State Mathematics and Science Curriculum Framework Development and Implementation

A Case Study Synthesis Paper

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High Plains Consortium for Mathematics and Science, Mid-Continent Regional Educational Laboratory, Denver, CO

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Midwest Consortium for Mathematics and Science Education, North Central Regional Educational Laboratory, Oakbrook, IL

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Introduction

This synthesis paper explores similarities and differences in Curriculum Framework (CF) development and implementation across 16 states and two U.S. possessions. It offers a broad array of approaches and compares contexts, resources, products, goals, and processes of CF development and implementation in the 18 cases. It is a resource to educators across the nation who are or will become involved in CF efforts.

While the focus is on mathematics and science CFs, the information is pertinent to any subject area. Since the paper offers a variety of perspectives from those who are developing and implementing CFs, it will be of interest to people across the educational spectrum—e.g., local community representatives, members of parent/teacher associations, classroom teachers, building and district administrators, regional educational service center personnel, and staff of state departments of education (SDEs).

During the initial stages of its work (see Sutton, Hoover, Larson, & Marble, 1993), the CF Task Force established the following operational definition of a CF:

> *A curriculum framework is a bridge between established standards and classroom practice. It articulates, organizes, and integrates the content and processes of education in a particular discipline. It facilitates multiple levels of policy and curriculum decision making, especially in school districts and schools.*

Just as CFs are evolving documents, the Task Force anticipates that this definition will continue to evolve.

Of the participants in this study, 14 delivered CFs or other curricular documents to the Council of Chief State School Officers (CCSSO) for analysis in *State Curriculum Frameworks in Mathematics and Science: How Are They Changing Across the States*? (Blank & Pechman, 1995). This analysis addresses three key areas: states that have or are developing CFs and what it is that they are calling a CF; the purpose, content, organization, and dissemination of the submitted documents and how they relate to other state policies; and how state CF documents address content standards and other key elements. The CCSSO study also explores "exemplary framework development" and "major issues in developing state" CFs.

The present study differs from CCSSO's *State Curriculum Frameworks* in that data were collected primarily through personal interviews rather than document analysis. While it was often necessary to examine CF documents to provide context, the focus was not on the documents themselves but on the processes involved in developing and implementing the documents. If the reader desires more information about specific CF documents of case study participants in the study, we suggest consulting the CCSSO publication.

Following a description of the research methodology used by the CF Task Force, this synthesis paper is divided into five sections:

1. the context of CF development or implementation,
2. types and origins of resources,
3. a brief description of CF products developed by the cases,
4. the goals for CF development and implementation, and
5. the processes involved in CF development and implementation.

Each section begins with **Key Ideas** from the analysis of the 18 Case Studies, and contains one or more **Vignettes** from individual case studies that present specific case stories pertinent to that section. Each section concludes with **Lessons Learned** by case study participants. These lessons were offered at the September 1995 Chicago CF Conference sponsored by the CF Task Force. An individual **Case Summary** for each state and U.S. possession in the study appears in Appendix A.

Research Methodology

In April 1992, the Laboratory Network Program and the National Network of Eisenhower Mathematics and Science Regional Consortia (both funded by the United States Department of Education's Office of Educational Research and Improvement) agreed to collaborate on a Curriculum Framework (CF) Task Force. During the first year of the three-year project, the Task Force developed the *State Curriculum Framework Analysis Tool* (Sutton et al., April 1993) and collected and analyzed state curriculum documents for common elements. The results of this study were published in *A Summary of Analyzed State Curriculum Framework* (Sutton, May 1993). While providing coordinated technical assistance to states developing, revising, or implementing CFs in mathematics and science, the Task Force became interested in the processes of development and implementation.

To understand these processes more fully, Task Force members conducted a series of case studies focusing on the following research question:

> *What processes are being used at the state, intermediate, and school levels to develop and implement state mathematics or science CFs?*

Two sets of focus questions were developed to guide the research—one concentrating on CF development (Appendix B), the other on CF implementation (Appendix C). Data collection for the case studies began in the fall of 1994 and continued through September 1995. States and U.S. possessions participating in the case studies, in alphabetical order, were Arkansas, Florida, Indiana, Louisiana, Massachusetts, Mississippi, Nebraska, New Hampshire, New Jersey, New Mexico, New York, Ohio, Pennsylvania, Puerto Rico, South Carolina, South Dakota, the Virgin Islands, and Wisconsin.

Eight Task Force members met in August 1995 to develop a synthesis of the case studies. CF development, implementation, and revision appeared to be a circular process, often with no clear distinction between development and implementation. Thus the writing team decided to prepare a single synthesis paper, merging the sets of focus questions into a single set. Complete responses to all focus questions for each case were not available for analysis.

The writing team broke into pairs and each pair drafted a section of the paper; these were subsequently compiled into a single document by the Task Force's lead laboratory, the Southwest Educational Development Laboratory. The resulting draft was discussed at a national CF conference held September 14–15, 1995, in Chicago, Illinois, that was attended by many who had contributed to the case studies. Sections were read by small discussion groups. Six members of the writing team met again in November 1995 to revise the draft. Final changes were made by the lead laboratory.

Context of CF Development and Implementation

Contextual information was gathered about each case's impetus for engaging in CF development or implementation. Focus questions addressed the political context, influence of reform efforts, and linkage to other educational endeavors.

Key Ideas

In this study, events that most strongly influenced the existence of state CF projects in mathematics and science included the following:

- national standards, especially those developed by the National Council of Teachers of Mathematics (NCTM), but also draft science standards and *Benchmarks for Science Literacy*;
- the availability of funds for mathematics and science CF development, particularly Eisenhower CF and the National Science Foundation's Statewide Systemic Initiative (SSI) funds;
- legislated mandates for either developing CFs or aligning curriculum and assessment;
- changes in classroom and state assessment approaches; and
- subject area curriculum revision cycles.

National Reforms

Current reforms focus on both what and how students learn. These efforts not only encompass the classroom but also touch on nearly all aspects of the educational system (e.g., length of class sessions and school year, changes in school management, approaches to professional development). National standards have been developed in several core subject areas, and many others are being written. The 1989 publication of *Curriculum and Evaluation Standards for School Mathematics* (generally referred to as the NCTM *Standards*) prompted some states to develop CFs. The NCTM *Standards* was frequently used as a model for CFs. In addition to the use of national standards, some states reported using CFs from other states as models.

Voluntary national standards for mathematics have been in place since 1989, and national science standards were published in 1996. Several other documents have been available in science: the National Science Teachers Association's *Scope, Sequence, and Coordination of Secondary School Science: The Content Core* (1993), the American Association for the Advancement of Science's (AAAS) *Project 2061: Science for All Americans* (1989), and AAAS's *Benchmarks for Science Literacy* (1993). The National Research Council has distributed several drafts of *National Science Education Standards* (February 1993, July 1993, and November 1994).

Funding as an Impetus

In 13 of the 18 cases (72 percent), development or implementation of mathematics and science CFs was assisted by grant money from SSIs or Eisenhower CF funds. In nine of the cases *both* of these funding sources were used. Some state or private offices also

supported CFs. For instance, the Louisiana Board of Regents committed $5 million to support the state's collaborative SSI effort; a portion of this funding was devoted to CF work. More detail is included in the Resources section.

Legislated Mandates

Of the 18 cases reviewed for this report, 7 developed CFs in response to a regulation or law (see Table 1). Arkansas' Act 236 legislated both the development and the implementation of CFs in all core content areas. In Massachusetts, a 1993 Reform Act set goals for learning and called for writing CFs in 7 areas. In New Mexico, legislation required identification of standards and criteria for mastery of student competencies. New benchmarks are being developed that identify specific expectations for classroom implementation of New Mexico's vision of educational excellence.

Table 1.

Participating Cases Whose CF Was Legislated or Mandated by Law

State	Legislated CF	State	Legislated CF
Arkansas	•	New Mexico	•
Florida		New York	
Indiana	•	Ohio	
Louisiana	•	Pennsylvania	
Massachusetts	•	Puerto Rico	•
Mississippi		South Carolina	
Nebraska		South Dakota	
New Hampshire	•	Virgin Islands	
New Jersey		Wisconsin	

In South Carolina, the elected commissioner of education wanted an update of published objectives as part of a systemic reform effort. Consequently, the South Carolina SDE is producing CFs in eight disciplines over three years. In the Virgin Islands, Law 68 and Law 18 shifted control of education to the local level and stated that education should be guided by standards. The appointed commissioner of education mandated CF development because he believed that the curriculum guides were outdated and did not reflect national standards efforts. In New York, the Board of Regents called for CF development as part of *A New Compact for Learning,* which described a rationale and vision for additional educational reform.

Assessment as an Impetus

Assessment has either driven or been linked with CF reform efforts in some of the states (e.g., Indiana, Louisiana, Mississippi, New Hampshire, Ohio, South Carolina). Legislated statewide assessment for grades 3, 6, and 10 in New Hampshire resulted in the development of a CF to guide test construction, thus linking curriculum and assessment. The Indiana legislature gave the SDE responsibility for developing and implementing both state standards and a statewide testing program. Implementation of the state-mandated CF in Mississippi is being coordinated

with the state
assessment office to maximize reform efforts. Louisiana legislation links curriculum standards and assessment, shifting the emphasis from minimum competency to grade-level expectations.

CFs have led to alternative assessments in mathematics and science in many states. For example, Arkansas schools have incorporated portfolio assessments in mathematics and in English and language arts to reflect the different kind of teaching and learning called for in the CFs. New York developed vignettes that illustrate alternative methods of assessment as part of its support for local implementation, and Nebraska added model activities and alternative assessment strategies to the
CF. Some states use the CF for school assessment as well as student assessment.
More detail is included in the Evaluation section.

Curricular Revision Cycles

Some cases (e.g., Mississippi and Indiana) developed CFs as part of a revision cycle tied to textbook adoption. In Indiana, Proficiency Guides serve as the basis for textbook selection as well as revision of the K–12 curriculum.

While some cases wanted to develop CFs in all subject areas concurrently and others wanted to develop mathematics and science CFs at the same time, standards and sources of funding have not been available for all content areas. Though many states have developed only mathematics and science CFs, they plan to use them as models for other disciplines. The case studies uncovered no evidence that mathematics and science CFs have been greatly influenced by CFs in other disciplines.

Precursors

Most current CFs were preceded by a curriculum guide, state syllabus, or proficiency or competency document. For example, since the mid-1980s, Wisconsin curriculum guides for all subject areas have closely resembled CFs. In another state, however, a teacher described the precursor as a "content dictionary, a book that never left the shelf and had very little to do with what was actually being taught." Sometimes the states provided alternatives to curriculum documents. For example, in Nebraska, the SDE provided client-centered and student-focused consultations to districts to assist them in their mathematics curriculum review.

VIGNETTE

Ohio's Competency-Based Science Program

Context for CF Development

In 1995, Ohio legislation required all school districts to prescribe a curriculum that would be approved by the state board of education. This gave the SDE responsibility for developing competency-based models. For three years, Ohio SDE staff members wrote framework drafts, circulated them to thousands of Ohio science educators from all parts of the state and at all levels for comments, then incorporated revisions in a final document published in October 1994. Most of the early design work relied heavily on Project 2061 documents for both substance and philosophy.

Context for CF Implementation

The 1995 legislation required districts to use the SDE developed models as the basis for designing their curriculum. If a district curriculum is reasonably comparable to the model, the state will approve the district's proposed curriculum. The intent of this legislation is to preserve local control over the curriculum while ensuring reasonable agreement with state-approved models.

Vignette 1. Ohio's Competency-Based Science Program

Many districts have their own curriculum guides for the various disciplines, but often teachers do not use them. A teacher in one state found that very little follow-up or training accompanied curriculum documents, so they had little effect on classroom curriculum. She went on to note that changes "have been more directed by what particular textbook has been selected by the school."

In most cases, the new CF documents are less comprehensive and more broad-based than previous documents, which were often in the form of checklists of what students should know. Newer documents may include sections on vision, teaching strategies, learning theory, equity, alignment or integration, assessment, resources, current research, and the infusion of technology. These new CFs allow districts latitude in developing curriculum guides; however, new curricula are to be aligned with state guidelines. One reader of the mathematics CF in South Carolina described the framework as follows: "It does not contain the specific, detailed curriculum that is actually taught in each school. Rather, it sets out broad curricular themes, topics, and objectives in multi-year blocks."

Lessons Learned

- Education reformers, policymakers, and the public have conflicting opinions regarding what is meant by "reforming public education" and "standards."
- Reform efforts without mandated time lines allow for extensive stakeholder involvement and the development of support networks.
- Political buy-in has to exist throughout the whole process.

The Lessons Learned (provided by case study participants) indicate that factors other than those initially targeted by case study questions influence the contextual setting for CF development and implementation. While legislative action influences the processes, participants express concern about the language used in such mandates, especially the different interpretations of terminology by legislators, educators, and the general community. All stakeholders need time to reach consensus on the meaning of terminology and to establish agreed-upon expectations if a CF effort is to provide a useful product and be successful.

Legislation, funding constraints, or other external factors set time lines for CF efforts that may not allow for the kind of product or level of implementation that is hoped for. Efforts are more likely to succeed if ample time is provided to gain support of a wide range of constituents.

Continuing political buy-in strongly influences CF development and implementation. Even with minimal public support, a legislated CF effort is likely to be completed. On the other hand, even with ample funding and strong public support, a CF effort may be eliminated by the actions of a single public official.

Resources

Issues in this section pertain to funding amounts and sources, support of human resources, and use of printed and electronic materials. Also of concern are the types of support or opposition received from existing local, state, or national efforts or organizations.

Key Ideas

In this study, the data collected support the following general observations:

- The availability of funds (particularly Eisenhower CF and NSF SSI funds) for developing mathematics and science CFs influenced a state's involvement in CF efforts.
- Whenever possible, funds from federal, state, and local sources were combined to enhance the impact of any single source.
- SDE commitment of funding and personnel resources to the CF effort varied greatly among the cases.
- In some cases, legislative mandates included state-funded resources for staff, training, or CF development.
- In most cases, a support cadre provided focused training to a limited number of persons who would eventually become leaders in CF development or implementation.

Funding Sources

Sources of funding for the development of CFs included state funds, competitive CF grants to states from the Eisenhower Mathematics and Science Program (U.S. Department of Education), state funds under the Eisenhower program, and other sources (CCSSO, 1995). Of the cases in this study, half (9) received Eisenhower CF grants. Eight of these also received NSF SSI funds and devoted a portion of them to development or implementation of CFs. Only five cases (Indiana, Mississippi, New Hampshire, Pennsylvania, and the Virgin Islands) did not have external federal funding for CFs. For some of these, the only funding came from local districts in the form of teacher release time, workshops, and after-school training.

States with minimal CF funds were generally funded by a single source. South Dakota, for example, only received funds from an SSI grant. SSI staff members initiated and conducted CF development in the state. Because the South Dakota SSI supports individual site plans rather than employing a statewide approach, CF implementation by SSI staff primarily impacted SSI sites.

Across the cases, most available funds were spent on CF development, with a limited amount allocated to implementation efforts. States relying solely on federal money may have no funding for continued implementation or subsequent revisions after that money is exhausted. Lack of funds in some states has restricted professional development to support CF implementation.

Table 2 lists primary CF funding sources. While Eisenhower and SSI money has been the main source of funding, these grants may not be the only funds devoted to CF efforts. For

instance, only a portion of Louisiana SSI funds has been directly devoted to CF development; however, a large portion of the state's SSI funds has supported professional development, thus contributing to increased CF awareness. Information on dollar amounts spent by each state was not available.

Table 2.

Funding Sources for Cases

State	National Science Foundation SSI Grant	National Eisenhower CF Grant	SDE (may include state Eisenhower dollars)	Other sources
Arkansas	•	•	•	SDHE,* private
Florida	•	•	•	Consortia
Indiana			•	Local districts, REL*
Louisiana	•	•	•	
Massachusetts	•	•	•	Private foundation
Mississippi			•	Consortia, local districts
Nebraska	•	•	•	Local districts
New Hampshire			•	
New Jersey	•	•	•	REL
New Mexico	•		•	
New York	•	•	•	
Ohio	•			USI*
Pennsylvania			•	REL
Puerto Rico	•		•	Goals 2000
South Carolina	•	•	•	
South Dakota	•			
Virgin Islands			•	
Wisconsin		•		
Totals	**12**	**9**	**15**	**10**

*SDHE—State Department of Higher Education; REL—Regional Educational Laboratory; USI—Urban Systemic Initiative

VIGNETTE

Louisiana's Leverage of Resources

In 1991 the state of Louisiana was awarded a five-year NSF SSI grant ($10 million) to establish the Louisiana Systemic Initiatives Program (LaSIP). In support of this effort, the state Board of Regents and the Board of Elementary and Secondary Education each contributed $5 million as matching funds for the NSF award. LaSIP projects have generated add-on money (more than $1 million) from universities, school systems, and the private sector. The Louisiana Collaborative for Excellence in the Preparation of Teachers (LaCEPT) was also funded by both an NSF grant ($4 million) and state funds ($2.5 million from the Board of Regents). In 1993 the state was awarded a three-year Eisenhower CF grant. Connections among these efforts have collectively enhanced support of the CFs throughout the state.

There has been "unprecedented cooperation among the various partners in educational reform within Louisiana. Groups are not simply giving 'lip service' to collaboration, but actually coming together to discuss common needs and possible solutions to problems" (Palmer & Clark, March 1995).

Vignette 2. Louisiana's Leverage of Resources

Major Players

Many states relied heavily on the time and talent of educators and other stakeholders to develop and implement CFs. An analysis of the individual case studies indicates the following categories of participants: school leaders; state boards of education; legislatures; SSI principal investigators, directors, and staff; SDE curriculum and assessment supervisors and directors of instruction; teachers; curriculum consultants; local mathematics and science supervisors; citizens; higher education personnel; business and professional leaders; writers; school administrators; parents; service providers (e.g., intermediate education agencies); and informal science educators.

States are also major players. States that followed a top-down approach were generally working in response to mandates, regulations, or laws. In states with a top-down approach, the SDE's and/or SSI's participation ranged from the identification and approval of all team members to establishment of procedures for CF development.

In many of the cases in this study, people at the state level have multiple job assignments, and CFs are often put on the back burner. In one state, for instance, it was noted that, "some of the leadership people are very involved in a large number of activities and the development of a CF was never completed" (Frederickson & Magelky, 1995).

Staffing has been a problem in some states. Low salaries have hampered both hiring and retaining staff. While Arkansas had enough CF grant money to hire three staff members to work on mathematics and science CF implementation, the pool of applicants was so small that only two of the positions were filled. New Hampshire's CF staff was reduced to generalists with a work scope that divided their attention over many content areas. Additionally, all the CF positions were funded with soft money and did not offer long-term security.

VIGNETTE

New Hampshire's Reliance on Volunteers

In order to inform construction of a new test for assessment of students in grades 3, 6, and 10, mandated by the New Hampshire legislature, many dedicated individuals (local citizens, educators, and reform leaders) volunteered to develop a CF that would describe what students need to know and be able to do. Funds available to produce the CF came from the state budget and from the Regional Alliance for Mathematics and Science Education Reform (a regional Eisenhower Consortium). Dependence on volunteers and a small SDE staff slowed the development process. The project hired one outside reviewer. State and district Eisenhower funds were used to provide staff development, although implementation of the CF is voluntary.

Vignette 3. New Hampshire's Reliance on Volunteers

Expertise of Development or Writing Team

States used different criteria for defining CF development expertise. Few states sought out-of-state consultants; most tried to involve a cross-section of grade-level experience. Some members of writing teams had worked on previous state or district curriculum guides, but most team members had either limited or no experience with CFs. Some states included exemplary teachers on the teams. In Nebraska, experience at the state level (e.g., professional association work) was considered an indicator of expertise. A wealth of practical experience was a criterion cited by South Carolina.

Support or Opposition

Most states reported little opposition to the CF effort or documents. Some states solicited input from a wide variety of organizations, thus ensuring that opposition would not be a hindrance.

A unique situation arose in the development of an integrated math and science CF in Massachusetts. While reviewing a draft of the CF, a group of technology educators thought that technology was slighted and that it was misrepresented when it was mentioned. After lobbying by this group, the SDE intervened in the writing group's efforts and made significant changes to the CF, describing technology as a distinct and critical discipline integrated with math and science. This compromise affected implementation of the framework. Some of the original developers and writers are now dissatisfied with the description of one or both of the disciplines (science and technology), while other members of the writing team have lost ownership in the document.

A teacher in Nebraska found that while there was little opposition to the CFs, overcoming apathy was a challenge. She stressed the importance of informing parents before CFs were implemented. Similarly, a Wisconsin teacher encountered no significant negative reaction to the CF but voiced a different concern: the mismatch between available textbooks and an integrated district framework based on the CF.

State professional associations were often involved in developing and implementing CFs. These organizations have access—through newsletters, conferences, professional development workshops, and general membership—to large numbers of mathematics and science educators. In many cases, CF documents would have had difficulty winning local acceptance without the educators' support. For example, the Mississippi State Science Teachers Association's annual convention selected implementation of the state's science framework as its theme. Sessions provided information about the CF and how to implement it.

Lessons Learned

- Time is critical to CF development and implementation.
- The donation of time and effort by dedicated constituents provides vital support.
- Funding may be the determining factor for CF development and implementation.

In the first section of this paper, time was cited as a factor that legislative constraints imposed on CF development and implementation. Time is also a resource issue. CF case study participants agree that it always takes *much* longer to do CF-related work than was allowed. As one informant noted, "Three times more time needs to be spent on building awareness than you thought" (Bassett in Palmer & Powell, 1995).

Inflexible time constraints make it difficult to create a good product, regardless of how much money is involved. Many participants in this study reported valuable voluntary contributions of time and energy by teachers, SDE staff, SSI staff, and others. Conversely, a few projects were hampered because leaders were unable to provide the direction needed to develop or implement the CF because of their involvement in other competing projects—a linked time and resource issue.

The availability of funds directly affects the quantity and quality of CF work. Some states mandated the development (or implementation) of a CF, yet allotted few or no funds to support the effort. Adequate funding allows the inclusion of a broad range of perspectives in the development process and is absolutely critical in the implementation phase when district representatives and classroom teachers develop local curricula based on the CF.

Variations in state resource allocation may be a function of factors not addressed by this study. Political climate, level of state control, and the history of support for education in a state seem to be important factors in determining the approach taken and the resources available for CF development and implementation.

Products

We report product information here to shed light on the *processes* of CF development and implementation, not on the products themselves. A detailed treatment of mathematics and science CF products is found in the Laboratory Network Program's *A Summary of Analyzed State Curriculum Frameworks* (Sutton, 1993). For a comprehensive study of CF documents as of August 1994, see Blank and Pechman, *State Curriculum Frameworks in Mathematics and Science: How Are They Changing Across the States?* (1995). Key areas of interest in this section include formating, integration of subject areas, alignment with national and state reform efforts, and the degree to which implementation is addressed.

Key Ideas

A survey of products developed in the 18 case studies resulted in the following observations:

- Most CF documents attempt to align with national or state standards and with assessment. Some are also intended to align with teacher licensure, textbook selection, or other state reform efforts.
- While some states have developed integrated CFs (e.g., mathematics and science or mathematics, science, and technology), most CFs address a single content area, regardless of whether a state produces only one or a series of CFs.
- The format of CF products varies widely and may include printed materials, electronic versions (diskette or CD-ROM), or videotapes.
- In general, states having no outside funding developed fewer products and provided schools and districts with less support in implementing the CF than did states/entities having federal monies.
- Multiple resources are often produced to assist CF implementation (e.g., teacher handbooks, sample lessons, videotapes, brochures).

Format

Although this report refers to the various documents used in this study as CFs, often they are not labeled that way. The documents originated in efforts to create curriculum standards (New Jersey and New York), curriculum guides (Arkansas), integrated curricula (Wisconsin), competency-based guides (Florida and Ohio), or in response to mandates for grade-level testing or assessment (Indiana and New Hampshire).
As development proceeded and the concept of frameworks became more common, the products were often described as CFs.

Of the 18 cases, only Wisconsin did not produce a print document as its primary information source (see vignette 4 about CF on CD-ROM). Four other states have produced or intend to produce diskettes or electronic versions of their CFs to be used as templates to allow local districts to develop and distribute portions of the document to distinct audiences. Revision plans for the Virgin Islands CF include greater inclusion of technology and availability on diskette.

Thirteen of the 18 cases produced multiple documents, usually a CF with supporting materials. Of the 5 that produced a single document (Mississippi, New Jersey, Pennsylvania, South Dakota, and the Virgin Islands), 3 (Mississippi, Pennsylvania, and the Virgin Islands) had no federal funds to support their CF development efforts.

Massachusetts provides a printed analysis tool to measure compliance with the state's CF. Florida developed two separate resources to support implementation of the CF. One is a description of suggested approaches to professional development, curriculum development, school-community relations, resources, and evaluation. The second, a curriculum-planning tool, is a software package used to facilitate the design of science programs that align with state documents and programs.

VIGNETTE

Curriculum Framework on CD-ROM

From its inception, the Frameworks in Science and Mathematics (FISM) Project in Wisconsin was designed to promote local involvement in school reform. The product, *Changing Perspectives,* presents a logical planning context for systemic reform.
It is a resource designed to provide a philosophical context for systemic reform of mathematics and science programs. Users can search the CD-ROM to locate relevant research (e.g., information on systemic change), standards, learning goals, alternative assessment strategies, and strategies for organizational development. It leads users through a consensus-building process about issues important to the design and development of curriculum, such as equity and diversity, learning theory, strategies for community involvement, and effective classroom learning environments. It does not, however, provide answers or give specific directives on what the decisions should be.

In addition to the CD-ROM, *Changing Perspectives* includes a resource manual, videotapes, audiotapes in five languages, and reference materials. A unique aspect
is a series of "grappling papers" that learning communities can use as they plan and implement change. None of the components is intended to be used alone. This resource is accessible to all members of the community who are concerned with education. Its application goes far beyond the creation of a printed CF document, and the plan is to generalize it for use outside Wisconsin.

Vignette 4. Curriculum Framework on CD-ROM

Integration of Subject Areas

Wisconsin's integrated mathematics and science CF urges the user to present learning as a coherent whole, rather than a fragmented set of isolated school subjects. In developing its science CF, Mississippi formed strand teams to monitor each specific content area for development of a cohesive scope, sequence, and coordination of concepts throughout a student's 13-year public school experience. Massachusetts solved the integration problem by using identical chapters in each of the seven
subject-area CFs developed in the state, making them distinguishable only by the insertion of

subject-area content chapters. Florida included in its CF document a chapter that addresses pertinent questions: Why should subjects be integrated with other subjects? What kinds of connections are possible? What do connected units look like? How do you make connections?

For each case, Table 3 indicates whether the CF addresses single subjects or multiple subjects (e.g., integrated mathematics and science or integrated core subject areas). Of the 18 states and possessions participating in the case study, 12 developed single-subject CFs (8 math only and 4 science only), while the remaining 6 developed integrated CFs (3 math and science and 3 math, science, and technology).

Table 3.

Case Study CF Development: Subject Areas

State	CF Subject Areas			
	Math	Science	Integrated	Other
Arkansas	•	•		All core content areas
Florida	•	•		Computer
Indiana	•			
Louisiana	•	•		
Massachusetts			Mathematics, science, technology	4 subjects
Mississippi	•			Social studies
Nebraska			Mathematics, science	
New Hampshire	•	•		
New Jersey	•			7 subjects
New Mexico	•	•		11 subjects
New York			Mathematics, science	
Ohio		•		
Pennsylvania	•			
Puerto Rico	•	•	Mathematics, science	
South Carolina	•			2 subjects
South Dakota	•		Integrated	
Virgin Islands	•	•		Language
Wisconsin			Mathematics, science	

CF Document Alignment

CF authors acknowledged alignment with national and state standards, assessment, district accountability, teacher certification or licensure, and other reform efforts.

Standards alignment

In developing CFs, some cases relied primarily on existing or emerging national mathematics and science standards. Others relied on a broader collection of resources, including other state CFs and such publications as *Everybody Counts* (Mathematics Science Education Board, 1989) and *Using Curriculum Frameworks for Systemic Reform* (Curry & Temple, 1992).

Sometimes state standards, learner goals, or learner outcomes are part of the CF document. In other cases, they are separate documents (either published or in progress). The CF usually refers to them or says that both the state standards and the CF should be considered when designing curriculum. For instance, the Wisconsin CF helps local schools to link their goals and objectives to state learner goals.

Alignment with assessment and accountability

Most CFs in the study are aligned with assessment, usually in one of three ways: (1) the extent to which the CF addresses classroom assessment strategies and techniques and how one integrates them into the curriculum; (2) the connection between the CF and the state student assessment system; or (3) the extent to which the district or state holds curriculum developers accountable for implementing the CF.

Although assessment is addressed in all 18 case studies, documents to support the classroom use of *alternative* assessments have been developed by only 5—Arkansas, Louisiana, Nebraska, New Hampshire, and New York. A training-of-trainers model in Arkansas provides training in delivering professional development about performance assessment (tasks, projects, and portfolios) to teacher-trainers, administrators, and other instructional leaders from schools and regional service cooperatives. A manual accompanies the training. In New York, products for use in local training include detailed vignettes, videotapes, and alternative methods of assessment. Plans for CF revision include exemplary models of mathematics activities that use both standards and assessment strategies. Louisiana has incorporated a model for integrating curriculum and assessment into its CF. The model includes sample lessons with associated performance tasks and scoring guides for different grade levels.

Most CFs include performance or proficiency criteria that focus on what students should be able to do as well as on what content they should learn. Indiana developed a CF-supporting document that specifically addresses aligning student assessment with the CF. Florida's CF document includes section questions to guide classroom evaluation. For example, the reader is asked about the evaluation process, methods for making improvements, the implementation process, and next steps.

While several states have included more performance-based items in their state student assessment programs, Arkansas and Louisiana are using the CF as a basis for changing their entire state assessment systems. Louisiana included a representative from the SDE assessment division on the CF development team to both inform and be informed. Teacher handbooks accompanying the CF correlate statewide student learner outcomes to assessment. Long-range plans include incorporating mathematics performance items on the statewide assessment two years after completion of the mathematics CF. Arkansas made more formal links between student assessment and the CF in its Goals 2000 plan. State officials believe that realignment of

the state's testing program with the CF will ultimately drive CF implementation.

At least five states (Florida, Indiana, New Hampshire, Mississippi, and South Carolina) use a statewide, high-stakes, accountability-driven system of interval testing across several subject areas to connect the CFs and statewide assessment. Their CFs are designed to match the tests' sequence and complexity of concepts and content. In South Carolina the state test may be used to define performance criteria at specific grade levels in mathematics. Performance benchmarks are consistent with those
suggested in the NCTM *Standards* and are closely tied to its content and sequence.

About half of the state CFs clearly emphasized classroom assessment in conjunction with CF development and implementation and the importance of integrating learning assessment in classroom instruction. In New Mexico, New York, and Wisconsin, assessment was explicitly intended to be aligned with instruction and curriculum through the use of performance testing with alternative formats and strategies. In these states, mandatory accountability testing seemed to be of secondary concern.

Indiana, Massachusetts, and Mississippi have made direct links between the state accountability system and the CF. For instance, in Massachusetts, all schools are held accountable for aligning curriculum with the CF. If they fail to do so, they risk losing their accreditation. An analysis tool was developed that includes criteria for evaluating mathematics, science, and technology curriculum and programs, and this tool is to be used by schools and districts to measure compliance of existing programs to the state CF. In Florida, schools are urged, but not required, to align with the CF.
If they neglect to do so, they may be offered technical assistance.

Other areas of alignment.

Arkansas and Nebraska are working on subject area licensure that is consistent with the CFs. Massachusetts has announced that both teacher certification and recertification will require knowledge of the CFs. Florida stresses aligning science programs with other state efforts and the CF and encourages the use of a curriculum-planning tool to facilitate this alignment. In addition, some states attempt to guide textbook selection by requiring new adoptions to be aligned with the CFs, but this requirement is not always clearly stated.

CF Documents Addressing Implementation

Two-thirds of the case study subjects created additional resources to help users implement the CF in districts and classrooms. The resources include supplementary printed materials and services. In eight of the cases (Arkansas, Florida, Massachusetts, New Mexico, Ohio, Puerto Rico, South Carolina, and Wisconsin), supplemental services assist in translating the state CF into district curricula
consistent with the CF. These support services include leadership training for instructional leaders, curriculum support personnel, and regional or intermediate service providers.

Several cases produced documents aimed directly at teacher implementation or included components for use with teachers. In Louisiana, a teachers' manual contains student objectives, sample lessons with performance tasks and scoring guide, a section on problem solving in the mathematics classroom, and
large-scale assessment samples. In New Hampshire, a document for teachers contains grade-by-grade strategies, teaching episodes, relevant instructional resources, and information about constructivism, mathematics reform, and assessment.

CFs from Arkansas, Massachusetts, and New Mexico directly address classroom implementation. The Massachusetts CF includes an implementation program that identifies, showcases, and supports the implementation of substantial multiyear curricula supporting the CF. Arkansas provides training for leaders to guide CF implementation. The New Mexico Competency Framework is intended to be used by teachers in their classrooms.

Other Product Information

Rather than indicating specific objectives for each grade, most CFs cluster content objectives by multiple grade levels (e.g., K–5, 6–8, 9–12). CFs that arose from grassroots efforts tend to have broad content objectives that allow a district or teacher maximum flexibility in designing instruction to meet the objective, while CF efforts that were more centrally controlled resulted in very specific content objectives.

Lessons Learned

- A CF is a guide that allows schools or districts to construct locally based curriculum.
- High-quality mathematics and science instruction can be offered in many ways; it is important to allow flexibility in curriculum design and delivery.
- CF documents need a common vocabulary and consistent terminology.
- CFs must be aligned with assessment programs if teachers and other educators are to support them.
- CFs are more likely to be implemented if products are developed that help educators do their job.

In some instances, CF participants questioned whether or not the documents they produced (or were producing) were, in fact, CFs. In other instances, the curricular document was never intended to stand alone as a CF. For example, in addition to a state competency framework, New Mexico has a student-centered policy framework for systemwide educational change, has student "Standards for Excellence," and is currently developing content standards and benchmarks for mathematics and science. Others have chosen to include state standards, student expectations, and information about systemic change in a single CF document.

The decision to produce single-subject-area CFs, one or more multisubject-area CFs, or CFs integrating two or more subject areas was addressed differently in various cases. There was a difference in interpretation across states of what an "integrated" CF looks like. Approaches ranged from complete integration of content and process standards or objectives for two or more subject areas to single documents with a few pages or a chapter addressing standards or objectives for each subject area to be "integrated." This issue of negotiating terminology will appear again in the Process section.

The importance of involving all stakeholders continuously in the development

of the CF was affirmed repeatedly by participants:

> *There is often a disconnect among educational reformers, policy makers, and the public regarding what is meant by reforming public education. Although almost everyone agrees [it is important] to raise standards, there is not agreement about what the standards mean* (Zapantis & Bonderew in Palmer & Powell, 1995).

Aligning CFs with standards and assessment was repeatedly stressed in the case studies. States advocate alignment with national standards and acknowledge the importance of using alternative ways of assessing students. There is some consensus among case study participants that CFs will not be implemented by teachers unless there is the direct link between approaches and content called for in the CF and the statewide assessment instrument employed. Some states are also aligning other
educational areas (e.g., teacher certification, textbook adoption, preservice and inservice) with the CF.

States frequently found it necessary to develop additional products in order to
support CF implementation. Some produced specific materials (e.g., teacher handbooks, benchmarks, sample lesson plans, or alternative approaches to assessment) to help teachers translate the CF into classroom curriculum. Others focused on public engagement, and developed brochures, newsletters, or videotapes to inform the public.

While some participants considered developing electronic versions of CF
documents to be essential in facilitating implementation, a Florida SDE staff member expressed caution. Even though diskettes containing the Florida CF were sent to all districts, the SDE had to follow up the effort with printed copies, since many districts lacked sufficient technology (hardware, software, or both) to use the electronic CF.

Goals and Expected Outcomes

Goals and outcome statements provide a foundation for CF development and implementation. Topics addressed in such statements include systemic reform, alignment with other components of the educational system, and changes in instructional delivery.

Key Ideas

- CF goals and outcomes are linked to those identified by national groups attempting to shape systemic reform of science and mathematics education.
- While the majority of CFs were developed to elevate standards, they are also used to guide local school reform and to assist with developing local curriculum.
- Regardless of the history of state involvement in defining school curriculum, every case describes a role for the state.
- Alignment of curriculum and of components of the educational system are seen as important outcomes of CF development and implementation.
- The CF and statewide assessment are assumed to be related, either explicitly or implicitly.
- In most cases, connections between expectations for classroom assessment and the CF are not clearly defined.
- Opportunity to learn and improved achievement levels for all students were cited as reasons for development and implementation of CFs in almost all cases.
- An instructional approach consistent with the CF was clearly stated as a goal or outcome in most CFs.

Systemic Approach

CF goals and intended outcomes address the need for a systemic and comprehensive approach to reform. They are generally seen as part of an extensive effort that results in improved learning opportunities for students. Some cases view the CF as a policy document for systemic reform and a motivation of grassroots activities. In New Jersey, the CF provides policymakers, instructional leaders, teachers, and community members with the support, definition, and direction necessary to reconstruct mathematics education. A New Mexico teacher said the CF should result in a whole new way of looking at science.

Some CF goals mentioned the relation of the CF to other statewide initiatives. In several states with federal systemic initiatives (Louisiana, Massachusetts, New Mexico, and Ohio), the goals lay out a plan to coordinate activity across educational arenas. Collaboration with urban and rural systemic initiatives was not specifically mentioned in any of the cases reviewed.

Alignment of the Educational System

Five states (Indiana, Louisiana, Mississippi, Ohio, and Wisconsin) mentioned modification of teacher certification standards and enhanced professional development in the goals and intended outcomes. The relation between textbook selection and CF development was included in the goals and outcomes for three states (Florida, Indiana, and Nebraska).

Most of the goals and intended outcomes explicitly require alignment of content and process outcomes in local CFs. Whether the CF contains broad descriptions of content or detailed, grade-level-specific content, such alignment is clearly expected. For example, the Puerto Rico CF outlines general content and skills that all students are expected to achieve by the end of their schooling. The New York CF is a bridge between content standards (national) and curriculum; it describes principles, topics, and modes of inquiry in specific areas. The Mississippi CF is a structural base from which districts can develop an instructional delivery model that integrates curriculum, assessment, and instruction. Nearly all cases connected assessment of learning and the CF in their goals and outcomes.

VIGNETTE

Definition of Higher Standards in South Carolina

In response to the new Commissioner of Education's commitment to improving education for South Carolina's children, a Curriculum Congress, a statewide group of teachers, parents, business leaders, and other interested citizens, took on the task of defining, "What do we want children to know and be able to do." The answers to this question were articulated through a CF process.

The CF assumes that all students can learn at a high level. State resources and programs are redirected through the CF, which presents a shared vision of instructional excellence and paints content in broad strokes that describe what each student should accomplish. The CF also calls for broad-based mathematical power and literacy for all students, who should be able to use mathematics to solve real-world problems.

Vignette 5. Definition of Higher Standards in South Carolina

Changed Instructional Delivery

All CFs were written in expectation of a unified instructional structure and improved student achievement in mathematics and science. The framework provides higher standards and the means for helping students achieve those standards.

Some states indicated that the CF should foster a shift in the way subjects are taught. Terms like "constructivist approach" (New York), "student-centered" (Virgin Islands), "competency-based" (Ohio), "authentic experience-based" (Nebraska), and "multi-age grouping, thematic, essential" (New Mexico) describe the intended philosophical basis for curriculum and instruction.

Related to improved student outcomes and grassroots policymaking, many CFs expect a

revival of opportunities for professional development. In the Virgin Islands, professional development activities from an NSF teacher-enhancement grant have been tied to the CF at grades K–6. In some cases with SSI grants (Arkansas, New Jersey, Puerto Rico, and New Mexico), SSI and the CF groups cooperate on professional development.

School Governance

The level of detail concerning goals and intended outcomes in the case studies varied greatly. In some, goals and intended outcomes were inferred from statements of purpose or a vision statement. The national movement toward local control of education may help explain a lack of specificity in goals and outcomes in CF documents.

When material is developed at the state level and influenced by national movements, local acceptance may present challenges. Funding the changes in instruction, materials, and assessment becomes an important factor in implementation. For states only now moving toward greater local control, the CF may become a vehicle for sorting out the relative roles and responsibilities of districts from those of the state.

Expectations for the use of CFs vary according to the level of local control. The Ohio CF is a model, and local schools determine whether to use it and how. In Arkansas, copies of the CF were sent to all school districts as a model for developing curriculum guides. In New Hampshire and Indiana, the CFs support a legislative assessment mandate.

Lessons Learned

- Goals must be clearly articulated and communicated to all constituents and at all stages of the process.
- All stakeholders must be included during development of a CF to assure consideration of all viewpoints.
- CFs have limitations in their ability to address all issues and solve all problems.
- Development and implementation of a CF is a time-intensive process and generally requires more time than anticipated.

The extent to which a CF document explicitly states goals or expected outcomes has implications for the processes followed both in developing the CF and in implementing it. Although there may be a shared vision of the CF as a document to stimulate systemic reform, to elevate standards, to align curriculum with other educational areas, or to boost student achievement levels, there may be wide variation in how people see that happening. Explicit goals can help to clarify and define the vision, providing direction for their realization. For instance, states with CFs directly tied to state accountability systems will have goals that more clearly affect the state testing program than states that focus on instructional pedagogy.

When developing goals, it is important to consider the end users of the CF. Case study participants recommend that representatives of each target constituency participate in the initial dialogue and be involved in the CF process from the beginning. Research on the change process indicates that people pass through successive stages before fully internalizing new concepts. Being aware of and supporting concerns of implementors will facilitate successful implementation of the CF. Change takes time and support.

Process

This section deals with approaches used in developing and implementing CFs, support of the effort, equity concerns, professional development plans and approaches, and evaluation of the project and products.

Key Ideas

- Each state, regardless of its role in CF work, attempted in a variety of ways to generate some form of grassroots support for the effort.
- While CF development activities generally came from SDEs, SSI sites have often led implementation efforts.
- Programs that attempted to identify potential opposition to CFs and to engage opposition groups in the CF process from the start were able to reduce the organized opposition.
- A training-of-trainers model involving large numbers of persons was the primary mode of developing leaders for the CF effort.
- Technology frequently provides access and resources in place of, or in addition to, traditional dissemination methods.
- Equity issues arise and opportunities exist for consensus building during CF development and implementation.
- The outcomes of developing CFs have been as varied as the origins of the need and the means by which the state and local organizations have developed and implemented their versions of a CF.

Approaches to CF Development and Implementation

Approaches to developing CFs in this study varied. Some were clearly top-down in that the legislature or a state agency (usually a state board of education) mandated the creation of a CF and then directed and controlled the process centrally. Puerto Rico's experience provides an example of this approach. The opposite end of the continuum might be termed a grassroots approach, in which interested people originated the process and, although they may have received some support from the state, directed and controlled it. Nebraska and Wisconsin are examples of the grassroots approach.

Most states fall somewhere between these extremes—states provide clear direction and support, but broad-based representative groups do much of the writing, piloting, and refining of the outcomes through intermediate agencies and local schools. Such projects usually incorporate related programs, such as SSIs. Arkansas followed such a modified approach.

In nearly all the cases studied, planning or writing teams and advisory groups based their efforts on the various national standards that had been or were being developed. Those that received money from such sources as the Eisenhower CF grant or the NSF SSI grant often reflected these agencies' expectations. SSIs (e.g., in Arkansas, Nebraska, New Jersey, New Mexico, and Puerto Rico) frequently found ways to enhance the SSI goals of staff development and public awareness in CF projects.

Development of an Implementation Plan in

VIGNETTE

Florida Districts

In each Florida district, school leaders designed the implementation process. In the Space Coast School District, teachers

- examined materials, strategies, and activities they had used successfully as they taught science,
- studied current learning theory research to gain an understanding of the relation between their successes and what is known about the way students learn,
- compared their successes with Project 2061 materials,
- learned more about assessment to see if they were really testing important things in ways that made sense,
- examined the state CF in the context of all they had learned, and
- created and implemented their own science program.

Through all of this, they had ongoing discussions about the roles of different stakeholders. Communication channels were established to ensure that everyone understood why the science program was changing and the role that they each would play. Early on, potential blockers were identified (even a board of education member), and special efforts were made to bring them along.

By the year 2000, every student in the graduating class will have had the benefit of high-level science learning every school year. Textbooks will no longer drive the curriculum, and teachers will be using hands-on activities that engage students. These positive changes are anticipated to result from CF implementation.

Vignette 6. Development of an Implementation Plan in Florida Districts

CF Support

Financial support

Not all support for development and implementation of CFs is financial, although that is essential for success. Financial support seems to take two specific forms. The first is funding from SDEs, although it is difficult to discern how much of that is in direct contributions and how much is indirect. For example, in Wisconsin the project director is on the staff of the SDE and in Puerto Rico, SDE staff members provide CF assistance as part of their duties.

Another major source of financial support is the U.S. Department of Education's three-year Eisenhower CF grants. CF efforts interact with other funded programs and agencies in many states. In particular, the SSI program plays a part in Arkansas, Florida, New Jersey, New Mexico, Ohio (only a minor part, but with potential for more), and Puerto Rico. In New Mexico, the U.S. Department of Energy's Laboratories have supported professional development, as has the New Mexico RE:learning project.

Nonfinancial support: Grassroots or top-down

Although *development* of a CF was often a top-down decision, grassroots efforts frequently directed *implementation*. SDEs had major responsibility for developing and implementing a state's CF; implementation, however, was frequently seen as the prerogative of

schools or districts through the development and utilization of local curriculum aligned with a state CF.

In roughly two-thirds of the cases, CF development was directed by the state. For example, in Massachusetts the CF was mandated but was written by teams of teachers, business members, and science and mathematics leaders. In South Carolina, an appointed writing team of teachers began with only state-published objectives and SDE staff facilitated writing-team meetings. The intention was to

produce a document that had input from a broad base of individuals; the work, writing, revising, and reviewing were all seen as grassroots efforts. Although Nebraska's CF effort was initiated by the SDE's application for a CF grant,

development of the document was a grassroots effort; implementation is ultimately the responsibility of the classroom teacher, with support provided by the SDE.

The Louisiana SDE directed workshops and led panels that developed the CF. Additionally, it selected 20-member teams (teachers, administrators, supervisors, and higher education professors) who developed performance benchmarks (state standards). The New York CFs were developed by the SDE. The perception that a mandate was being imposed by the state was avoided, however, by soliciting responses from a wide range of professional organizations and including them in the CF revisions.

While CF development activities generally came from SDEs, SSI sites have often assumed responsibility for implementing the CFs. In some cases, the SSI directed pilot tests of draft CF documents at district sites. At times, these pilot sites formed collaboratives with museums and businesses to combine resources and increase public awareness of education reform. At other sites, however, limited SSI funds meant that only a few schools could be selected as SSI schools. For instance, in Puerto Rico, schools can become SSI schools only if they commit to joining the SSI, where professional development activities are built around the CFs.

Other nonfinancial support

Professional organizations have increased awareness of CF work by including information about it in their newsletters. The involvement of large numbers of participants in the CF development process generated professional and public support in New Jersey. The Ohio Coalition for Mathematics and Science has provided ongoing support through participation of its members. In Arkansas, the implementation effort brought together practically all major programs dealing with education reform: SSI, Goals 2000, other major grant programs, and various state resources (such as a new statewide electronic network).

None of the cases reviewed carried out a systematic public relations effort to inform and engage the general public with the state CF. South Carolina did incorporate awareness strategies (including formation of the Curriculum Congress, public review of draft documents, public discussion sessions, and teleconferencing) before formally adopting the CF. Because districts are expected to make implementation decisions and plans, South Carolina has no organized state implementation effort.

Public opposition to CFs did not appear in organized form in any of the cases, a fact that raises the question of whether the public (parents of school-age children in particular) knows very much about CFs. Some CF developers purposefully left potentially controversial topics in science for local districts to handle, thus avoiding one source of public opposition.

Finally, these documents make little reference to sustained support. Those projects depending on national grants that expire apparently made no plans for continuing the CF effort. They may have hoped that once a CF was in place it would become the cornerstone

of instruction and generate the support necessary for professional development, textbook and materials revision, and assessment.

Equity and Diversity

In analyzing the cases across states, the issue of equity arose in three different contexts: makeup of the development or writing team(s), text of the CF document(s), and selection of pilot schools. None of the case studies referred to equity concerns in professional development.

Writing team members

In a few states, the writing was done entirely by one or two people, who usually worked either in the SDE or with the SSI. In most cases, teams provided ideas, if not the actual writing. Efforts were usually made to ensure that at least one representative from each cultural group and geographic region within the state was included. In selecting team members, most states considered the following characteristics: geographic region, ethnicity, school size, school type (i.e., public, nonpublic), level of instruction, gender, and census category (i.e., rural, urban, suburban). Some states tried to ensure that teams were representative of both *the state's actual population* (e.g., race and gender) and *school types* (e.g., in ratio of public to nonpublic schools, size and wealth of school districts).

Other considerations related to writing-team composition included level of district funding, the needs of special populations (e.g., special education, learning disabilities, ESL), and business needs. For example, Florida included a specialist in teaching science to students with disabilities. Some development teams were made up of volunteers and some were selected using a preestablished criterion that ensured representation of diverse populations. In Indiana, the most significant selection criterion for serving on a team was the personal time commitment each member could make.

Equity in the CF document

Some state CFs and associated documents made no mention of equity. Of those that did, some mentioned only one area (e.g., the needs of handicapped children or exceptional learners) or made general statements about the education of students. Others dealt with equity issues more directly.

Several states (Arkansas, Florida, and New Jersey) devoted full sections to equity concerns (i.e., excellence and equity for all students, special needs for students with disabilities, tracking and ability grouping, multicultural education). A few states embedded equity concepts throughout their CF documents. For instance, Massachusetts began with a guiding principle that "learners learn best in an environment that acknowledges, respects, and accommodates each learner's background, learning style, and gender." Equity is addressed in other sections of the CF as well. Florida titled its CF *Science for All Students,* and Wisconsin's CD-ROM is available in five languages.

Equity in selection of pilot schools

Areas of equity that were considered in selecting pilot schools included census category, geographic region, and school size.

Professional Development

The issue of professional development was treated extensively in some CFs while being almost completely ignored in others. A few states addressed professional development directly and extensively both in the CF document and in the provision of plans and support (both human and financial) for widespread classroom implementation. As noted earlier (see Products section) several states developed specific support materials or training to assist teachers in translating the CF into classroom instructional and assessment activities. CF products often served as the basis for professional development.

Products as professional development tools

A few states might argue that the CF document is a professional development tool, since it assists teachers in translating standards or learner outcomes into classroom practice. New York, for instance, included vignettes that describe classroom settings in which the CF is being implemented appropriately and successfully.

Three states have developed print documents that specifically focus on professional development. Arkansas produced a manual, *Training for Curriculum Leaders,* composed of modules on instructional strategies and methods for defining, writing, and using performance tasks. A document titled *Science Program and Professional Development Design* was developed in Ohio. A companion document to Florida's CF, *Science for All Students,* is *Science for All Educators.*

Wisconsin's CD-ROM is intended to be used by districts and communities as a tool to develop understanding of the systemic reform effort and for creating local curricula based on standards, learning goals, and alternative assessment strategies. Both Florida and Ohio developed special software packages to assist teachers and district leaders in curriculum planning.

Professional development activities

Ely and Huberman (1994) listed five levels of engagement in dissemination that can be applied to the goals of professional development associated with state CFs: awareness, understanding, adoption or adaptation, implementation, and institutionalization. These levels are also consistent with the stages of change recorded in the Concerns-Based Adoption Model (Laboratory Network Program, 1994). Stages 0–2 (awareness, informational, and personal) relate to an individual's concerns about the change. In stage 3 (management), the concern shifts to the nature of the task, and in stages 4–6 (consequence, collaboration, and refocusing), the concerns are about the effect of the proposed change.

Activities: Awareness and understanding. Activities conducted for awareness and for understanding engage people in the initial stages of the change process. Simple dissemination of documents might address this purpose, but that is not generally considered professional development, even when accompanied by short presentations focused on increasing awareness and understanding of the documents. Until an individual has actually moved beyond the awareness stage, complex professional development activities will probably prove ineffective. Educators and citizens must know about the CF in order to value, implement, or institutionalize it. Therefore, public engagement in the CF process is important in creating awareness and understanding of CF goals.

Awareness activities reported by sites include distribution of CF copies in short sessions

that sometimes involved only teachers but in other cases involved administrators, members of the higher education community (some of whom were collaborating with SDE staff to address teacher training), and other educators and citizens. In Florida, a two-day symposium for 40 higher education representatives was held at the annual convention of the state science teachers association. In Mississippi, the schedule of the state convention was extended one day to facilitate CF dissemination and training efforts. In Massachusetts, a two-hour program on CFs was transmitted to all schools by closed-circuit satellite TV. In Florida, project leaders conducted a comprehensive public relations campaign throughout the state to announce the arrival of the CF. This activity resulted in more than 15,000 requests for the CF.

Workshops can be held to increase awareness and understanding, as well as for purposes of adaptation or adoption. Workshops were offered by SDE or SSI personnel, regional cooperatives or intermediate service centers, university personnel, in-state or out-of-state consultants, district personnel, or master teachers. The audiences were generally teachers or teacher trainers, with a few workshops aimed at administrators or higher education personnel. Workshop approaches ranged from traditional (lecture) to more constructivist models, from a single contact to multiple sessions with
extensive follow-up.

In South Carolina, an administrators' leadership institute helped districts accept CFs as guiding documents and align local practices with the new concepts. The SSI of New York took on the task of helping teachers understand systemic change (including the vocabulary of the change) and explore ways to apply these ideas
to their teaching.

Activities: Adoption or adaptation. In these activities people learned to work with the CF and found ways to incorporate its tenets into professional activities. Though not normally considered a professional development activity, participation in a
writing or development team was probably one of the most successful approaches for gaining buy-in to the state CF.

In Wisconsin, a community of learners (students, parents, community members, business leaders, industry representatives) was created to be the CF writing team. Before actually writing, they studied collaboratively for six months, reviewing, discussing, and sharing information about systemic reform. The group also established a collective vision of the CF. In drafting the document, they stressed empowerment.

Activities: Implementation. Those sites focusing on CF implementation often conducted professional development activities through extended workshops
and higher education courses. In several states, special university courses were developed to train teachers to use the CF effectively. For instance, in Arkansas,
university courses in the systemic reform of mathematics and science education are team-taught by master teachers and university personnel. At South Carolina, a new university course—Problem-Based Learning to Develop District-Level Teams—
focuses specifically on professional development and the CFs. The New Mexico SSI involved university personnel in the CF development effort, then offered
competitive grants to universities to hold summer institutes to improve mathematics and science education. Before offering the institutes, higher education personnel participated in a workshop designed to familiarize them with the state CF and other systemic reform efforts. Three of five universities in the Florida higher education network use the state CF as a required resource in their preservice course work. One university requires both a semester grad-

uate class and three follow-up sessions before teachers receive credit. This requirement gives the teachers an opportunity to use the CF in their classrooms and to discuss practical applications, challenges, and successes with their peers.

In Massachusetts, a long-term professional development activity brought together teams of teachers, professors, museum educators, and other mathematics and science educators for three days a week for one semester. During the remaining two days, participants applied the principles they had learned. In New York, two networks—the Science Mentor Network and the Inquiry Network—connect the CF project and the local schools. Through these networks, members bring new strategies and ideas to other teachers in the district.

Another CF implementation activity reported in the cases was pilot testing of draft CF and supporting documents and activities. In Louisiana, Nebraska, New Jersey, Ohio, and Wisconsin, pilot teachers or schools were selected to review materials and activities. In Arkansas, pilot test sites were asked to develop curricula documents based on the state CF.

Activities: Institutionalization. CFs are institutionalized when their major concepts are incorporated into the routine operation of the system. At the state level, the system includes curriculum, assessment, professional development, and teacher licensure requirements, in addition to policy matters addressing school management, structure, and finance. While none of the case studies involved all these segments of the educational system, several states had plans to make systemic changes supporting the CF.

At the local level, institutionalization can be seen in classrooms that model exemplary mathematics and science instruction and assessment. To effect this change, the New Mexico SSI created Leadership Change Agent Teams in selected schools. Each team consisted of parents, teachers, administrators, and community members and was provided a budget and technical assistance to plan and implement quality mathematics and science education. Adequate resource materials and ongoing technical assistance will be critical to success in this area.

Evaluation

The case studies describe different types of evaluation: evaluation of CF drafts, evaluation of final CF documents, internal and external project evaluation, monitoring the development and implementation process, determining the success of a CF, and evaluation as a topic within CF documents themselves.

CF document evaluation

VIGNETTE

Math Crusade as Arkansas' Professional Development Model

To reach large numbers of teachers and to familiarize them with the kind of instruction called for in the NCTM *Standards*, Arkansas established the Math Crusade in 1991. The Arkansas Mathematics CF, based on the *Standards,* was developed in 1993, and the Math Crusade was the natural avenue for providing professional development consistent with the type of instruction called for in the CF. This delivery model was adapted to include science for teachers of grades 5–16 and an integrated reading, mathematics, and science program for grades K–4.

Completing a Math Crusade class earns participants university credit. A college professor and a public school teacher team-teach the course, in which teachers of grades 5–16 work in cooperative learning groups, use manipulatives and calculators, investigate how these tools support mathematical concepts, and learn new content as they study the connections within mathematics across grade levels. The Integrated K–4 Crusade, a six-hour university course, emphasizes integration of mathematics, science, and reading for the primary grades and encourages incorporating the entire school into reform efforts. In addition to this course, an intensive one-week K–4 workshop is offered.

The Crusades have made the CF come alive to 3,000 teachers statewide. Accordingly, these teachers have increased their understanding of mathematical concepts and developed greater confidence in their instructional ability.

Vignette 7. Math Crusade as Arkansas' Professional Development Model

In all the case studies, drafts of the CF document were reviewed. In most states, reviews were conducted by district or state stakeholders, while in others, teams of national specialists provided feedback. Teachers, administrators, parents, university personnel, community leaders, renowned curriculum and assessment specialists, nationally recognized subject-area specialists, and representatives of state professional organizations were all on review teams. Only one state mentioned specific review of documents by administrators.

Methods of eliciting feedback varied among the states and included holding regional forums, seminars, symposia, or retreats; conducting focus groups to review and critique drafts; disseminating drafts to national validation teams; and seeking feedback from representative stakeholders. New York attached a response form requesting feedback to each draft, while Massachusetts asked applicants who were not selected to be on the CF writing teams to serve as reviewers. In Louisiana, revisions were made to the CF after pilot-testing handbook activities.

In Indiana and New Hampshire, out-of-state reviewers read drafts of the CF. In Louisiana, drafts were sent to five national specialists each month for review and comment. Arkansas used an expert panel composed of members of the CCSSO to advise, support, and assist in overall evaluation. In South Carolina, public review of the CF was facilitated by a Curriculum Review Panel, which conducted a field review, collected feedback, made revisions, and recommended to the State Board of Education the adop-

tion of the state CF.

Annual evaluation was a stated goal of Nebraska's CF document. Massachusetts plans to publish a regular journal that will address elements left out of the CFs because of lack of space (e.g., exemplary math units). Louisiana plans to revise the CF and handbook continuously to reflect changing needs and concerns.

Evaluation of the CF project

The states and possessions have taken two basic approaches to evaluation. The first involves the monitoring and assessment of project progress as specified in the project proposals (i.e., SSI and CF grants). The other, used primarily in states that mandated the CF, assesses district compliance and uses this information as an indicator of project success. Three cases provided no plan for monitoring implementation.

To assess project progress, some states hired independent evaluators to monitor the project while others used state directors for assessment and evaluation. A few cases elicited peer review on implementation efforts. In Arkansas, an external consultant will determine local implementation through development of case studies of pilot schools' implementation efforts. Both pre- and post-CF measurements will be collected. In South Carolina, SSI staff and others in the field informally monitor local implementation. In New York, the state office of evaluation has been involved in every aspect of the process, addressing both development and implementation.

Massachusetts uses district compliance as an indicator of project success. It established an ongoing feedback loop in which districts regularly assess compliance with the CF. Implementation plans call for ongoing evaluation of both school and teacher compliance. The Arkansas CF proposal calls for product and process evaluation techniques for program evaluation. Process evaluation matrices were used to analyze project tasks and assign responsibility for completion. The ultimate goal was to use achievement data and enrollment in mathematics and science courses to monitor student progress. Student tasks and portfolio assessment strategies are also used to assess CF implementation. Student performance, then, is used indirectly in assessing implementation success.

Mississippi SDE personnel monitor development, implementation, and dissemination efforts with two instruments: a management information system that assesses the number of students enrolled in high school science classes, number of curriculum staff assigned to districts, number of science specialists in the districts, and number of lead teachers serving as science supervisors for a portion of the school day. The SDE believes that this information provides a realistic accounting of district participation in, and commitment to, the reform process.

Lessons Learned

- Begin by determining your state's needs and operational method. Then look at CF experiences of states with similar characteristics.
- Have a clear idea of what you hope to accomplish and a comprehensive plan before beginning the CF process.
- Involve a broad base of constituents throughout the process, especially governmental and administrative leaders who could potentially have the power to derail the effort.
- Document the entire process—who is involved, groups communicated with, steps taken to get over the hurdles, what works and what doesn't work—to help in evaluating development

and implementation efforts.

- Use technology and electronic telecommunications when appropriate to increase efficiency and stakeholder involvement in CF development and implementation.
- Include professional development as a key ingredient in implementing CFs.
- Provide support and technical assistance to increase the likelihood that the CF will be implemented.

While there is no clear-cut path to follow in developing or implementing CFs, several key process issues can be identified from both the case studies and the lessons learned. Initial concerns in CF development and implementation are the identification of needs (as eventually reflected in goal statements) and the involvement of a representative sample of stakeholders, both those supportive of the effort and those opposed to it.

Persons involved in CF efforts have found that it is important to involve a broad base of constituents from the beginning of the process and to keep them informed throughout the process. This strategy will prevent the development of opposition to the CF and will result in a product that reflects a consensus of stakeholders. This level of effort is especially important when dealing with political leaders and governing entities that have the power to eliminate a CF if they do not understand and support it.

Since consensus-building is especially challenging with large groups, stakeholders may need to divide into smaller groups to tackle specific tasks and come back together periodically for the whole group to affirm progress. Terminology will have to be continuously renegotiated (e.g., "CF," "integrated," "standards," "content objectives," "process skills," "benchmarks," "assessment," and "vision"). Confusing terminology can be eliminated and concepts discussed in terms that the general public can relate to. Technology has proved particularly useful in CF efforts as a communication tool between groups and within groups.

Other process issues to be addressed in developing CFs include determining:

- the decision-making process (e.g., who has the final authority over the content and format of the CF product),
- who will do the work and how they will be selected,
- what kinds of resources and support will be solicited,
- how the review and revision process will proceed,
- the extent to which educators and the public will be kept informed,
- how to deal with organized opposition, and
- how the product and project will be evaluated.

If these factors are adequately addressed and equity issues are integrated throughout the product and the process, CF development will take longer than originally planned. On the other hand, the CF might be considered an evolving document, continuously updated and revised, so that development, implementation, and revision become indistinguishable. The draft CF review process brings attention not only to what may have been left out but also to what should not be included, what is too weak, too strong, too specific, or too vague, and what may be an impossible goal.

Once the CF has been approved, an implementation plan must provide both resources for professional development for those implementing the CF and the support of credible persons. CF development is meaningful only if teachers actually provide instruction based on the vision, and professional development can make the vision a reality. CF

implementation can be made more manageable by pooling the resources of SDEs across traditional departmental boundaries, systemic initiatives, professional teacher organizations, universities and colleges, regional educational service agencies, districts, and individual schools.

Successful professional development that leads to changed instructional practice actively involves participants in in-depth training and allows for reflection and practice, with additional opportunities to regroup, share experiences, and continue to build on experiential learning. This type of professional development has financial, managerial, and logistical implications for implementing CFs. Teacher preparation institutions must also buy into the goals and standards of the CF and to changing their institutions to prepare future teachers to meet these expectations.

When engaged in the CF development and implementation process, participants have found that more than producing a document, they are, in effect, documenting a process that empowers all students to be successful learners.

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Appendix A:

Case Summaries

Arkansas

Subject area: **Mathematics**

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Development approach. While the SDE was beginning a revision of the state mathematics curriculum content guide to bring it more in line with the NCTM *Standards*, legislation was passed calling for the development of CFs that would establish new and higher standards for student performance.

The Arkansas Board of Education adopted a format for CF structure that identified seven components, each having multiple subcomponents. Also described was a five-step process for CF development, which was followed in developing the mathematics CF. The CF was approved in the fall of 1993.

Implementation approach. At the state level, six districts were chosen to develop model curricula based on the CF. A staff development program provided assistance to these districts in organizing their task. To encourage diverse products, no guidelines or specifications for the curricula were given. SDE imposed a consistent format on the six documents produced and then disseminated them on computer diskettes to all districts statewide. Regional one-day workshops were held to explain their use and the potential for developing local guides. In addition, SDE staff provided technical assistance, including a statewide telecourse. Other statewide activities have included professional development in portfolio assessment and
providing model in-service and preservice training programs.

At the intermediate level, the Regional Service Cooperatives (Coops) assist districts in implementing the CF. Regional or single-district workshops have been held, at times focusing on parents or principals.

Expectations. The expectations range from "improvement of learning in mathematics for all students" to specific outcomes for each school and each teacher.
New curricula, new methods, new ways of using technology are all expected.

Support. Arkansas has been successful in integrating various national and state programs with the CF grant (SSI, other NSF grants, Goals 2000, and various state programs). Three major SSI activities have supported the state's CF effort—Arkansas Math Crusade, the K–4 component (supporting the Arkansas Early Childhood Initiative), and the Arkansas Science Crusade.

The means by which various stakeholders have been involved and kept informed vary from district to district. At the state level, there has been no evidence of opposition.

Florida

Subject area: **Science**

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Development approach. The Commissioner of Education appointed the Florida Science Framework Commission, which consists of an Advisory Committee and a Writing Committee. The Advisory Committee includes members from the business and industry communities, institutions of higher education, and government (most of those members also serve on the advisory committee of the Florida SSI). The Writing Committee included teachers, representatives of institutes of higher education, district and school science specialists, and SSI regional coordinators. The Writing Committee was charged with drafting *Science for All Students,* which is to act as a guide for curriculum developers. The draft underwent review by the Advisory Committee, with additional one-day reviews held at each of the six SSI regional centers.

In addition to the CF, Florida also produced a framework for preparing science teachers (a preservice piece) and software to help local curriculum planners in their school improvement efforts.

Upon completion of the above documents, a committee of 10 science curriculum planners met to define the curriculum planning software. The development work was contracted out and then pilot-tested. The set of materials had a common implementation plan.

Implementation approach. Copies of the CF and the preservice piece were distributed to all district superintendents. Project leaders visited districts and schools to raise awareness about CF availability. In addition, the SSI regional centers use the CF in their demonstration model schools and have hired trainers to deliver workshops on using the CF. Promotional videos are being produced to increase awareness of the CF among school board members and in the larger community.

Expectations. Florida is moving toward local control of schools. The CF is not mandated, but the state encourages curriculum specialists to use it to develop local documents.

Support. Florida provided little information about how local support was sought, although this effort was based on the statewide system for school improvement and education accountability, which is in turn based on input from both the field and the community.

Indiana

Subject area: **Mathematics**

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Development approach. The legislature charged the SDE with the task of developing both statewide standards and testing programs. The SDE convened a committee of 12 state mathematics teachers to develop standards by revising the *Indiana Curriculum Guide* and aligning it with the NCTM *Standards*. The committee worked during the 1988–1989 school year, and, in March 1990, distributed more than 3,000 draft copies to local schools. In May 1990, the committee reviewed comments and completed a revision. Between June and September 1990, revised drafts were sent to groups of business and industry people and educators. Simultaneously, the draft was reviewed by two out-of-state reviewers. The writing team again revised the document, and 50,000 copies of the final product were distributed across the state.

In June 1991, work began on a document to guide statewide testing; some members from the standards team served on this team. This group was asked to create testing materials that were aligned with the new curriculum guide. After field review, the *Mathematics Classroom Assessment Guide* was released in March 1992.

Implementation approach. Implementation consists of document distribution and provision of limited training. The SDE has trained a cadre of facilitators at the intermediate levels to provide inservice presenters and on-site support.

Expectations. Use of the CF is voluntary. Success will depend on teachers taking the initiative to change their instructional patterns and local administrators supporting teachers who implement programs aligned with state guidelines. The mandated assessment program is high stakes (requisite for graduation) and may provide the impetus for change.

Support. The process for developing support was not specified.

Louisiana

Subject area: **Mathematics**

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Approach. The Curriculum and Curricular Materials Panel of LaSIP was the foundation for the CF effort in Louisiana. LaSIP evolved from a collaboration of the SDE and the Louisiana State Board of Regents; that collaboration was also instrumental in organizing the CF project.

The Louisiana SDE applied for and received an Eisenhower CF grant. After deciding to concentrate on mathematics, grades 5–8, those working on the CFs held monthly meetings and established strands and performance benchmarks. Two writers were engaged to compile a working draft in the summer of 1993. The draft was sent out for critique and 30 teachers were invited to pilot-test the CF and provide feedback on it and the accompanying teacher handbook. An assessment strand was added in 1993. At the same time another panel began developing the K–4 CF. The combined K–8 CF and handbook was pilot-tested in 1995–1996. Another subpanel met in January 1995 to begin developing a CF for grades 9–12.

Expectations. The process through which the CF has evolved will probably become an example for other states, and the products will be accepted and used widely in the schools of Louisiana. Furthermore, Louisiana expects to use this process to develop a CF for science.

Support. The widespread support for the Mathematics CF seems to be evidenced by the number of schools and teachers volunteering to serve as pilot classrooms and the number of schools eager to use the CF even before the pilot is completed. Financial support came from the NSF for the SSI project, from the SDE and Board of Regents, and from the Eisenhower CF program of the U.S. Department of Education. In addition, in-kind support was provided by school districts in the piloting projects.
Because classroom teachers, parents, and other people were involved at every stage of the project, the base of support has been broad.

Massachusetts

Subject area: **Integrated mathematics, science, and technology**

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Development approach. The development of the CF began with the establishment by the Massachusetts Department of Education of the NSF SSI project "Partnerships for the Advancement of Learning in Math and Science" (PALMS), with 13 local sites, followed by passage of the Education Reform Act. Advisory committees were formed, and two CF writing teams were contracted. The drafts of the CF were rewritten by SDE staff in 1993. The final draft was submitted to SDE in the spring of 1995.

Implementation approach. The PALMS project resulted in Leadership Change Teams and the development of a seven-stage plan: Awareness and Study, Forming District Leadership Teams, Gap Analysis, Creating an Action Plan, Identifying New Curricula, Professional Development, and Ongoing Feedback Loops.

State math and science coordinators and other administrators from PALMS, along with a number of staff people from SDE are assigned to the implementation of the CF. Some teachers have been trained to be facilitators. Professional organizations, such as NCTM, have been involved. The project has developed print, electronic, and other media and model curriculum guides. State-level training is provided.

At the intermediate service level, Regional Resource Providers at five regional offices assist with the pace of reform and use of the CF. The existence of other reform efforts has sometimes created a crosscurrent of concern on the part of teachers, who see themselves as being asked to do too much.

Locally, leadership change teams have been established. PALMS specialists work with selected districts to develop flexible action plans for local districts.

Expectations. The partnerships that have led to the CF will continue their cooperative efforts. Schools will voluntarily adopt the CF and then develop their own processes to continue professional development. The statewide process that led to the mathematics CF will be replicated for a science CF.

Support. Support has come at various levels: statewide (SSI and SDE), intermediate service centers, and local districts.

Mississippi

Subject area: **Science**

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Development approach. In Mississippi, the revision of curriculum documents is the responsibility of the curriculum specialists in the SDE and coincides with the textbook adoption process. In the past the results have been textbook-driven and objective-oriented. The new science document presents 15 competencies to be mastered at each grade level. One or two years are allotted to the development of new curriculum documents. During a one-year pilot program, local adoption is optional. After that, all schools are required to follow the new guidelines, but they have flexibility in developing their own objectives.

The committee writing the science CF was selected in December 1993 and met many times in the spring of 1994. The team consisted of 30 members, 24 of whom were classroom teachers. In April the team submitted a draft to review committees, also broadly representative of the state, which resulted in feedback and revisions by the writing and review teams. The final document was released in February 1995 and contains three main sections:

- statewide competencies
- sample objectives for each competency
- various resources and contacts

Implementation approach. The primary steps in implementation consisted of sending two copies of the CF to each school district as the basis for appointing a five-person team to become a training team for the district. A variety of workshops were then held for the district teams and will continue. Many of the workshops are being done by the science specialist, but other trainers are engaged as resources become available.

Expectations. The CF will become the basic document by which school districts determine their science programs. Because of broad representation on the writing team, general approval and acceptance are expected.

Support. Financial resources were very limited, being confined to funds from the SDE, with some limited help from the SERVE Consortium for Mathematics and Science Education, which provided two consultants. Other in-kind services were provided by school districts and informal science agencies, and other evidences of support have come from the Mississippi Science Teachers Association.

Nebraska

Subject area: **Integrated mathematics and science**

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Development approach. The CFs and the models were written mainly by teachers, and since these teachers are now presenting implementation workshops, the process is clearly a grassroots approach.

Implementation approach. Those ultimately responsible for the implementation of the CF in Nebraska schools are individual teachers in their classrooms. The state is supporting these teachers through coordinated training and distribution of the CF document to individual schools. The state coordinator is a teacher on leave. Teachers are also provided with guidance and advice from post-secondary content and education specialists, community members, and parents, many of whom serve on the advisory board or as reviewers of the document.

Teachers were compensated for writing curriculum models and piloting them in their own classrooms. These documents were then collected and refined for use in state leadership institutes.

CF implementation into school curriculum is voluntary; however, many schools are using it to point the way in developing new curriculum. Schools that want to implement the CF must include professional development during implementation. This professional development involves teachers in leadership institutes with three days of training and with a commitment to spend 32 hours helping other teachers in their system to make needed changes. In addition, two follow-up days are devoted to sharing teaching strategies and providing feedback and support. To facilitate networking, communication links have been established among the participants.

Expectations. Students will be expected to have a better understanding of the concepts and a grasp of the skills that are now a part of various national standards. Most supporters acknowledge that it will take time to bring about changes in teacher behavior, development of classroom materials, extension to the secondary schools, and acceptance by parents.

Support. Federal funds were awarded for three years. Educational service units and the SSI project provided sites for implementation workshops. The state professional teachers organizations provided publicity in their newsletters.

New Hampshire

Subject area: **Mathematics**

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Development approach. The New Hampshire legislature mandated development of new assessments at grades 3, 6, and 10. To inform the development process for these new assessments, the New Hampshire SDE convened two writing teams, one for grade 3 and one for grade 6 and grade 10 (size of teams was unspecified). Both teams were asked to identify appropriate outcomes for students. The teams, working voluntarily and without legislative sanction, included representatives from the classroom, SDE, State Board of Education, institutions of higher education, and state professional association affiliates; a non–New Hampshire resident served as a single outside reviewer. Public comment was sought by mail and through public hearings.

The development effort had no precursors, so much of both the process and the product was invented by the teams as they went along, without within-state models.

Implementation approach. New Hampshire is largely a local-control state, with state funds accounting for only 7 percent of local education budgets. The use of the CF is entirely voluntary. The CF was distributed to every principal in the state. Under the legislation mandating new assessments, the SDE is to respond to local requests for assistance, but very few staff members are available to do so. The SDE will help schools interpret test results as the new tests are implemented. Most likely the real implementation issue will be raised at this point: What are the consequences of not meeting state performance standards, and who will provide support to those schools that do not meet these standards?

Expectations. No clear expectations are provided for implementation of the CF. Its development was undertaken as a mechanism to support the assessment mandate from the state legislature, and its local use is entirely voluntary.

Support. The CF apparently was not opposed. Buy-in was sought through inclusion on the CF writing team, as well as through the draft review and public hearings. The document was approved by the SDE, then sent to the State Board of Education and the Legislative Oversight Committee, both of which approved it.

New Jersey

Subject area: **Mathematics**

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Approach. In response to an SDE plan to develop standards in all subjects, New Jersey began the development of curriculum standards in 1993. At that same time, the Mathematics Coalition and the SDE received an Eisenhower CF grant to develop a mathematics CF. Mathematics educators and others, with support from the NJ SSI project, collaborated on a preliminary version of the framework in which they used comments from the development of the standards document.

The preliminary version of the framework, with "standards" incorporated, was reviewed by the New Jersey education community and by a nationally recognized expert. It will be revised in the fall of 1995. The New Jersey SSI project pilot tested the mathematics standards with 248 teachers during the 1993–1994 school year and in 17 school districts during the 1994–1995 school year. In 1994–1995, 30 school teams piloted the CF, with 500 educators attending regional forums to review it.
A "final" version will be developed in the fall of 1995 for distribution.

Expectations. Classroom teachers and New Jersey school districts are expected to use the CF to guide the development of policies and activities consistent with national standards. It will provide policymakers, instructional leaders, teachers, and community members the support, definition, and direction necessary to reconstruct mathematics education.

Support. A variety of constituents were involved in development, indicating a wide base of support and input.

Leadership team:	30 people
Advisory committee:	49 people
District teams:	6 regional teams, 30 district team coordinators
Mathematics standards panel:	31 people
Mathematics Coalition:	29 people

The state standards on which the CF is based were developed before the CF grant was received.

New Mexico

Subject area: **Science**

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Approach. The New Mexico State Legislature mandated identification of essential competencies for student mastery. Five different SDE documents were developed to provide guidance toward achieving New Mexico's vision of educational excellence and to present a unified approach to educational excellence.

To develop the *New Mexico Competency Frameworks,* one of the five documents, the New Mexico SDE assembled people from all core content areas in 1991. A team of 15 to 20 science teachers and professors from around the state worked to determine what should be included in the two-to-three-page science segment of the framework. All content areas were combined and published as a 22-page document that included a two-page introduction, a set of general assumptions, and outcomes for each subject area. Single copies were placed in each school in the state.

Concerned about the implementation of the *Competency Frameworks* and its usefulness to classroom teachers, the SDE and the New Mexico SSI convened a writing team to develop a document explicitly outlining science content standards. "New Mexico Science Standards and Benchmarks" is being developed by a team of science educators, scientists, and parents. The document will be submitted to the State Board of Education for approval.

Expectations. The *New Mexico Competency Frameworks* is intended to provide guidance and present a unified approach toward achieving New Mexico's vision of educational excellence. The "New Mexico Science Standards and Benchmarks" is intended to clarify the intentions of the science framework and to provide more assistance to teachers and districts trying to implement the state CF.

Support. The New Mexico Board of Education supports reform efforts by permitting and encouraging new university approaches to preparing teachers of math and science. Also, alternative assessments are being explored at the local and state levels.

The New Mexico SSI stimulates preservice reform efforts and provides summer institutes and follow-up support for Change Agent Teams in 90 participating schools. Five regional centers each assist 18 schools with in-service workshops and technical assistance during the school year. Support for reform efforts also comes from the RE:learning statewide project and from the two U.S. Department of Energy laboratories.

New York

Subject area: **Integrated mathematics and science**

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Developmental approach. The CF was written by the New York State Curriculum and Assessment Committee, which consists primarily of teachers but also includes scientists, engineers, and mathematicians. The CF was based on the 1991 Regents' *New Compact for Learning,* which establishes broad educational standards. The CF document proposes nine standards of knowledge and outlines performance standards and their indicators. The draft was circulated to a broad group of individuals, accompanied by a review response form (to date, 1,400 responses have been received). In addition, seminars and symposia have given stakeholders an opportunity to discuss the CF and its implementation in schools. Organizations have also been encouraged to respond. The CF is being pilot-tested in 104 schools.

Implementation approach. CF implementation is not mandated, but the Regents' *New Compact* has redefined roles and relationships and created a more supportive role for the state. In the past, the state provided curriculum guides and syllabi that districts adopted. Under the *New Compact,* the SDE sets standards and performance criteria, but local school districts develop curriculum. Thus, the state's role is changing from one of generating curriculum to one of supporting local curriculum development. In accord with this role, the CF contains detailed vignettes as examples of desired instruction but does not serve as a curriculum guide.

Expectations. The state intends for the CF to support the local development of curriculum. The state expects the SSI to provide continuity after the framework grant ends, as well as the impetus for teacher participation in implementing the CF.

Support. The SSI is the main support structure for local implemention of the CF. Also, workshops have featured discussions with officials from other states that have undertaken successful systemic reform efforts. Given the CF's relation to the *New Compact,* it may not be problematic to gain support for the effort.

Ohio

Subject area: **Science**

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Development approach. The Ohio CF was published and disseminated in the fall of 1994 after three years of development and the efforts of thousands of science educators from all parts of the state and at all school levels. Ohio SDE staff members received input, wrote drafts, circulated the drafts for comments, and then incorporated revisions in a final document published in October 1994.

Implementation approach. Four characteristics of Ohio's implementation plan were strong leadership from SDE science consultants, tactical planning and regional resource matching, statewide delivery system for professional development with many agencies participating, and connection with a variety of other reform programs (e.g., SSI).

Two strands will be in play simultaneously: Ohio science program development and professional development. Many of the services will be provided by intermediate service units. Because of the careful and systematic CF development process, the early involvement of curriculum leaders around the state allowed them to begin implementation before the official release and adoption of the model.

Expectations. The CF is expected to close the gap between what students should know about science and what they do know, change the way that science is taught, and result in an understanding of the connection between what is taught and how it is taught. The design of new curricula will be controlled locally. The state will create models, but the school district will determine how closely its plan will follow the state model.

Support. This process has been characterized by productive interaction among the SDE, teachers, and various intermediate or county agencies. The Ohio Coalition for Mathematics and Science will serve as a valuable communications link because of its broad membership base. Ohio's SSI project offers professional development for middle school teachers and, with eight regional sites, has the potential both to contribute to and to benefit from a broader interaction with teachers. Urban Systemic Initiatives (USIs) in Cleveland, Cincinnati, and Columbus have the potential to take an active role in CF development.

While there has been no strong opposition to the CF, some adverse reactions to other reform movements have arisen in the state. Potentially controversial topics in science have been left for districts to handle.

Pennsylvania

Subject area: **Mathematics**

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Approach. As a result of curriculum regulations mandated at the state level, the mathematics CF will be a guide in developing activities consistent with the learning outcomes adopted as part of curriculum regulations.

Pennsylvania SDE initiated the work in the fall of 1993. The state mathematics supervisor organized a writing team. Drafts and final versions were reviewed by selected teachers and other interested stakeholders. The CF has now been revised and printed. Workshops for teachers at each intermediate unit throughout the state will facilitate implementation.

Expectations. The CF will be a guide to assist schools in developing curricula that address student learning outcomes, local district assessment, instructional strategies, and a useful format to communicate expectations for student learning to students and a broad range of constituencies.

Support. No information provided.

NOTE: Since this information was received, some changes at the state level have resulted in a moratorium on all staff development activities related to curriculum frameworks.

Puerto Rico

Subject area: **Mathematics**

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Approach. A CF development team made up of local, higher education, and K–12 educators is revising the existing curriculum guide. The CF development team determines the outline, aligns the CF to national standards and benchmarks, develops content, elicits feedback from various constituents, and revises content based on the feedback.

Public hearings will provide feedback for revision. Various professional organizations and department officials must express agreement before the PR secretary of education gives final approval. Implementation of the draft CF has already begun, largely through the SSI, which is drawing on the content material as well as on national documents and studies to implement curriculum reform.

Expectations. The CF will help change the teaching process to better prepare students, who will achieve higher goals in content and skills areas. Through the use of the framework for teaching particular disciplines, new standards of student achievement can be reached.

Support. The SDE coordinates the framework project, but most of the financial support for the various activities seems to come from the SSI project. In addition, the SSI has leveraged other funds tied in with its activities on behalf of the framework project, including Goals 2000 and other NSF-funded projects. Other support comes from a variety of related offices and programs. Program directors participate in planning, offer recommendations, and draw on the framework for some of their professional development activities.

Implementation will take place at schools in various regions and at regional dissemination centers. This process requires a series of approvals before the secretary of education gives final approval.

The SSI is carrying out professional development associated with the CF, implementing curricula in local schools, and establishing support centers in schools. Missing at this point is a plan of assistance for non-SSI-funded schools or a public information effort to help people become knowledgeable about the CF.

South Carolina

Subject area: **Mathematics**

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Development approach. Under the direction of the state education commissioner, a statewide group of citizens surveyed educational needs in 1991. As a result, a CF process began in 1992. Along with an NSF SSI grant, the process was part of a systemic reform effort coordinated by the South Carolina Department of Education.

The conception, design, and content of the CF was a grassroots effort that involved teachers, administrators, and post-secondary faculty on the writing team. An initial draft underwent public review guided by a curriculum review panel.
The CF was adopted by the State Board of Education in November 1993.

Implementation approach. The CF was printed in an attractive "marketable" format to encourage its use and dissemination, and supplemental materials were referenced. All teachers (not just mathematics teachers) received a copy. Local districts were encouraged to copy and distribute it widely. The state has developed implementation guidelines, but true implementation decisions will be made locally. Public forums are being held. The SSI statewide system of regional hubs has played a major dissemination role through the provision of staff development associated with the CF.

Expectations. The CF is intended to move all learners toward high achievement standards and to redirect the states' resources and programs to achieve these standards. With an equal emphasis on policy and practice, the CF includes suggestions for assessment, teacher preparation, inservice training, and more. As a result of the CF, all of these should become more effective in meeting students' needs.

Support. The commitment of state leadership has been a major reason for the rapid progress and acceptance of the CF. The inclusion of widely representative groups in the writing, review, and dissemination process has also been a major factor. Unsolicited support has come from various organizations.

State funds supported the development process, and Eisenhower funds provided for dissemination. The SSI has supported inservice training.

South Dakota

Subject area: **Integrated mathematics**

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Development approach. The development and implementation of South Dakota's CF (referred to as the SD Benchmarks) has resulted from the impetus of the SD SSI project. SSI personnel initiated and conducted the development process, which used teams of teachers and other educators. Some of this effort involved Northern State University, which offered a graduate course devoted to curriculum reform. The final draft was completed in the summer of 1995.

Implementation approach. Implementation currently rests with the SSI Project, but Chapter I personnel may become involved. Although the primary responsibility for implementation lies with local districts, it is not clear at this time whether copies have been systematically provided to all districts. The SSI personnel will provide various kinds of assistance to local schools pertaining to the Benchmarks.

Expectations. The development and implementation of the CF is an objective of the SD SSI.

Support. Support has come almost entirely from the funds of the SSI project. Because South Dakota is a state with strong local-control traditions, various local activities, perhaps in conjunction with SSI, are probably efforts to implement
the Benchmarks.

Virgin Islands

Subject area: **Mathematics**

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Approach. The development of the CF has been a team effort, modeled after approaches used in other states and based on knowledge gained from the review of national standards, current research, and local scores, methodology, experience, and materials. The major players are the state director for curriculum and the district coordinator of mathematics. Well-informed teachers serve on the task force.

A curriculum development task force was organized and trained. Then curriculum work sessions were organized, and writing and editing of the CF document began. Piloting of the CF is currently under way, and feedback for revision will follow.

Consistent with its rationale, the task force has used and embraced the NCTM *Standards*. A state NCTM affiliate was organized and established while the CF was being developed. Other national reform efforts and related research were considered and adapted.

Expectations. A unified CF with learning outcomes for students in grades 1, 3, 5, 7, 9, and 12 is expected to result. It will be meaningful, challenging, and student-centered, will reflect advancements in technology, will be a living document reflecting an ongoing process, and will provide the basis for professional development.

Support. Professional development for K–6 is under way through a NSF teacher enhancement grant. Plans call for providing local funds for 7–12 professional development.

No opposition to the CF has appeared. Although an opportunity will be made for the public to come in and read the document at curriculum centers, not much response is expected.

Wisconsin

Subject area: **Integrated mathematics and science**

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Approach. Wisconsin is developing a CF project based on a three-year grant from the U.S. Department of Education. The project integrates science and mathematics and provides support for creating a curriculum in an electronic format on CD-ROM. A development team made up of K–12 and higher education science and mathematics educators began the project in 1992–1993.

The approach to CF development began with intense study, discussion, sharing, and visioning by a group that would become the Framework Development Team. Activities progressed through discussions, writing, and software programming between December 1993 and March 1995. During that time a media services company was engaged to develop the CD-ROM, which was to be completed by September 1995. Informal pilot testing provided feedback to the development process. Training sessions for school districts piloting the material in 1995–1996 were scheduled for summer 1995.

Expectations. The CF will be an electronic resource that provides the philosophical context, support, and stimulus for systemic reform to educators and the public. Making it available to teachers and providing guidelines for teacher education programs and professional development models will promote grassroots involvement of local school staff members.

Support. Cooperation with a U.S. Department of Education project is built into the project in many ways, e.g., the formation of a 70-member Joint Advisory Council and an In-House Executive Team. The SDE has placed few constraints on the project, even though the project director is a staff member.

No significant negative reaction to the CF has arisen, although the pilot projects will probably require a systematic public relations effort.

The fact that the project is funded from only one source seems to have helped streamline the process; sustainability once those funds are gone is a concern, however.

Appendix B:

Case Study Focus Questions: Curriculum Framework Development

Case Study Focus Questions: Curriculum Framework Development

Research Question

- What processes are being used in your state to develop a statewide mathematics and/or science CF?

Research Areas

Context

- What is the impetus for engaging in CF development (e.g., legislated mandates, Eisenhower grant, SSI funding)?
- In what context is your state developing a CF? What legislative restrictions, if any, are there? What institutional limitations facilitate or inhibit the development of the CF (e.g., initiative controlled by state assessment division, curriculum division, or mathematics/science division)?
- Was there a precursor to your state's CF (e.g., state or district curriculum guides or frameworks)? If so, what is the relationship of the new document to the previous one? How are they (a) similar and (b) different?
- Have other CFs been developed? If so, how have they influenced development of the mathematics and/or science framework?
- To what extent is the development of your state's CF (a) a grassroots effort or (b) a top-down effort?

Resources

- What resources are available (e.g., people, programs, funds)?
- Who are the major players and how will they interact?
- How has diversity been considered in selecting a CF development team?
- What is the level of CF experience of each of the people working on your state's development team? Are these people from within the state? Have outside consultants been brought in to serve in or support this role?
- If funding is available for development of your state's CF, are the funds committed for a portion of the developmental phase? What is the status of funding for any planned implementation phase?
- Is funding coming from multiple sources? If so, how is it being coordinated?
- What types of support or opposition has your state received from existing efforts or organizations (e.g., state professional organizations, NSTA, NCTM, Project 2061)? To what extent are the CF development efforts being coordinated with efforts of these organizations?
- What is the extent to which the process of CF development in your state is being informed by the national reform efforts (e.g., emerging national instructional and assessment standards)?

Process

- What approaches are being used in your state to develop a CF (e.g., grassroots effort, committee or team effort, the use of consensus decision making)?
- How was the development process derived? Was it modeled on other CF development processes?
- How does the CF approval process work in your state? Who has buy-in and who does not?
- How is equity being assured in the CF development process?
- How are different needs of different users accommodated in the CF development process (e.g., rural, urban, suburban, public, private, traditional, radically innovative)?
- How do the CF developers deal with opposition?
- To what extent is the CF effort aligned with other state reform efforts (e.g., textbook adoption, assessment, certification)?
- What is the time line for development of the CF?
- What are the mechanisms for CF revision and how do they function?
- What special problems arise in states developing integrated mathematics/science CFs as opposed to a single-subject focus?

Implementation

- What plan does your state have for implementing and disseminating the CF?
- Who will be informed of the CF and how?
- How has diversity been considered in the implementation and dissemination effort?
- To what extent is dissemination of the CF document accompanied by staff development?
- What forms of staff development are planned, when will they begin, and how long will they continue?
- How will the intended use of the CF be supported (e.g., follow-up to staff development)?
- How will implementation and dissemination of the CF be monitored?

Outcomes

- What are the expectations or goals of the CF? Are these goals shared by all constituents?
- What is the intended use of the CF? What is it intended to do?
- Is the emphasis of the CF on policy or practice (or both)?

Product

- What form does the CF take? How is it packaged?
- How does the CF address the following major framework components: purpose, history, structure, philosophy, mathematics and science in society (e.g., equity, ethics, multicultural issues), content, strategies (e.g., learning, teaching, and assessment), technology, assessment, materials, implementation (e.g., long-range planning, staff development, curriculum development, school-community relations, resources)?
- To what extent is content addressed in the document (e.g., skills/processes, competencies, attitudes, performance outcomes, subject-area specificity)?

Appendix C:

Case Study Focus Questions: Curriculum Framework Implementation

Case Study Focus Questions: Curriculum Framework Implementation

Research Question

What processes are being used at the state, intermediate, and school levels to implement state mathematics or science CFs?

Research Areas (State Focus):

Context

- What was the impetus for engaging in CF implementation (e.g., legislated mandates, Eisenhower grant, SSI funding)?
- In what context is the state implementing a CF? What constraints, if any, are there (e.g., legislative, district, building)? What conditions facilitate or inhibit implementation of the CF?
- Was there a precursor to the state's CF implementation effort? If so, what is the relationship of this effort to the previous one? How are they (a) similar and (b) different?
- To what extent is the implementation of the state's CF (a) a grassroots effort or (b) a top-down effort?
- If the CF directly addresses the implementation issue, which of the following components are included and to what degree of specificity: long-range planning, professional development, curriculum development, school-community relations, resources, evaluation?

Resources

- What resources are available for the implementation effort (e.g., people, printed materials, computer software, professional development support, programs, funds)? What form do they take and how are they packaged?
- Who are the major players and how do they interact?
- How has diversity been considered in selecting the CF implementation team(s)?
- What is the level of CF experience of each of the people working on the state's implementation team(s)? Are these people from within the state? Have outside consultants been brought in to serve in or support this role? If so, how were they selected?
- If funding is available for implementation of your state's CF, are the funds committed for a portion of the implementation effort or all of it? What is the time frame during which these funds will be available? What is the status of funding for the current implementation effort?
- Is funding coming from multiple sources? If so, how is it being coordinated?
- What types of support or opposition has your state received from existing efforts or organizations (e.g., state professional organizations, NSTA, NCTM, Project 2061)? To what extent are the CF implementation efforts coordinated with efforts of these organizations?
- What is the extent to which the process of CF implementation in your state is being informed by the national reform efforts (e.g., emerging national instructional and assessment

standards)?
- To what extent does the state align its CF implementation effort with other state reform efforts (e.g., textbook adoption, assessment, certification)?

Process

Approach

- What approaches are being used in the state to implement and disseminate a CF (e.g., grassroots effort, committee or team effort, the use of consensus decision making)?
- How was the implementation process derived? Was it modeled on other CF implementation processes?
- What is the time line for implementation of the CF?
- What are the expectations or goals of the CF implementation efforts? Are these goals shared by all constituents?

Support

- Who will be informed of the CF and how?
- Who has buy-in to the implementation effort and who does not?
- How is the state dealing with opposition to the CF implementation effort?

Equity

- How is equity being assured in the CF implementation dissemination effort?
- How are different needs of different users accommodated in the CF implementation process (e.g., rural, urban, suburban, public, private, traditional, radically innovative)?

Professional Development

- To what extent is dissemination or implementation of the CF document accompanied by professional development?
- What forms of professional development are planned, when will they begin, and how long will they continue?
- How will the intended use of the CF be supported (e.g., follow-up to professional development)?
- Are implementation efforts consistent with the professional development standards?

Subject-Area Integration

- What special problems arise in states implementing integrated mathematics/science CFs as opposed to those implementing a single-subject focus?

Evaluation

- How are implementation and dissemination of the CF being monitored?
- What are the mechanisms for CF revision and how do they function?