolitan School District (MMSD):

- Collaborative Immersion Unit Development Sequence
- Collaborative Professional Development Sequence
- Systemic Support
- Evaluation and Feedback Loops



These areas encompass aspects of all the SCALE goals as articulated in the strategic plan and are crucial for meeting the objectives of Year 4. Thus, the Goal 2 Immersion Design Teams (IDT) will continue to coordinate efforts with relevant work in the other SCALE goals and with relevant existing and developing school district initiatives. The IDTs will build further on

existing collaborations with the Research and Evaluation Team (RET) to measure the impact of Goal 2 work as it integrates into SCALE districts.

Plan of Work for Year 4

In Year 4, the University of Wisconsin (UW) and University of Pittsburgh-based IDTs will complete development, field-testing and revision of the ten immersion units already under development for elementary and middle school science. Up to three new science immersion units will be identified, developed, and field-tested, involving all four SCALE districts. The UW IDT will develop an immersion unit for Grades 1 and 2 and is beginning work on identifying and developing a high school Biology unit. Under consideration by the University of Pittsburgh IDT is the development of high school units in Chemistry and/or Physics. While a few of the SCALE districts have expressed interest in high school immersion units, agreement has yet to be reached as to how these units would be developed and integrated into the core curriculum. Initially, the Chemistry and Physics unit development work will be conducted in the Pittsburgh Public Schools. Potentially, these units would be co-developed by the IDT and a SCALE partner district, and be designed around transportable topics for replication in other districts.

During the 2005-2006 school year, professional development and implementation of Science Immersion Units will increase. As modeled in Year 3 in the Los Angeles area, implementation for Year 4 will be defined by and integrated into Goal 1 and Goal 3 initiatives for science in the SCALE partner districts. One of the primary challenges the immersion development teams have encountered in the SCALE districts is the limited ability to build the capacity of the district personnel in providing professional development and follow-up for the implementation of immersion units. The development teams are taking the next step towards focusing on the professional development providers in the district and the local IHEs. This effort involves providing professional development for the providers of professional development and by co-developing facilitation guides for professional development while working within the districts' resource allocation system. Teacher professional development materials will be created that guide facilitators to support teachers in successfully implementing immersion units as they were designed to maximize student learning.

Evaluation of the immersion units will expand as well, through feedback solicited by unit developers; with new research planned for the targeted studies by the Research and Evaluation Team (RET); research of the design process, classroom implementation and student learning planned by the University of Pittsburgh; and curriculum review of units by outside experts. More specifically, additional meetings will be held between the IDTs, districts, IHEs, and the IFL to generate specific district benchmarks on accountability, monitoring and professional development in conjunction with immersion units. These benchmarks will include essential details with respect to unit implementation in each of the SCALE districts. The IDT and immersion unit developers will work with the RET to further develop and identify means that will allow SCALE to evaluate the extent to which students demonstrate the intended outcomes when the immersion units are successfully implemented. The UW IDT and RET plan to conduct evaluation on three immersion units for fidelity of implementation in SCALE districts. The University of Pittsburgh plans to use videotapes of professional development and classroom implementation, and data from embedded assessments, to evaluate immersion unit design, implementation and outcomes. Evaluation will be done on all immersion units by outside reviewers for overall quality and scientific accuracy. All of this feedback will drive further refinement of the SCALE Science Immersion Unit Concept Paper to reflect a revised theoretical

framework for the identification and development of immersion unit resources.

Further integration of Science Immersion with work across the other SCALE goals will also continue to emerge in Year 4. Goal 2 leadership will make explicit the integration of its work with the other SCALE Goals in the four areas identified in all four SCALE districts:

- Collaborative Immersion Unit Development Sequence (Goals 1, 2, 3, 4)
- Collaborative Professional Development Sequence (Goals 1, 2, 3, 4)
- Systemic Support (Goals 1, 2, 3)
- Evaluation and Feedback loops (Goals 1, 2, 3, 5)

An additional challenge encountered by the IDTs is related to the co-development process of the immersion units. During Years 1 and 2, the development teams struggled with engaging STEM and education faculty in the development process beyond reviewing the final unit. During Year 3 we have made strides towards incorporating STEM and education faculty directly in the construction of the immersion units. This occurred through partnering with the Quality Education Development (QED) award to CSUDH and LAUSD. The CSUDH and California State University Northridge (CSUN) STEM and education faculty, LAUSD personnel, and SCALE curriculum developers have come together to develop two immersion units in full collaboration. This model is beneficial not only in developing a high-quality immersion unit, but also in providing an additional resource for capacity to the district through the IHE faculty.

The ongoing implementation of science immersion units continues to inform us and to identify challenges for the IDTs in the SCALE districts. The primary challenges continue to include:

- Presenting immersion units to teachers as integral parts of the curricula and as designed learning opportunities in which students are engaged over an extended period of time, focusing intensely on a particular concept or idea in the content area currently being taught, rather than just as additional items to teach;
- Designing and implementing immersion units in light of district resource realities, including personnel constraints, policies on teacher time out of the classroom, budget freezes, etc.;
- Equity and commitment issues due to relying on “volunteerism” for teacher participation in professional development workshops;
- Aligning expectations between SCALE and district administrators (and teachers) in terms of classroom support and implementation as well as future training responsibilities for the immersion units; and
- Designing evaluation models for tracking effective teacher implementation of immersion units in the classroom, and for assessing student achievement and learning.

By continuing to integrate the Goal 2 work with that of the other SCALE goals, SCALE is continuing to advance a coherent working plan from the IFL, the IDTs, IHEs and district leadership to address these challenges.

GOAL 3: Coherent IHE Participation and Professional Development

Since its inception in the original SCALE proposal, Goal 3 has been reconfigured several times to better reflect the emerging work with institutes of higher education in partnership with K-12 school districts, increased engagement with STEM and education faculty, pre-service professional learning, integration with Goal 2 Immersion development, and integration with Goal 1 on professional development.

New objectives for Goal 3
As of June 2005, most of the original benchmarks set for Goal 3 have been met, and Tracks 1 and 2 accomplished the key objectives that were initially focused at the University of Pittsburgh. During Year 3, Goal 3 extended its reach to the four SCALE districts and their affiliated IHEs. In addition, an emerging emphasis on STEM and education faculty involvement in our initiatives with SCALE K-12 districts has created the need to establish a new set of objectives for Goal 3. Now Goal 3 has four main objectives aligned to four of the NSF Key Features for MSP Projects:

- **Partnership-Driven:** Promote coherence between each district and the IHEs that serve the district in ways that are consistent with and support SCALE and NSF objectives.

- **Teacher Quality, Quantity and Diversity:** Involve STEM and education faculty in providing quality and pre-service professional development opportunities for K-12 teachers.

- **Challenging Courses and Curricula:** Promote STEM and education faculty involvement in the development and implementation of challenging courses and curricula to improve the preparation of future STEM teachers.

- **Evidence Based/Institutional Change and Sustainability:** Develop opportunities for local post-secondary institutions to coordinate with the local districts to develop and implement new policies and practices that redirect and increase the resources available in K-20 organizations to incorporate the lessons learned and the evidence-based effective practices.

Taking the lead for Goal 3 on these objectives and their related initiatives are Terry Millar (UW-Madison) and Eunice Krinsky (CSUDH). Both are mathematicians and university administrators, who together bring over 50 years of experience to teaching and learning across the K-20 educational continuum. In Year 3, they were instrumental in coordinating and leveraging SCALE efforts with Department of Education TQE and Title IIb grants by writing proposals in collaboration with the SCALE LAUSD and MMSD districts.

The new objectives for Goal 3 will coalesce around regional partnerships between SCALE K-12 districts and their affiliated institutes of higher education (IHE). These regional partnerships have already begun in MMSD and LAUSD. Eunice Krinsky, along with STEM and education faculty at CSUDH, is taking the lead in building a strong regional partnership, linking LAUSD and several other California State University campuses in the Los Angeles basin. Eunice Krinsky is directing the coordination of K-12 and higher education institutions, aligning state and federally funded initiatives in mathematics and science, and collaborating with STEM and education faculty and district experts in the co-construction and delivery of improved curriculum, pre-

service, and in-service professional development. Similarly, Terry Millar has enhanced the collaboration with MMSD he began under the National Institute for Science Education (NISE) and the UW-Madison NSF GK-12 award, K-Through-Infinity (KTI). In 2004, MMSD was awarded an MSP Title IIb grant from the Wisconsin Department of Public Instruction. The program was developed jointly by MMSD and SCALE. MMSD and the UW-Madison Mathematics Department created and delivered four 1-credit core mathematics concept courses during the summer and fall of 2004 and spring of 2005. These courses will be repeated during summer 2005 institutes. The mathematics concept courses were delivered to more than 100 MMSD middle school teachers. MMSD and SCALE have been awarded a second grant to continue and expand the course models in 2005-2006.

Math Immersion

Science Immersion intended for classroom use is the focus of Goal 2 work. During the last year, we realized that we were developing a parallel idea in mathematics, but intended for the professional learning of teachers. For that reason, the work we have done in "Math Immersion" is included in Goal 3 rather than Goal 2. A Mathematics Immersion Concept Team was formed in September 2004 with representatives from both UW-Madison and CSUDH. It and has been working hard to:

1. Continue the conceptual work on what should constitute mathematics immersion.
2. Continue to work on the draft *Math Immersion for Middle School Teacher Professional Development* concept paper.
3. Begin testing math immersion resource units in various classroom and professional development settings.
4. Continue developing experimental mathematics immersion units, including the mathematics immersion resources and the accompanying work to align mathematics immersion resources with curricula, standards, and professional learning (taken all together, this will constitute a mathematics immersion unit).

In addition, the team has been soliciting input from such recognized experts as Tom Carpenter, Tom Romberg, Rich Lehrer, and Sharon Derry. The Team shared its first draft of the paper in April of this year, and is now busy digesting the feedback they have received from the SCALE partnership and beyond.

Plan of Work for Year 4

In Year 4, Goal 3 will continue to work on building the regional partnerships and will share their experiences in LAUSD and MMSD with the SCALE districts and IHEs in both Denver and Providence. To work towards meeting the revised objectives for Goal 3 the following activities are proposed for Year 4:

- Continue the co-construction of the science immersion units.
- Continue the work on the development of mathematics immersion.
- Conduct mathematics and science institutes in the Los Angeles area – at CSUDH and CSUN in the summer of 2005, and at CSUDH, CSUN, and California State University Los Angeles (CSULA) in the summer of 2006.
- Plan and convene the annual IHE conference in Spring 2006, to include SCALE-affiliated IHEs along with those connected to other MSP and TQE projects.
- Continue to work with IHEs local to DPS and PPSD to enhance the collaborative efforts of these institutions with the K-12 systems.

- Continue the collaboration between MMSD and the UW-Madison Mathematics Department.
- Solicit additional funding to develop resources in support of the mathematics and science immersion unit implementation and professional development.
- Work with STEM and education faculty at both Research I and Comprehensive Universities to rethink the initial preparation of teachers to increase the quality, quantity and diversity of the K-12 STEM faculty.

The Goal 3 strategy of regional partnerships has challenges that include:

- A long history of vertical "silos" across institution types;
- A long history of vertical silos with different institution types but across subdivisions;
- Matching the logics, rhythms, and forces that drive the different institutions and their component parts;
- Variations in mission and sets of stakeholders; and
- The scarcity of the precious resource of available time.

The ongoing development of the concept of mathematics immersion units has challenges that include:

- Making the distinction between mathematics immersion and the high quality standards-based mathematics curricula;
- Making the distinction between mathematics immersion and other high quality mathematics professional development approaches; and
- Making the case that professional learning based on mathematics immersion will prove useful to teachers who are trying to have students learn mathematics with understanding.

GOAL 4: Equity

The overarching benchmarks outlined in the Goal 4 Implementation Matrix will be used as a way to describe the Goal 4 implementation plan for the coming year. In general the overarching benchmarks are presented followed by a narrative, which describes how the Goal 4 activities will be achieved.

Benchmark 10a. Identification and Implementation of Equity Based Strategies. In Fall 2003, Goal 4 was expanded from its original conception, beyond issues of underrepresented groups in undergraduate STEM education, to focus on issues of equity throughout the K-12 system. As a result of the Equity Council of Twelve meeting in December 2003, the Goal 4 team began the following two lines of work.

> a) Identifying best practice strategies for addressing equity from the literature on K-12 school reform, particularly in mathematics and science, and
>
> b) Conducting a needs assessment of every district from a systems perspective to determine which strategies are most likely to result in more equitable conditions for all students, with the eventual goal of closing the achievement gap.

A working paper has been produced focused on the two streams of work mentioned above. During the next year, the Goal 4 team will continue to expand upon its current working paper, which is also being used in work with districts, as it outlines overall approaches to equity, equity goals and measures, and strategies that have been identified as best practices by experts in the field.

Benchmark 10b. Development and Implementation of Equity Benchmarks. The needs assessment work within each district has revealed that two of the SCALE districts (MMSD and PPSD) already have specific equity benchmarks in place. These benchmarks are used to mark progress at the district and individual school levels. For example, PPSD has developed a "Data Dashboard," which provides schools with key data markers for equity. In DPS, however, this work is not as well developed. SCALE and DPS staff will work over the next year to help DPS identify a set of valuable equity benchmarks, establish baseline measures, and help to create a system for monitoring and improvement.

At the time of this report, the status of equity benchmarks along with a monitoring and improvement system in LAUSD has not been thoroughly investigated. It was decided to first address the three smaller districts before examining LAUSD. During the later half of the third year, a separate Goal 4 liaison will be hired to work solely with LAUSD on this benchmark, while Erica Halverson (Goal 4 district liaison) will continue to work with MMSD, PPSD, and DPS.

The Goal 4 team is on track to reach this benchmark by the end of the third year. As described above, two districts have in place metrics, benchmarks and a means by which the district can work towards their benchmarks. In addition to these equity metrics, we are currently developing a system to help identify key barriers to implementing equity strategies and to address these barriers systemically and track their progress.

During the past year, the first two benchmarks have has served as the basis for the development of a Goal 4 plan for the second half of Year 3 and Year 4. Specifically, new subsequent benchmarks have been created along the following objective: to develop a systems-based model for attaining equity across all SCALE districts and identity individual district needs within this general model. This model follows closely with Goal 1 efforts. Coupled to this plan, the work accomplished during the past year, and recommendations from the National Advisory Board, new staffing is proposed. The new benchmarks and the personnel requirements are described below.

Benchmark 10c. Develop a model for attaining equity across all SCALE districts and identity individual district needs within this general model. The purpose of this work is to both define Goal 4 from a systems-based manner across all SCALE districts and to identify how every district can work to improve their functioning within that model.

Benchmark 10c-1. By the end of the third year, the Goal 4 team will have built a systems-based model for equity that is applicable across districts. This will serve as the basis for determining district progress and facilitating talk among districts. This model, currently in progress, will be completed by the end of Year 3 and developed into a paper. This model represents a generic system that broadly describes the work around equity in every district. The model currently contains four key components:

- *Benchmarks*: This includes both academic (primarily student achievement) and non-academic (e.g. school climate, parent involvement) that measure equity within each district and within individual schools in the districts. These metrics have either been developed within the district or are currently under development in conjunction with SCALE Goal 4 staff.

- *Strategies*: These refer to specific success-proven strategies and interventions that focus on mitigating inequities in the K-12 system around mathematics and science. They may be found at all levels of the system. For example, a district-wide strategy is the elimination of mathematics courses below the level of Algebra at all high schools, a school-wide strategy is the creation of a new, non-expulsion based discipline policy, and a student intervention might be the creation of an extra mathematics hour to help individual students who are struggling with the standard curriculum. The goal is for these strategies and interventions to be connected to the benchmarks that are developed at the district level.

- *Data to determine improvement areas*: Data are collected around these strategies and interventions to determine whether, and in what ways, they are successful for the particular district. This same data also points to "red flags," or places where the district should be attending in their benchmarks and strategies.

- *Barriers*: Barriers are the primary impediments to the cyclical functioning of the benchmarks-strategies/interventions-data system. Barriers can occur between two parts of the model (e.g. the ability to turn a new benchmark into a workable strategy or intervention) or within one part (e.g. the development of benchmarks). In this way, the development of equity metrics is seen as a barrier to the effective functioning of the

equity system and can be addressed as such. More about this is indicated in the summarized work that has been done thus far in each district.

Benchmark 10c-2. By the end of the third year, Goal 4 team will have worked with each district to understand their specific needs with respect to equity. This will include identification of equity issues, goals, strategies, and an understanding of each district's system. By December 2005, Goal 4 staff will have worked with every district to locate their work within this broad model by identifying the kind of data they currently collect, the benchmarks they have in place, and the primary strategies and interventions they employ. Table 1 shows a timeline for conducting this work.

Table 1
Identification of data, benchmarks, and strategies in SCALE districts

	DPS	LAUSD	MMSD	PPSD
Timeline	Spring 2005	Fall 2005	Winter 2004	Spring 2005

Initial work with DPS, MMSD, and PPSD is completed and has revealed that while there is a sophisticated system of interactions among data, benchmarks, and interventions in every district, this system is both unique and differentially developed across districts.

Benchmark 10c-3. By the beginning of Year 4, the Goal 4 team and districts will have identified barriers within each district that hinder the development of equity-based reforms, particularly as they related to other SCALE goals. The identification of barriers that impede the functioning of the equity system in each district is a key facet of the Goal 4 equity efforts. Through this process, Goal 4 staff and key district personnel will work to identify the challenges in implementing the benchmarks/strategies/data system across individual districts. For example, PPSD has identified the master scheduling process at the school level as an impediment to creating equitable access to rigorous content for all students. Goal 4 staff and members of the PPSD district team have agreed to develop a plan to study, understand, and address master scheduling as a barrier. It is anticipated that a primary barrier in DPS is the systemic use of metrics that demonstrate the improvement of equity over time. Table 2 outlines the timeline for identification of barriers in every district.

Table 2
Identification of barriers to functioning of equity system

	DPS	LAUSD	MMSD	PPSD
Timeline	Summer 2005	Winter 2006	Summer 2005	Spring 2005

Benchmark 10c-4. In the third and fourth years, develop and implement plans to address these barriers in each district. Once these barriers have been identified, Goal 4 staff and key district personnel will develop and implement plans to systemically address these barriers. See the "Goal 4 Activity Implementation Matrix" for specific details on plans to address barriers thus far.

Table 3
Implementation of SCALE plans to address barriers

	DPS	LAUSD	MMSD	PPSD
Timeline	School Year 2005 - 2006	March 2006 – January 2007	School Year 2005 - 2006	June 2005 – June 2006

Benchmark 10c-5. In Year 4, conduct an equity think tank with all four SCALE districts and all Goal 4 personnel to share district differences and commonalities that emerge as a result of district-specific work. Upon completion of the needs assessment, identification of barriers, and development and implementation of plans to address barriers, an "Equity Think Tank" will be provided for the SCALE districts. The purpose of this think tank will be to discuss the overarching equity system described in Benchmark 10c-1, as well as commonalities and differences across districts with regards to barriers and implementation plans. The result of this think tank will be further refinement of the systemic equity system, and the identification of places where districts can learn from others' successes and potentially implement these plans to address barriers that have yet to be addressed. It is anticipated that this think tank will take place in the summer of 2006.

Benchmark 10d-2. By end of year 3 create an Equity Advisory Board comprised of experts in the field of equity in K-12 education. Recommendations from the March 2005 National Advisory Board meeting indicated that Goal 4 needed additional leadership with expertise in equity across the K-12 system. In order to address this concern, the Goal 4 team will create an Equity Advisory Board, comprised of practitioners and experts from around the nation whose work is focused on issues of equity. Goal 4 staff will meet regularly with this Equity Advisory Board with dual chairs, yet to be determined.

GOAL 5: Research and Evaluation

SCALE Quality Indicator System (SQIS)

The SCALE Quality Indicator System is a set of indicators that represent major SCALE attributes as described in the strategic plan and annual reports. An indicator is a statistic that has particular meaning related to a policy or program. The SCALE Quality Indicator System (SQIS) is envisioned to be a collection of measures that have significance to SCALE as mapped out in its theory of change and as enunciated as the project evolves over time.

Three main purposes have guided the design of the SCALE Quality Indicator System. The system has been designed to produce valid and reliable information that can be used to:

1. Monitor the progress of the four partner school districts to attain district-defined outcomes related to student achievement, opportunity to learn, instructional quality, and teacher professional learning;
2. Judge the attainment of SCALE to reach the specified benchmarks identified in its strategic plan; and
3. Report information to the National Science Foundation to comply with the Management Information System requirements.

Note that the purpose of the SQIS is not to track all of the activities and policies of the four SCALE school districts. There are too many activities and policies for this to be done with the available resources. Rather, the SQIS has been designed to attend to the most important information and factors as determined by SCALE's goals, the requirements imposed on SCALE by NSF, and the functions of the districts influenced by SCALE. It is sufficient to build an indicator system that can describe with some degree of accuracy the changes that occur in the four school districts and to track the SCALE activities that may be associated with these changes.

In 2005 and continuing into 2006, the SQIS will evolve over time into an important deliverable from SCALE to the four school districts. To gather the necessary data to implement the SQIS requires close cooperation from the four school districts. This cooperation is much more forthcoming if district staff see value in the data gathering effort and the information that is produced. Districts have little or no capacity or time to analyze longitudinal trends in student achievement and other data. SQIS has the potential of making a contribution to the four districts both by producing valid data-collection instruments and constructing concrete procedures staff can use to produce information on instruction and student achievement over time. Thus, as we design and develop the indicator system to produce the information needed to track the impact of SCALE, we also working toward producing instruments that can easily be used by district staff.

In 2006, we will have obtained from the four school districts student achievement and participation data for the baseline years and the first two full school years of SCALE, 2003-2004 and 2004-2005. We will analyze these data longitudinally and produce descriptive tables and graphs to depict the changes in student achievement and participation over the first two years of SCALE compared to the baseline years. We will administer and analyze data from all four districts on teachers' participation in professional development and their instructional practices. We will continue to refine the questionnaires and data gathering instruments by attending to the needs of the four school districts. The instruments and sources of data that we will be implementing and analyzing in 2006 include: Teacher Background and Contact Survey; Teacher Professional Learning Participation Survey; Teacher Professional Learning History Survey;

Teacher Instructional Practices Survey; School Climate Survey; School Level Administrator SCALE Support Survey; List of SCALE activities; List of SCALE providers of activities; Student data record; Teacher data record; and School data record.

The indicator team is also charged with providing data to the MSP Management Information System (MIS) operated by Westat. There is substantial overlap between SQIS data elements and the MIS effort. One additional deliverable that will be provided to district SQIS liaisons is documentation of the cleaning necessary to convert submitted data to true longitudinal format. The implementation team has substantial experience managing and using microdata. Lessons learned, and derived principles for data organization, will be communicated back to district staff to inform their own data management practices.

Targeted Studies

Targeted studies are important for measuring the viability and impact of the implementation strategies of the SCALE goals. Their focus is primarily at the level of teachers and students. We are carefully coordinating the targeted studies with the other SCALE research and evaluation studies, particularly the indicator system, the case studies of IHEs, and the district case studies.

A major focus for targeted studies will be research and evaluation of the science institutes at CSUDH as part of their QED program. This study addresses three main research questions that are central to targeted studies:

1. In what ways do QED science institutes and follow-up activities enhance teacher content and pedagogic knowledge in science?
2. To what extent do QED science institutes and follow-up activities influence teachers' curriculum, instruction, and assessment?
3. To what extent do QED science institutes and follow-up activities contribute to high and equitable student learning outcomes in science?

In addition, the study will provide formative feedback on the principles and processes that support or impede the QED theory of action, and provide a summative analysis of the institutes' influences on teacher learning and the quality of teacher practice.

"Proof-of-Concept" studies will be conducted to field test newly-developed immersion units with a small sample to verify the unit can produce the desired learning outcomes. In LAUSD, teachers will receive training on four units at grades 4, 6, 7, and 8 in the summer of 2005, and will implement the units in 2005-2006. In MMSD, multiple units that build off of the FOSS modules will be field tested in 2005-2006. Classroom observations, student work samples, and teacher interviews are planned for each study.

The inclusion of immersion units in the science instructional guides in LAUSD offers an opportunity for an experimental, randomized study of science immersion. Targeted studies staff have developed an initial design for this study and will continue to work closely with LAUSD's Program Evaluation and Research Bureau (PERB) to initiate a study at the appropriate time.

With increased implementation of immersion units, "comparative studies" will examine how student participation in immersion units influences achievement in and attitudes toward mathematics and science. These studies will be quasi experimental in nature, taking into account

extent of participation, quality of implementation, pre- and post-tests of related content knowledge and attitudes, and prior and outcome achievement measures. Ideally, assessments of achievement will be multiple and will include standardized tests, performance-based tasks tied to immersion units, and general assessments for all students that are consistent with criteria for immersion units. The units of analysis will be the classroom level and the individual student level over time. Data will be disaggregated by student group to address equity issues.

District Case Studies

The transition to Year 4 is a time of increasing productivity for the case studies team. Year 3 will see the completion of a formal design paper, "panoramic" case reports on each of the four SCALE districts, and a cross-site synthesis. In Year 4, the team will focus on "in-depth" case studies in two districts of the impact of district instructional guidance on schools and teachers, plus a cross-site synthesis of those studies.

In Year 3, a design for the case studies was formalized, written up as a paper by William Clune, and presented at a symposium on SCALE research at the 2005 Annual Meeting of the American Educational Research Association (AERA). The design called for two kinds of studies: "panoramic" studies of the impact of SCALE on district instructional guidance and "in-depth" studies of the impact of that instructional guidance on schools and teachers. At this writing, one of the panoramic studies has been completed (Madison) and three others will be completed within a few weeks. Later in Year 3, a cross-site synthesis of the findings of the four reports will be written, distilling lessons learned for district practice and the field.

In Year 4, the team will focus on completing two in-depth case studies and a cross-site synthesis of those studies. The first planned in-depth study will cover the implementation of immersion units in Los Angeles; the second will cover the implementation of the core mathematics program in Denver. Both in-depth studies will extend findings of the panoramic studies in those districts. For Los Angeles, the in-depth study will build on the part of the panoramic study detailing changes in district instructional guidance supporting implementation of the science immersion units. The in-depth study will focus on how the immersion units were adopted (and adapted) by schools and teachers. For Denver, the in-depth study will build on findings in the panoramic study about the theory of action for mathematics and its components and perceived progress at the district level. The in-depth study will investigate implementation of the theory of action by schools and teachers. Currently, the plan is to combine a survey of the degree of exposure of teachers to the elements of the Denver plan, followed by interviews and focus groups exploring variation at the school level.

Two challenges and strategic modifications are reflected in the Year 4 plan of work. The case study team began Year 3 with an approach based on service and formative feedback to districts. After extended discussion between the RET Director, Andy Porter, and William Clune, the present design for two levels of case studies was developed and adopted.

Another challenge was the growth of the immersion unit effort in LAUSD, spurred by coordination with local IHEs and the QED grant. The case study researcher for LAUSD became part of a cross-RET team studying various aspects of this effort (a Building a Partnership effort studying SCALE-district interaction, a new case study of impact on the local IHEs, and the panoramic case study all focus on changes in district instructional guidance). To help fund the

multi-part research effort, one case study researcher (Linda Scholl) was moved off the district case study team and on to the IHE impact case study.

The case study team has three benchmark reports scheduled for Year 4:

1) The in-depth studies of LAUSD and DPS;
2) The cross-district synthesis written by William Clune; and
3) The Annual Progress Report and Implementation Plan.

In addition, the case study team will produce two other types of products:

1) Periodic technical reports to the districts on findings and policy options, and
2) Periodic presentations and summaries at SCALE and NSF organized events

Building a Partnership

During Year 4, the Building a Partnership team will proceed with four sub-studies that entail continued data gathering, analysis, and reporting to SCALE leaders, and will produce and further develop research documents intended for broad external audiences.

This work is structured into four sub-studies that have been underway since May 2005. The first two sub-studies—SCALE Views, and Mapping studies—respectively pursue the two main research questions that informed our 2004 SCALE-wide Check and Reflect interviews. The second two sub-studies— the Network study and the Working Group Cross Case Study—are outgrowths of our Formative Feedback #3 Report, "Mapping the Landscape: A snapshot of SCALE at 16 months."

1. SCALE Views study. The overarching research question for this study is: How do expectations for, and understandings of, SCALE goals, strategies, processes, and outcomes vary across SCALE participants? A key sub-question is: How do participants view the impact of SCALE on both SCALE participants and others affected by SCALE within and beyond each partner organization? Data on these questions will be gathered through interviews with some 25 top-level SCALE leaders and another 35 SCALE participants randomly chosen from the SCALE participant database grouped by partner organization and level of SCALE activity. These interviews will be conducted during spring and summer 2006. Analysis of these interviews, plus material from the 2004 and 2005 interviews, meeting and event observation notes, and documents, will be presented in a December 2006 SCALE Views report.

2. Mapping study. The overarching research question for this study is: How is SCALE structured, and how does the structure change over time, to meet demands associated with K-20 systemic improvement of mathematics and science teaching and learning? Key sub-questions are: What are the groups and participants that accomplish SCALE work? What do the groups and people do within SCALE? And, To what extent do the groups work together? Data addressing these questions will be gathered during the spring and summer 2006 SCALE Views interviews. Analysis and write-up will be integrated with findings from the Network study (below).

3. Network study. The overarching research question for this study is: What are the social networks that contribute to adoption of reform-oriented, K-20 mathematics and science curriculum and development of improved mathematics and science professional development policies, and how does SCALE fit into these social networks? A key sub-question is: How, if at all, do SCALE actors and artifacts directly or indirectly influence district-level administrators' teacher professional learning design and curriculum adoption decisions? Data for this study will

be gathered in two stages. The first stage entails designing and piloting a social network survey that will then be sent to top-level directors of math and science in the SCALE districts. The second stage involves administering the network survey and short follow-up telephone interviews to the individuals identified in the survey responses provided by the directors of math and science. Data from the Network and the Mapping studies will analyzed together during fall 2006. A report presenting findings for these two studies will be provided to SCALE leaders in late fall 2006.

4. Working Group Cross Case Study. The overarching research question for this study is: How and why do multi-institutional working groups contribute to build leadership capacity for mathematics and science teaching and learning improvement? Key sub-questions are: What resources (social and financial) do multi-institutional working groups offer to group participants that were not available in existing work settings? To what extent do working groups foster individual learning, organizational learning, and change barrier reduction/removal, and what are the group dynamics associated with these outcomes? and How do SCALE organizations influence working groups and, reciprocally, how do working groups influence SCALE? This study involves a cross-case analysis of four case studies of SCALE working groups (two in 2005 and two in 2006), and study completion in 2007. Data for each case study will include meeting observations and audio-recordings, semi-structured interviews with all members of the working group, and review of relevant documents.

The team will participate in writing one or more proposals for papers to be presented at the 2006 and 2007 meetings of the American Education Research Association. More importantly, the team will develop an initial conceptualization of a book manuscript.

This reorganization into the four sub-studies emerged from findings produced during Years 2 and 3, and responds to emerging processes within the SCALE project. For example, the "Roles and Impact of SCALE "Boundary Spanners" study described in our Year 3 Implementation Plan has been replaced by what we believe is a more effective study design, the Working Group Cross Case Study.

Case Studies of Institutions of Higher Education

The SCALE Research and Evaluation Team is launching a new study to document and analyze the impact of the SCALE MSP on its participating institutions of higher education (IHEs). This Year 4 Implementation Plan therefore provides an overview of the entire study, rather than a plan of action that focuses only on Year 4 activity.

The IHE Case Studies line of work is designed to test the implicit SCALE theory of action for meeting the MSP program goals pertaining to the role of faculty and IHEs. Based on SCALE planning documents and conversations with various SCALE leaders, we infer that SCALE leaders are pursuing the following theory of action pertaining to the role of faculty and IHEs: If improvements in IHE participation in teacher preparation in mathematics and science are to be sustainable and significant, then it is necessary that (a) change take place in the ways STEM and education IHE faculty participate in teacher preparation, both as individuals and in collaboration with other faculty and with K-12 districts in teacher preparation at various organizational levels; and (b) that organizational change takes place in ways that overcome the conservative nature of IHEs as organizations.

The new study will assess: (a) whether positive and sustainable improvements are underway in the ways that STEM and education faculty and the IHEs (as organizations) provide high quality professional learning opportunities in mathematics and science to pre- and in-service K-12 teachers, and (b) whether these improvements can be attributed, at least in part, to SCALE implementation of the above-stated theory of action. Accordingly, the research questions informing this study are:

1. What factors improve the efficacy of cross-institutional partnerships involving IHEs and K-12 school districts?
2. How, if at all, and why has the SCALE project resulted in change in IHEs such that STEM and education faculty: a) better understand and meet the needs of K-12 teachers they serve, particularly in the SCALE districts; and b) participate more effectively in reciprocal systemic efforts within and beyond their institution to improve science and mathematics education at the K-graduate education level?
3. In what ways are changes in the IHEs' support for reform-oriented teaching and for alignment of pre-service, induction, and in-service curriculum and pedagogy associated with: a) changes in faculty attitudes and behaviors pertaining to collaboration across departments within individual IHEs, across IHEs, and between IHEs and K-12 districts; and b) high leverage change factors (such as leadership at faculty and larger organizational levels, new funding, and new tools, practices, and policies) that temporarily enable the organization to function in a tightly-coupled manner?

We will use the following methods to gather data about the IHEs to be studied: a) interviews with faculty and administrators, b) surveys of faculty and administrators, and c) review of relevant electronic and paper documents.

Interview component. In order to assess the depth and breadth of spread of institutional change, we will interview IHE faculty and administrators who are actively involved in SCALE-related change efforts, as well as those who have been more tangentially involved or affected in the change efforts. The interviews will explore the following topics, among others: a) teaching roles, pedagogical practices, research programs, and K-12 outreach activities, and the relationships, if any, among these; b) participation in campus and inter-organizational programs designed to prepare K-12 teachers; c) campus mission, probing for differences in formal statements and lived experience of the mission; d) alignment of campus policies and practices; e) the policies and practices of state, federal, and other external groups that impinge on the how the IHE implements its goals pertaining to the preparation of K-12 teachers; and f) insights into factors and processes that enable/hinder both short-term and sustained organizational change on campus.

Survey component. We will turn to surveys to obtain information on attitudes and beliefs about teaching and K-12 teachers, participation in activities that involve cross-campus collaboration pertaining to the preparation of teachers, and participation in activities that involve collaboration and articulation with K-12 districts. Survey responses will be sought from all STEM and education faculty and all relevant administrators on a baseline (2005) and follow-up (2007) basis.

Document review component. We will gather and analyze the following types of documents: SCALE-related Department of Education grant documents about programs involving participating faculty, relevant campus self-assessment and policy documents, and documents that describe program components, processes, and practices. These documents will provide information about changes in mathematics and science learning outcomes experienced by pre-

and in-service teachers when working with IHE education, mathematics, and science faculty, and about changes in IHE faculty knowledge of pedagogy and the needs of K-12 teachers, and their related attitudes, and behaviors.

Informal formative feedback reports will be provided on an ad hoc basis to leaders at the IHEs and to SCALE Goal leaders. Formal end-of-year case study reports will be provided to the SCALE Goal leaders. The formal reports will provide findings from the three data-gathering components about change. Findings will include information about organizational policies, practices, and tools that were instrumental in leveraging change in faculty attitudes and in the effectiveness of teacher preparation programs. A draft history of SCALE impact on each case-studied IHE will be included in the report provided at the end of 2005, and will be revised annually for inclusion in a final report at the end of 2007. A final report provided at the end of 2007 will include revised and updated versions of these studies, along with a cross-case analysis. We anticipate that this cross-case analysis will be of special value to readers interested in understanding change strategy portability.