The Landscape of High School Science Curriculum Decision Making

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I. Introduction

In 1996, NSF solicited proposals for the first Curriculum Implementation and Dissemination Centers to facilitate the dissemination and implementation of curricula developed with Foundation funding. In their first RFP, NSF described their vision:

> *Science and mathematics education reform requires classroom implementation of high-quality standards-based instructional materials, together with a comprehensive program of professional development for teachers…along with the alignment of district policies, practice, and resources. The Instructional Materials Development and Teacher Enhancement Programs seek to establish implementation sites that will provide information and technical assistance to decision-makers who are responsible for selecting materials and ensuring their implementation in those districts that have decided to implement NSF-supported exemplary materials. These sites should increase awareness of alternatives; identify strategies for selection of materials that are appropriate for local needs; and provide technical assistance necessary for broad scale implementation….*

BSCS, with its long history of curriculum and professional development in secondary science, seemed a natural agent for carrying out this work in science. Believing that secondary science was in particular need of support and improvement, they wrote and received a grant in 2000.[1] A major activity of the BSCS implementation and dissemination center was the establishment and support of the National Academy for Curriculum Leadership (NACL) by BSCS. Between 2001 and 2005 BSCS worked with district teams seeking to improve their secondary science programs – and particularly their selection, adoption and implementation of textbooks and other instructional materials – with support from the NACL's three-year program. Inverness Research Associates evaluated that program.[2] BSCS also asked Inverness Research to undertake a complementary line of work to help it and the field better understand the support that is available for secondary science education and the context within which high school science curricular decisions are made.

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[1] In May 2000, BSCS received Award No. ESI-9911615 from the NSF to establish a high school implementation and dissemination center. BSCS named that project "The SCI (Science Curriculum Implementation) Center at BSCS." The funding for the SCI Center project ended in 2005; consequently, BSCS does not list the SCI Center at BSCS on its website. The work of the SCI Center continues within the BSCS Center for Professional Development, one of three centers established by BSCS in 2003. For more information about the BSCS Center for Professional Development, see the BSCS website at www.bscs.org.
[2] Findings from our report on our evaluation of this initiative, "The BSCS National Academy for Curriculum Leadership: Contributions and Lessons Learned" (2006) are available at www.bscs.org and www.inverness-research.org.

In 2000 we administered our first national landscape survey on curricular decision making in high school science.[3] It paralleled similar surveys that we administered for NSF Curriculum Dissemination Projects in elementary and secondary math.[4] Inverness and SCI Center staff conducted and debriefed follow-up interviews with high school and district-level science leaders to deepen our collective understanding of the interests, challenges and needs of high school science decision-makers at the departmental and district level.

Between 2000 and 2005, No Child Left Behind was instituted, funding and staffing challenges deepened, and calls increased for improved high school science programs. Therefore, BSCS asked for and was granted a supplementary grant in 2005 that included provision for replication of the 2000 study.

[3] On the surveys and throughout this report, we use the term curriculum to refer to curricular or instructional materials rather than to a course of study independent of the materials used to teach it.
[4] Results for the three surveys were presented at an NSF meeting of the centers in 2002.

II. Methodology

This report focuses on results from a survey we conducted in spring 2005. Selected findings from a study we conducted five years earlier are included to permit a discussion of changes and continuities over the five years. While there was considerable overlap in the content of the two surveys, the methodologies employed were different, as described below. (See Appendix A for additional details about the methodology, and Appendix B for survey protocols from both studies.)

2000 study

Inverness Research conducted a nation-wide study of high school science curriculum decision-makers for grades 9-12 in 2000-2001. The study included two separate, but complementary, methodologies. We first conducted a survey of decision-makers in high school science. We then conducted in-depth interviews with a sample of respondents to that survey.

We mailed the survey to 4,200 high school science education leaders including a random sample of high school science department chairs drawn from the National Center for Educational Statistics (NCES) database and science supervisors on the high school mailing list of the National Science Education Leaders Association (NSELA). We received 757 responses from 49 states and the District of Columbia, for an overall return rate of 18%.[5]

The vast majority of respondents (80%) held a school position (mostly as department chairs), another 15% worked at the district level, and 6% were on sabbatical, recently retired, etc. Respondents were asked to respond from their professional vantage point, i.e., those with a school-level position were asked to think of their school when answering questions about their "school/district," while those in district-level positions were asked to respond with regard to grades 9-12 in their district when responding to these same questions.

We received responses from 49 states and the District of Columbia. By locale, 17% represented a school or district in an urban area, 23% were in schools and districts in small cities, 39% represented a suburban school or district, and 22% were from a rural

[5] We do not believe that the survey presented any special barriers to completion. We have, however, noted a general (and continuing) decline in response rates for such surveys since the late 1990's. Anecdotal evidence suggests that a combination of "survey fatigue," privacy concerns, and increasingly heavy professional responsibilities tend to hold down survey response rates for both paper and online surveys, even when an honorarium is offered.

region.[6] This is somewhat similar to the distribution of all U.S. schools: 24% of American schools are in a large and mid-size city, 49% are in suburban or small city areas, and 27% are in rural areas.

Teams of Inverness researchers, BSCS NACL staff, and WestEd professional developers conducted 39 follow-up interviews with a representative range of survey respondents. Discussions of these interviews, along with findings from the initial survey, have informed the work of the SCI Center since that time.

2005 study

Nearly 700 schools and districts from 49 states are represented in our 2005 survey findings, and they provide a broad perspective on high school science curriculum decision making. Moreover, as can be seen in this report, there is considerable stability in the findings from 2000 to 2005. We therefore believe that our findings are useful for discussion of the status quo and trends related to curriculum decision making in high school science. However, there are issues with our 2005 respondent group that leave us unable to report with confidence that our respondents are fully representative of the nation's school and district high school leaders.

In spring 2005, we drew national samples of schools and districts from NCES databases. For schools we created a stratified sample based on region, locale, and a poverty measure. Our sampling plan for districts was based on region, locale, and size of district. We mailed invitations to respond to an online survey to 3,200 high school science department chairs and to an equal number of district supervisors of high school science. Invitations were addressed by title rather than name because names of science supervisors are not available for a randomly distributed survey. We offered an honorarium to early responders and held a drawing for honoraria for the rest. We also sent follow-up postcards. 694 leaders responded, for a response rate of 11%. We invited a small number of non-respondents to respond to a very short survey of key questions, but too few responded for us to be able to comment on the match between the respondents and the non-respondents. Rural leaders replied disproportionately, and presumably some of them are also among the numerous respondents who were invited to respond from a district perspective, but elected instead to respond from their vantage point as school science leaders. Further details on the methodology and response rates for the two surveys are provided in Appendix A.

[6] The following definitions were provided on the survey: urban area – strongly urban characteristics and population over 100,000; suburban area – population of 5,000 to 100,000 near or part of a larger populated area; small city – population of 5,000 to 100,000 not near or part of a larger populated area; rural area – strongly rural characteristics and population less than 5,000.

III. Summary of Findings

In the following five sections, we summarize the major findings from our landscape survey. Each section addresses a particular question related to curricular decision making. Where appropriate, we indicate perceptions of change over the last five years, and, where available, report comparisons to data we collected from a similar sample in 2000. In addition, where appropriate, we show differences between perceptions of school-level leaders and district-level leaders.

The question framing the first section – "*What is the current status of high school science curricula*?" – explores issues related to the current landscape of high school science programs. What does the typical program look like? What kinds of courses are offered, and in what sequence? What is the nature of the materials that are used, and what do leaders think of these materials? What are the characteristics of current science instruction? What are the contextual barriers to improvement or change? This section illuminates important contextual dimensions of the landscape.

The second section addresses the question: "*How are high school science instructional materials selected and adopted*?" Here, we present leaders' perceptions about the nature and quality of the selection and adoption process. We ask who the key decision-makers are, how selection and adoption takes place, and what resources decision-makers consult in their process and the relative value of those resources. This section also explores the extent to which leaders are familiar with NSF-funded materials, and whether they are negatively or positively inclined to know more or use them in their own schools and districts.

Section three presents an analysis of the questions: "*What shapes curriculum decision making?* and *What criteria do local science leaders use in selecting curricula*?" Following from the contextual barriers and issues presented in the first section, and the resources leaders use in the second, we outline ways other external factors – such as standards and tests – influence the selection and use of high school science curricula. In addition, we present leaders' reports of the most critical design criteria when selecting curricula.

The fourth section is framed by the question: *"How satisfied are local high school science leaders with instruction, instructional materials, assessment practices, and professional development?"* In other words, how satisfied are leaders with their science programs today?

In the final section of this report we present an analysis of the answers to the questions: *"How much interest is there in changing instructional materials?* and *How does change happen?"* This fifth and final section explores the extent to which and ways in which schools and districts are interested in and ready for change in their science courses and program. That is, given the current context for change, levels of satisfaction, resources and influences, what is the likelihood that schools and districts will change their science courses or programs?

We conclude each section with a brief summary and comments.

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1. What is the current status of high school science curricula and materials?

This section portrays the current status of high school science programs of the 694 respondents to our 2005 survey. It describes the ways in which their high schools organize and present science courses, the requirements they set for graduation, and the nature of materials in current use. It also summarizes findings related to the nature of high school science instruction, the role of professional development to support curriculum implementation, and leaders' perception of change in these factors over the last five years.[7] Finally, this section addresses current contextual barriers and issues facing schools and districts.

What were the typical high school science programs and course sequences at schools and districts represented by our survey respondents in 2005?

Number of semesters required. About half (47%) of all high schools and districts on the semester system required at least seven or eight semesters (three+ years) of high school science. Another third required five or six semesters, and small minorities required fewer semesters (13%) or more (7%) of science.[8]

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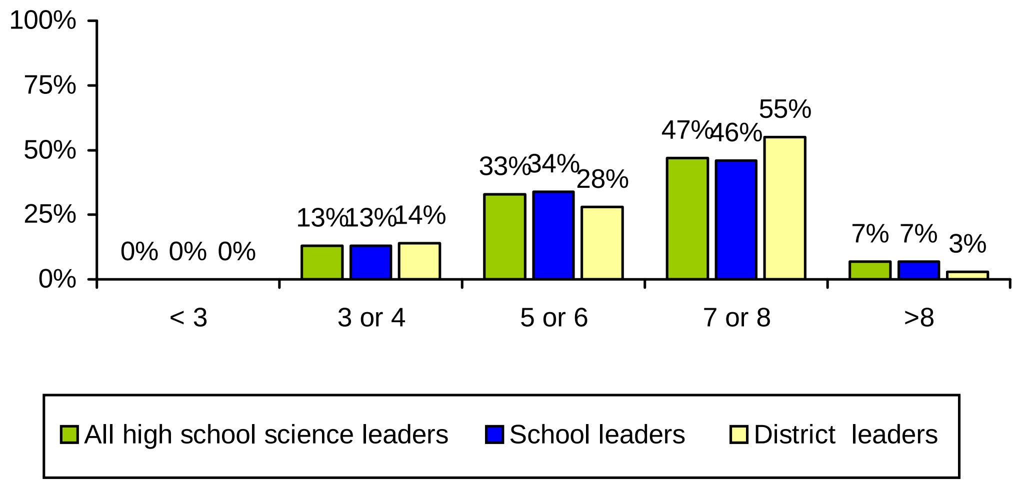
[7] There are two important points to remember about the data that follow: As indicated in the methodology section, we do not want to overstate the generalizability of the data we collected. While we sampled carefully to identify leaders to invite to participate, the response rate was not sufficient for us to feel confident that this group is broadly representative of all high school science leaders. Secondly, leaders at the building level (generally science chairs) and at the district level often gave very similar answers. Unless noted otherwise, results presented for leaders at the school and district level have been combined. Only when there are notable differences between the two groups are the two sets of results presented separately.

[8] About 7% of the respondents were on the quarter system. Of this small group, 38% required 4-6 quarters, 38% required 7-9 quarters, and 23% required 10-12 quarters.

Semesters of high school science required by schools and districts (2005)



Course sequence. Most of the surveyed schools and districts held to the traditional course sequence in high school science: first biology, followed by chemistry, and then physics, at least for their college-bound students.

Sequence in which core science courses were taught (2005)

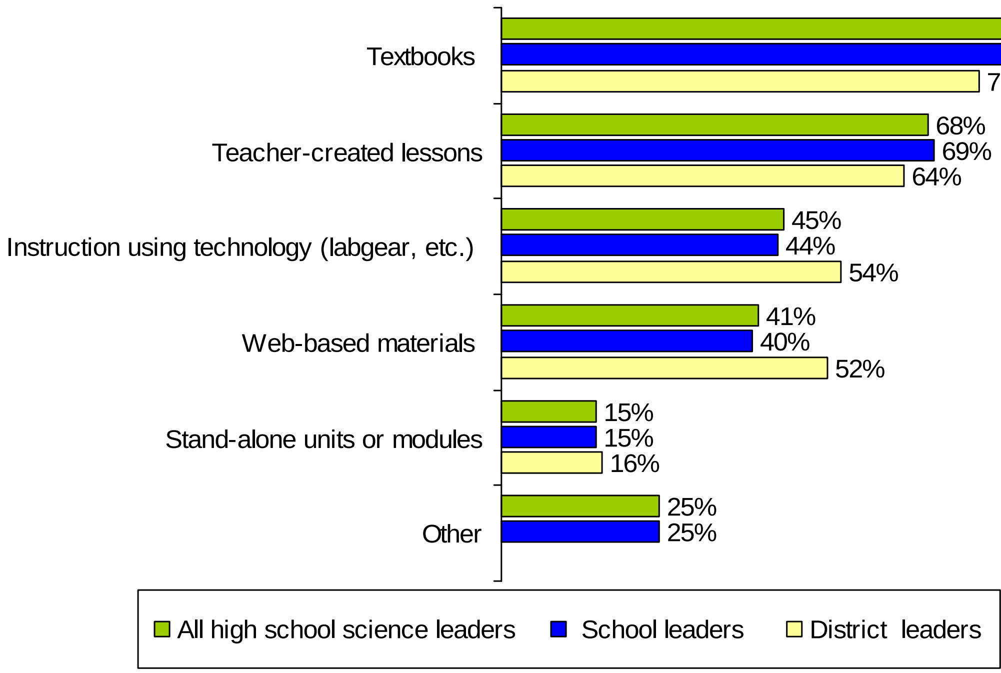
	Taught 1st	Taught 2nd	Taught 3rd	Varies
Biology	**83%**	11%	1%	5%
Chemistry	3%	**76%**	7%	15%
Physics	4%	2%	**73%**	22%

- However, about one in four of our survey respondents represented a school or district where there was a different sequence (e.g., Physics was not taught third) or the sequence varied. It could vary because of programmatic innovation, because there are separate tracks for college-bound and other students, or because of staffing limitations or low student enrollment. Several dozen respondents also commented that Earth Science or Physical Science precedes this sequence.

What is the nature of the instructional materials in current use?

Frequently used instructional materials. On average, leaders who responded to the 2005 survey said that their teachers made frequent use of two or three different types of instructional materials. Textbooks and teacher-created lessons were by far the most frequently used instructional materials, used often by 81% and 68%, respectively, of the surveyed schools and districts. Technology-based instructional materials (laboratory equipment and web-based materials) were used often in over 40% of the schools and districts. Only a small minority of schools and districts frequently used stand-alone units or modules at a course level or a lesson level.

% of leaders who reported that different kinds of instructional materials were used frequently in their schools and districts (2005)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not at all," 3 = "To some extent," and 5 = "To a great extent."

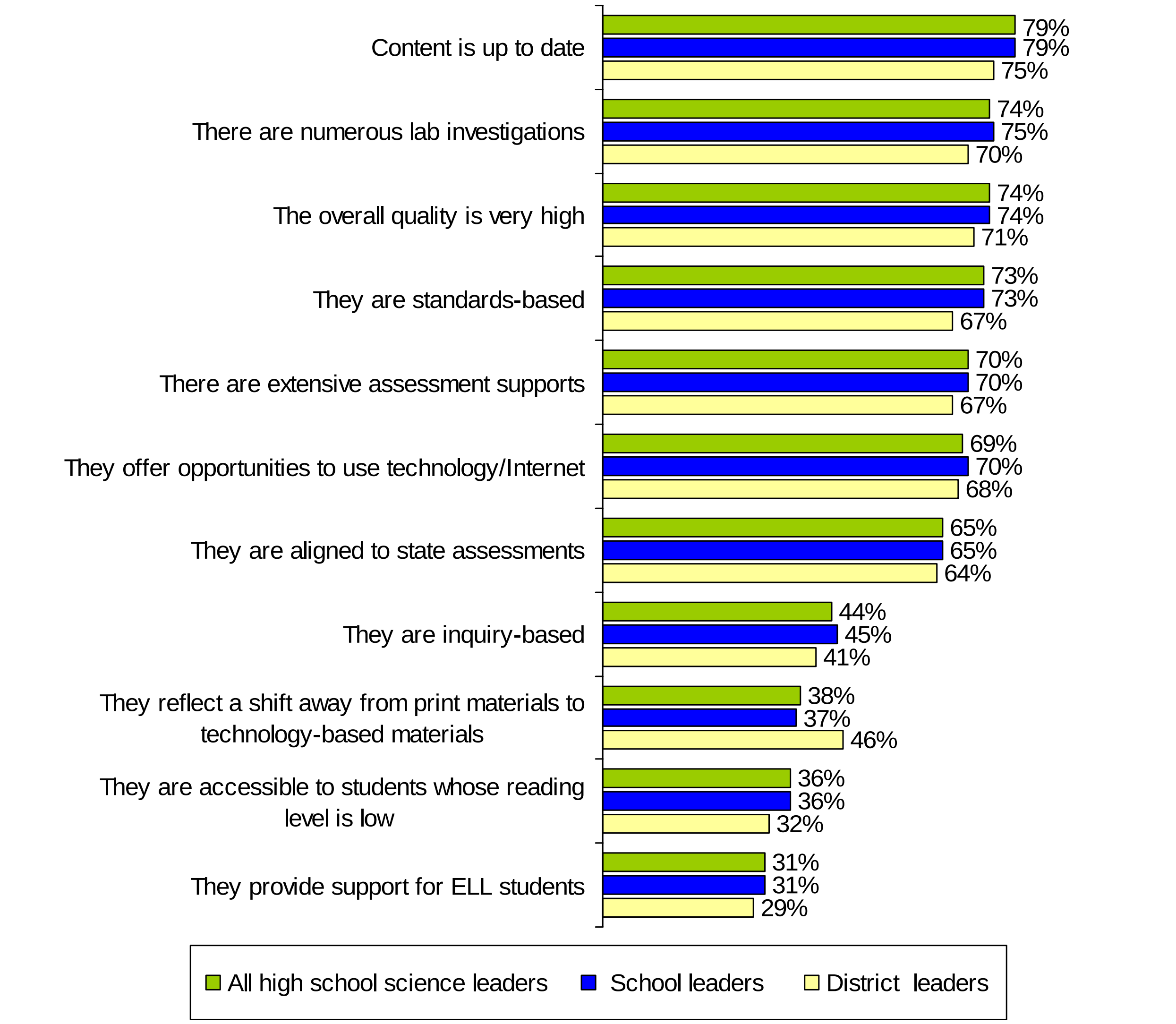
Very few who said that other materials were often used explained what they meant. One who did may have described a common situation: *"The use of instructional materials and technology in the classroom is very teacher-dependant. Some teachers change their instruction methods regularly and easily. Other teachers are doing the same things that they did five, ten or even fifteen years ago."*

Perceptions of instructional materials in current use in 2005. Three-fourths of the survey respondents reported that the overall quality of their own school's or district's local instructional materials in high school science was very high (74%). More specifically, they said that the content was up to date (79%), numerous lab investigations were included (74%), and there were numerous opportunities for technology use (69%). With respect to standards and assessment, they reported that their instructional materials were standards-based (73%), provided extensive assessment supports such as test banks and formative assessments (70%), and aligned to state assessments (65%).

Fewer than half believed that their materials were inquiry-based (44%) and/or reflected a shift away from print to technology-based materials (38%). About one-third reported that their materials supported poor readers (36%) and non-native speakers of English (31%).

Although high school science leaders gave generally high marks to instructional materials, two-thirds of them also indicated that the textbooks in current use in their schools and districts covered way too much content (67% reported that this was true), and/or were too big and heavy (66%).

% Of leaders who reported that current instructional materials for high school science have the following desirable characteristics (2005)

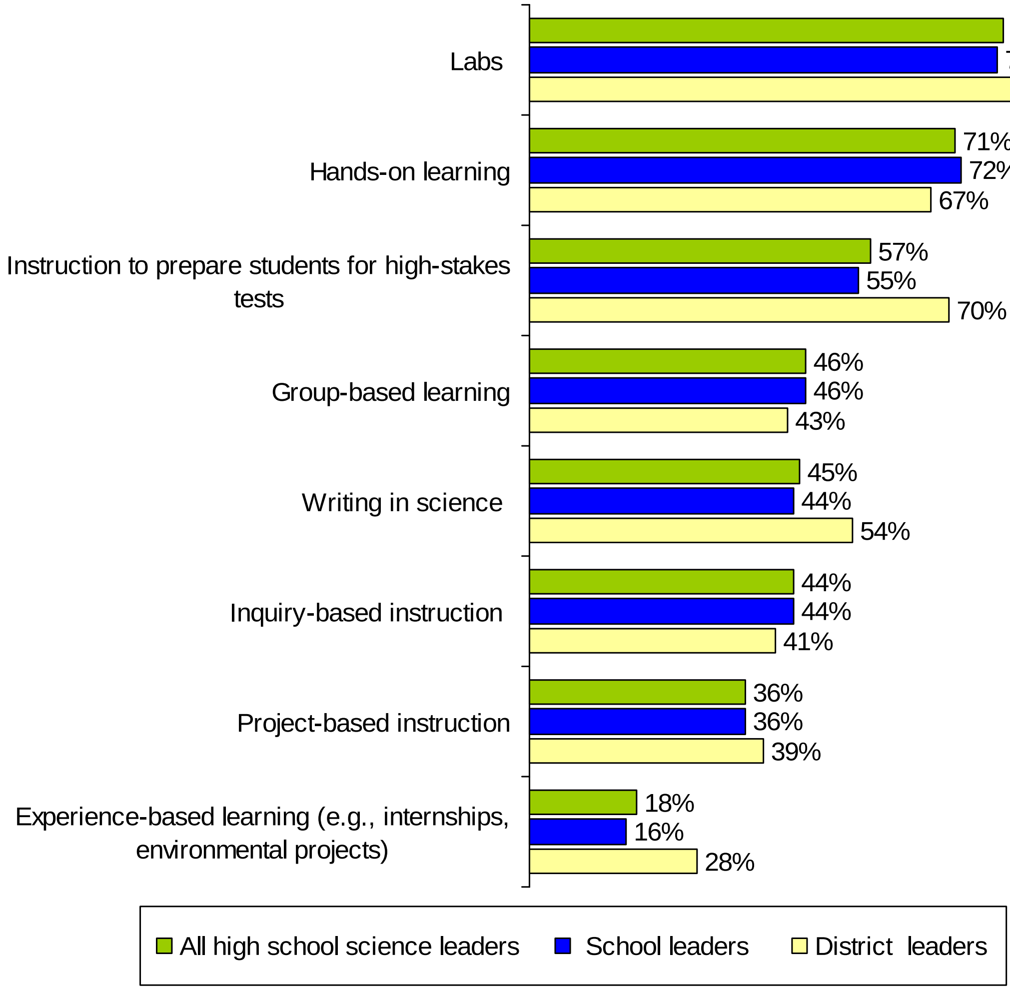


Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not true at all," 3 = "Mixed/varied," and 5 = "Completely true."

What is the nature of current instruction?

In 2005, about three fourths of our survey respondents reported frequent use of science labs (79%) and opportunities for hands-on learning (71%). Well over half (57%) reported that preparing students for high-stakes testing is a prevalent approach to instruction. Substantial minorities also reported frequent use of group-based learning (46%), writing in science (45%), and inquiry-based instruction (44%) in high school science instruction. Fewer schools and districts said that they use project-based instruction (36%) and/or experience-based learning in science (18%).

% of high school science leaders whose schools and districts frequently used selected instructional approaches in high school science (2005)



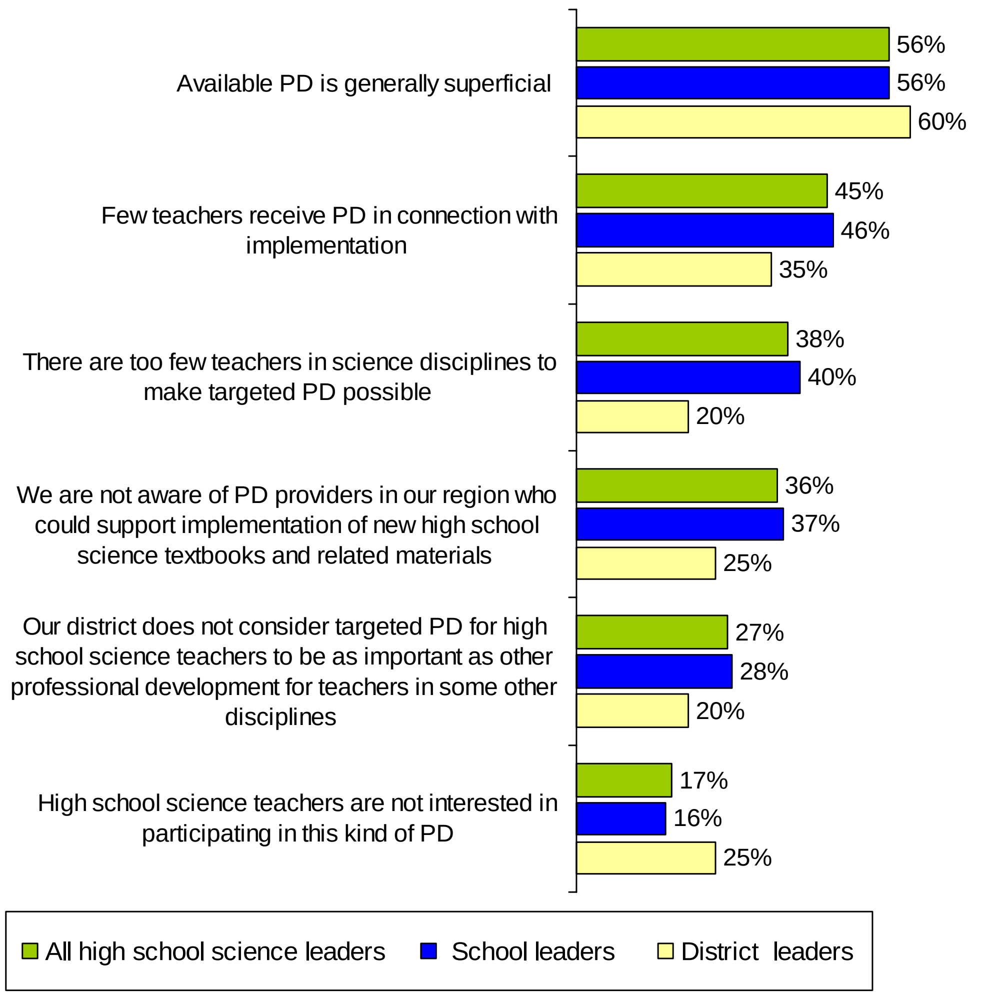
Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not at all," 3 = "To some extent," and 5 = "To a great extent."

How does professional development support curriculum implementation in high school science programs?

Influence of state standards and testing on the professional development offered in high school science. 63% of school leaders and 80% of district leaders who responded to our 2005 survey said that state standards and testing were major influences on high school science professional development.

Barriers to providing professional development (PD) to support implementation of high school science instructional materials. Almost half (45%) of the school and district leaders who responded to the survey reported that few high school science teachers received any PD in connection with materials implementation. However, that is not for lack of interest; only 20% said that high school science teachers were not interested in this kind of PD. Over half of our survey respondents (56%), said that the generally superficial nature of the PD that is available was a barrier to providing the substantive PD that would be needed to support best use of instructional materials. Other barriers they identified were the small numbers of teachers in particular science disciplines y (38%), absence of local PD providers that schools and districts could enlist to help (36%), and the low priority in the district for this kind of PD (27%).

% of high school science leaders who faced barriers to providing professional development that would support implementation of high school textbooks and other instructional materials (2005)



Percentages reflect the responses of the 84% of survey respondents who checked at least one barrier.

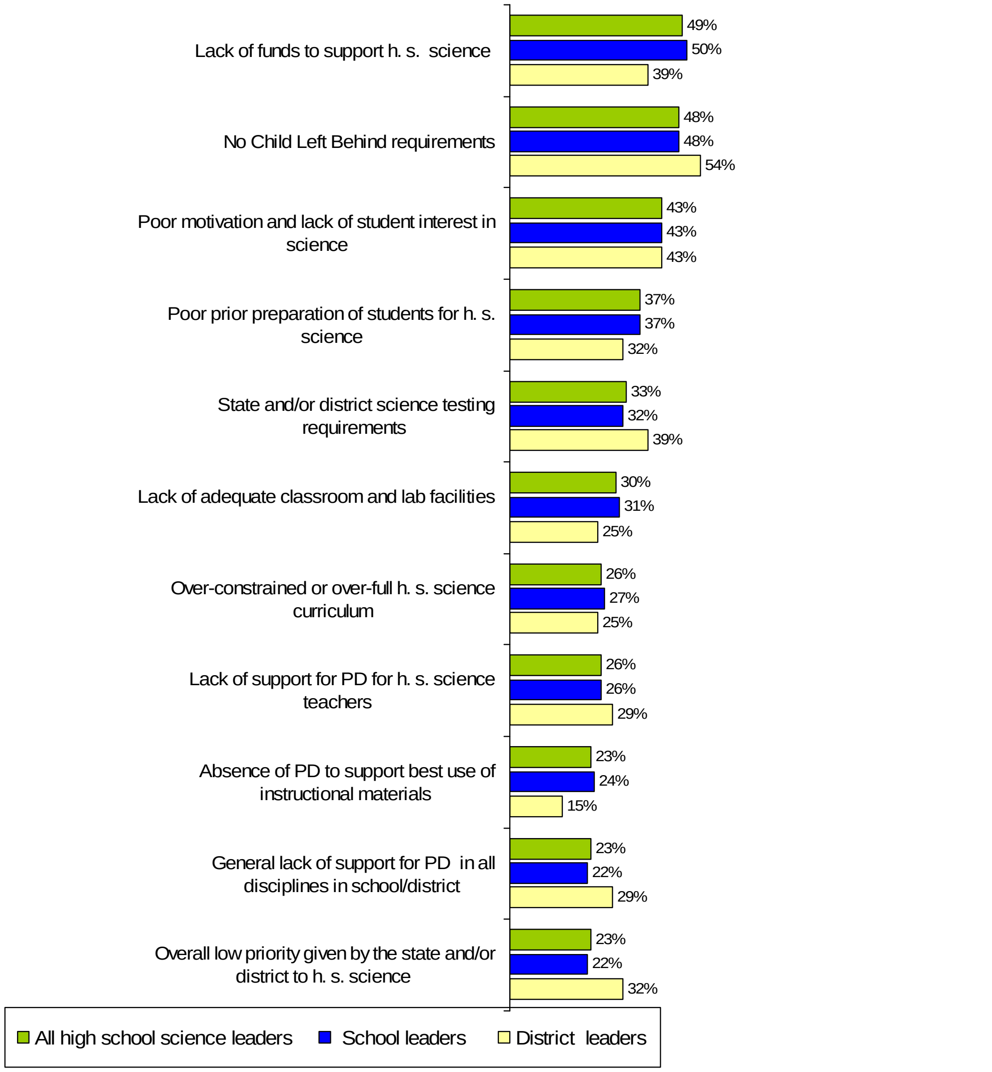
What are the major problems and barriers that shape curriculum decision making at the local level?

Contextual factors affecting high school science instruction reflect the climate of accountability. Funding, federal requirements around NCLB, and lack of student interest in science are the factors that concern the most leaders. Half of the leaders who responded to our 2005 survey said that a lack of funds to support high school science (cited by 49%) and/or the requirements of NCLB (cited by 48%) were substantial barriers to improving high school science.

There are other problems and barriers in a significant minority of districts. Forty-three percent of our respondents said that students' poor motivation and lack of interest was a problem and 37% reported that students' poor preparation was a problem. Twenty-six percent said that an over-full or over-constrained science curriculum was a problem.

About one-quarter saw the absence of support for professional development in high school science (26%) and/or the absence of professional development to support best use of instructional materials (23%) as problems. However, this does not appear to be a problem unique to science; 23% of our survey respondents said that there was also weak support for professional development across other subject areas such as mathematics or English.

Top problems and barriers shaping curricular decision making (2005)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not a problem," 3 = "Somewhat of a problem," and 5 = "A very great problem."

Other factors that we thought might be important in shaping curricular decision making were seen as substantial problems or barriers by only a minority (20% or fewer) of our survey takers. They include lack of a supportive and coherent assessment system (a barrier for 19%); a lack of a clear vision for high school science (a concern for 17%); a dearth of good curriculum and instructional materials (a barrier for 15%), tracking policies (11%); teachers who are not well-prepared to teach science content knowledge (10%); teachers' weak instructional skills (9%), and teachers teaching out of field (7%).

How has the status of high school science changed over five years?

Throughout this document we report on change in the status of high school science between 2000 and 2005. "Change" is measured in two ways: one is the current leaders' *perceptions* of change (the perspective of respondents to our 2005 survey as they reflected on changes over the prior five years) and the other is our comparison of results from our 2005 survey with results from our 2000 study.

Below we highlight leaders' perceptions in 2005 of the nature and extent of changes in high school science between 2000 and 2005. Additional detail follows this summary.[9]

Comparing the status of high school science in 2000 and 2005, our survey respondents said:

- More science is required now in a third of the schools and districts

- High school science course offerings have changed in two-thirds of the schools and districts, and the changes have been significant in a quarter of the schools and districts

- High school science courses are offering more active learning opportunities in at least half the schools and districts, with increased labs in half of them, and more fieldwork in a quarter of them

- There is more differentiation of course offerings to meet the needs of low, average, and high level learners, with, for example, more offerings for at-risk students in 47% of surveyed schools and districts

- Twenty percent of the science leaders indicated that the boundaries that segregate students according to ability, that isolate different science disciplines, and that hold science apart from other disciplines have been reduced or lowered over the past five years

- The percentage of science leaders who said that state standards are a significant influence on high school science professional development has tripled (from 22% to 65%)

- The percentage of science leaders who said that a frequent purpose of instruction is to prepare students for tests has also nearly tripled (from 22% to 57%)

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[9] For complete data on change over five years for each section, see Appendix C.

Areas where leaders said there has been little change include:

- The sequence in which biology, chemistry and physics are typically taken

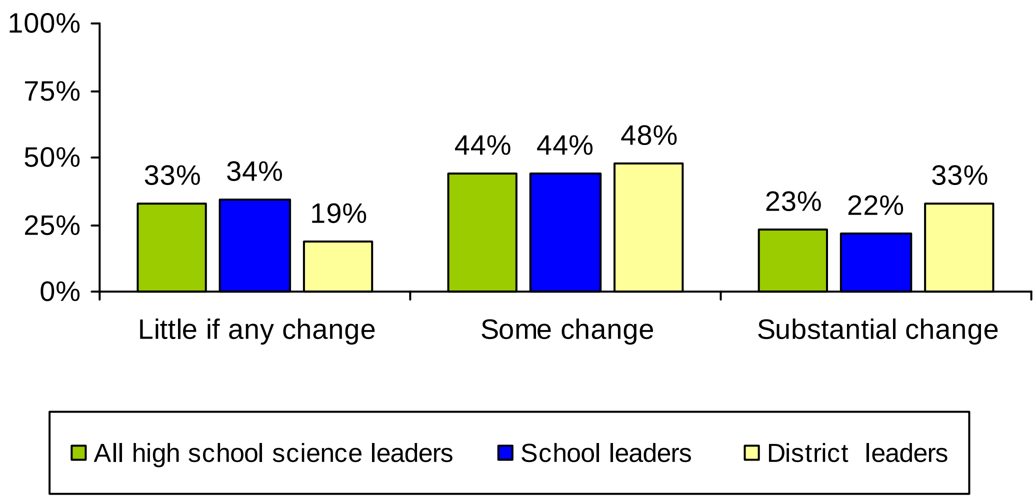
- Use of appropriate instructional materials with at-risk and non-native English speakers

Below we provide further detail on some of these findings.

Amount of science required. In the five years between 2000 and 2005, more than a third of the schools and districts represented by survey takers (35%) had increased the number of semesters of science required. In contrast, during the same period, just 2% of the schools and districts had reduced their science requirements.

Course offerings. Fully two-thirds of the respondents (67%) said that their course offerings had changed to some extent, and a quarter said that there had been significant changes. Schools have, for example, added or eliminated a science survey course at 9th and/or 10th grades, added career related courses (e.g., in biotech or agriculture), or modified course offerings in direct response to testing. More district representatives reported change than did their school counterparts.

Amount of change in course offerings over last five years (as reported in 2005)



Sequence of core science courses. Despite other modifications to the set of science courses that were offered, over the last five years there was virtually no change in the sequence in which the most common high school science courses were taught. The traditional sequence remained first biology, then chemistry, and finally physics, especially for college-bound students.

Nature of courses offered. Nearly half of the science leaders (48%) reported that the lab component of science courses has increased.

% Of high school science leaders who reported in 2005 that selected aspects of high school science courses have changed over the prior five years

	Decreased	Stayed the same	Increased
The lab component of science courses	8%	44%	48%
The fieldwork component of science courses	11%	64%	25%
Integrated/multidisciplinary science courses	7%	73%	20%
Science courses that include other disciplines (e.g., mathematics)	5%	77%	18%

Courses that target particular kinds of students. About half of the science leaders (47%) reported that more science courses were targeted to students "at-risk" in 2005 than five years earlier. A substantial minority also had more courses targeted for other students as well: in 2005, 38% had more AP courses, 35% had more courses for average students, and 25% had more for remedial students. About a quarter of the leaders said that there were more courses where students were grouped heterogeneously, and 12% said that there were currently more tracked classes.

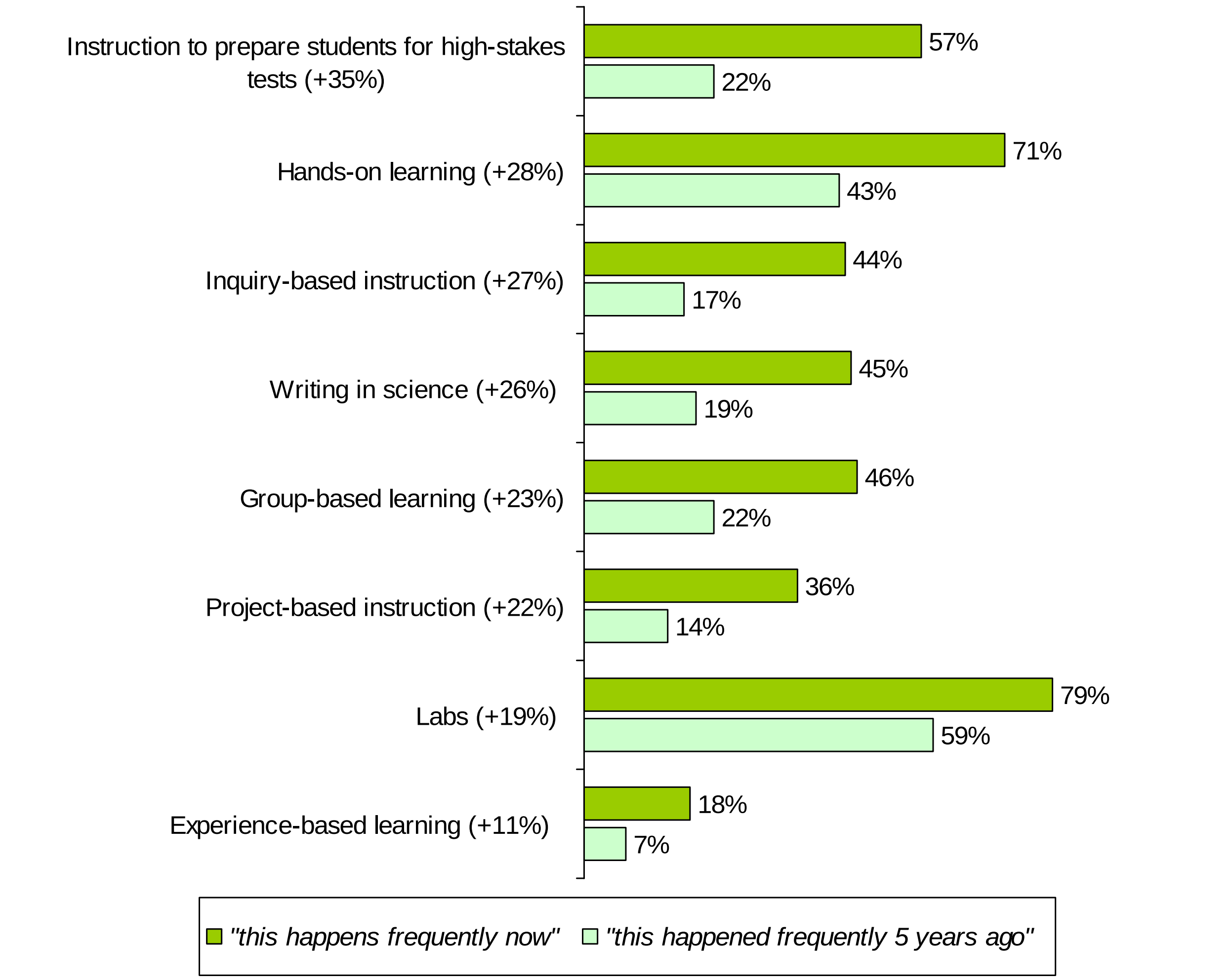
% of high school science leaders who reported in 2005 that the number of courses targeting particular kinds of students decreased or increased over the last five years

	Decreased	Stayed the same	Increased
Courses targeted to students at risk	6%	47%	47%
Courses targeted to AP students	10%	52%	38%
Courses targeted to average students	2%	63%	35%
Remedial classes	13%	60%	27%
Courses in which students are grouped heterogeneously	6%	71%	23%
Courses in which students are tracked	18%	70%	12%

Teaching styles and instructional strategies. About a third of the survey respondents (36%) told us that the teaching styles and instructional strategies used in high school science in their school or district have changed to a large or great extent between 2000 and 2005.

The number of schools where there is frequent instruction to prepare students for tests increased the most; the percentage of schools and districts where there is frequent instruction to prepare students for high stakes tests nearly tripled over five years (57% of schools and districts, up from the 22% of schools and districts where test-oriented instruction was often provided five years earlier). Almost all of the rest of the teaching styles and instructional strategies we asked about were used more frequently in 2005 than five years earlier in as many as 20% to 30% of the schools and districts represented by our survey respondents.

% of high school science leaders who reported in 2005 that teaching styles and instructional strategies were in frequent use currently and five years earlier (ranked by extent of perceived change over the five years)[10]



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not at all," 3 = "To some extent," and 5 = "To a great extent."

Use of instructional materials. Nearly one-third (29%) of the science leaders reported that there has been a large to great change in the instructional materials used in high school science in their school or district over the previous five years. More district-level

[10] Separate change data for district- and school-level high school science leaders are provided in Appendix C.

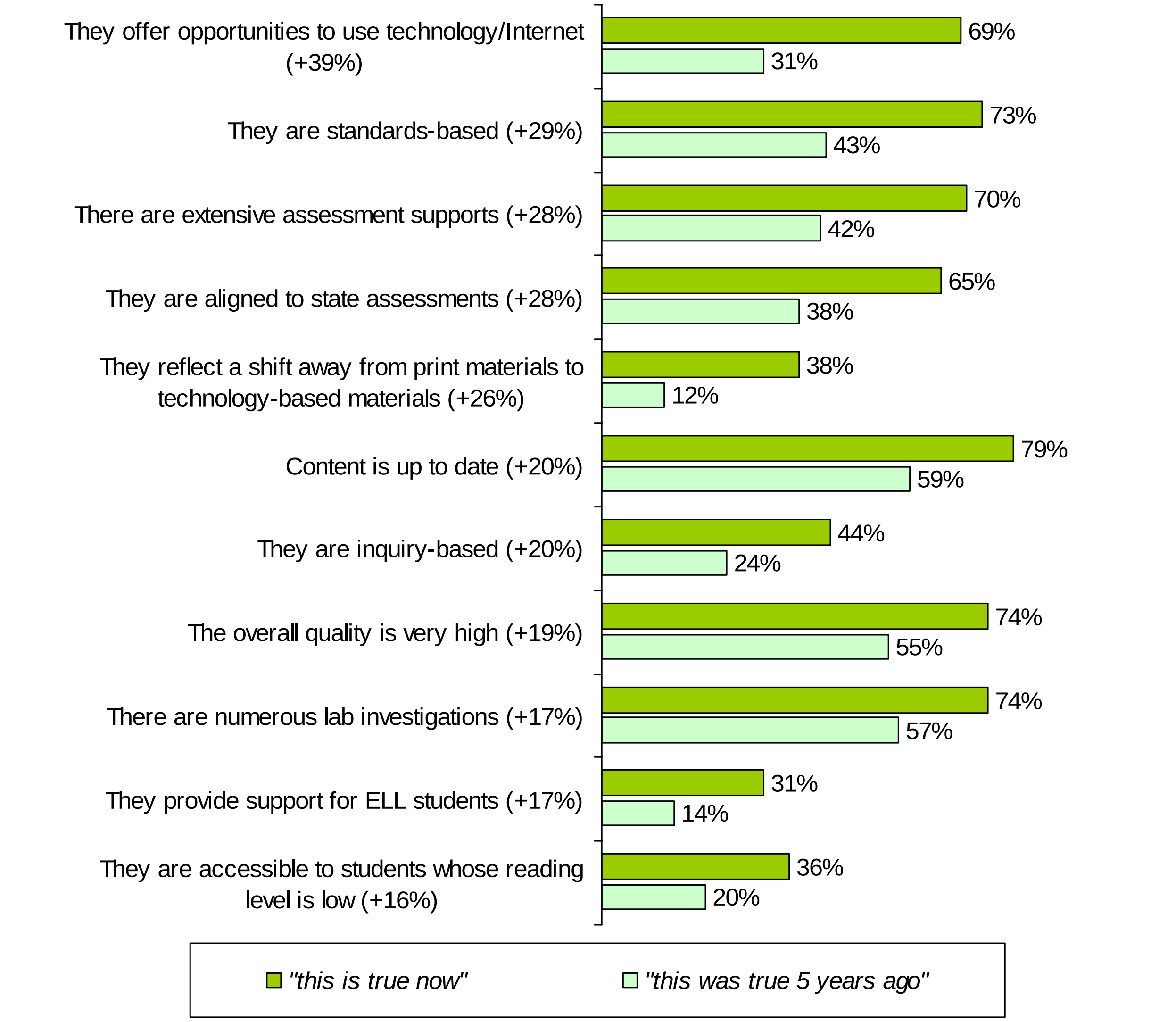
leaders (40%) perceived a substantial change in instructional materials than did school-level leaders (27%).

A third of the schools and district leaders who reported they currently made frequent use of web-based materials and technology-based instruction said they were not using them frequently five years earlier.

Characteristics of instructional materials. Between 2000 and 2005, the most widespread changes in instructional materials were that in 2005, more schools and districts were using materials that utilize technology (up 39%), that offer extensive assessment support such as test banks or formative assessment (up 28%), and that are standards-based and aligned with state tests (up 29% and 28% respectively).

There has been little movement in several aspects of instructional materials, specifically the implementation of high school science materials to address the needs of at-risk students and non-native speakers of English. In 2005, just one in six respondents said that their schools and districts had better instructional materials for these students than they did five years before.

Characteristics of instructional materials in current use (2005) and in use five years earlier (2000) (ranked by extent of change over the five years)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not at all," 3 = "To some extent," and 5 = "To a great extent."

Summary and Comments

In general, science leaders in 2005 were quite satisfied with the curricula and instructional materials they were using. This was also true five years earlier, according to leaders' recollections. This suggests that efforts to improve curriculum are not and will not be driven by dissatisfaction with the current programs. In addition, now and five years ago it remains true that the majority of instruction is based on textbooks and teacher-generated lessons, very traditional instructional materials. However, the perceived increase in the use of technology to support classroom instruction may have implications for curriculum developers.

District leaders perceived more change in several areas than did their school-based colleagues. For example, more district leaders said in 2005 that a lot of instructional time was currently given to preparation for high-stakes testing, writing in science, and experienced-based learning. It is possible that district leaders believed that schools were using instructional approaches that were in vogue or that responded to external mandates more often than the schools actually were doing so.

The impact of the current climate of accountability, including the NCLB act, is noteworthy. Although NCLB is not targeted specifically at high school science, our survey findings are consistent with the intent of the act – that it would influence the entire K-12 system. Districts and schools reported that curricular choices and teaching quality are increasingly constrained by the need to prepare students to succeed on standardized tests, and to meet state and national content standards and requirements. Other contextual factors outside of the control of most schools and districts – such as funding and student preparation – have also been perceived as considerable barriers to improvement.

While overall satisfaction with instructional materials is high, the need for improvement seems greatest for materials designed for non college-bound students as well as for English language learners. This was true in 2005 and also five years earlier in 2000.

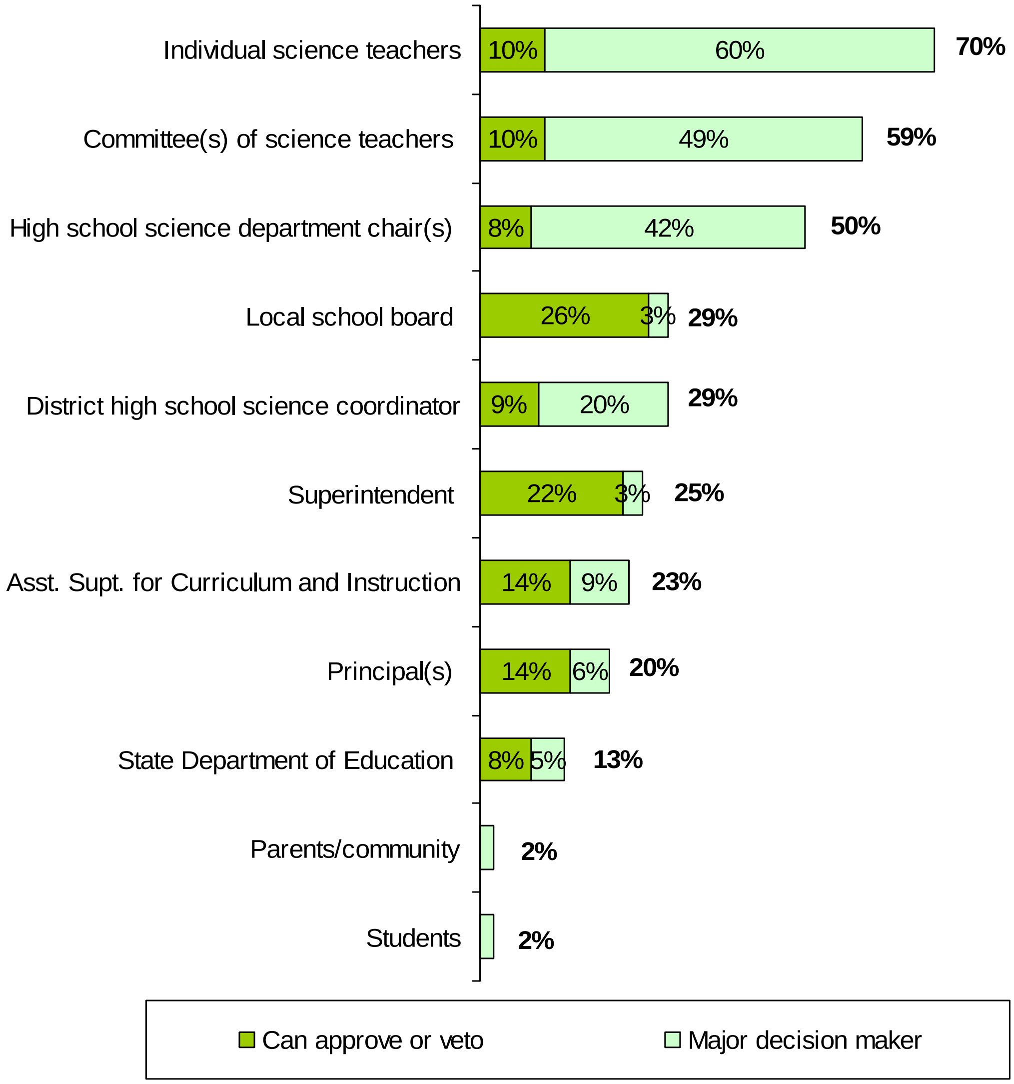
2. How are high school science instructional materials selected and adopted?

This section portrays the processes by which decisions are made for selecting and adopting curriculum materials. It outlines who makes decisions, the processes used in selection and adoption, and the degree to which leaders are satisfied with those processes. In addition, we asked leaders to identify resources they used to inform these processes, and how valuable they found those resources. Finally, this section summarizes leaders' familiarity with NSF-funded materials, and their impression and usage of those materials. We also present data from our 2000 survey of leaders' familiarity with and interest in NSF-funded materials.

Who is involved in selection and what are their roles?

Major decision-makers. Survey results suggest that, as might be expected, science teachers have a major voice in decisions about curricular materials. Individual science teachers (identified as key decision-makers in 70% of the schools and districts), committees of science teachers (important in 59% of schools and districts), and high school science chairs (central in half of the districts) are the only key decision-makers that a majority of the schools and districts have in common. Looking more closely, we see in the districts and schools represented by our survey respondents that local school boards and superintendents have veto power in a quarter of the schools and districts.[11]

Major decision-makers in selecting high school science textbooks and related materials (2005)

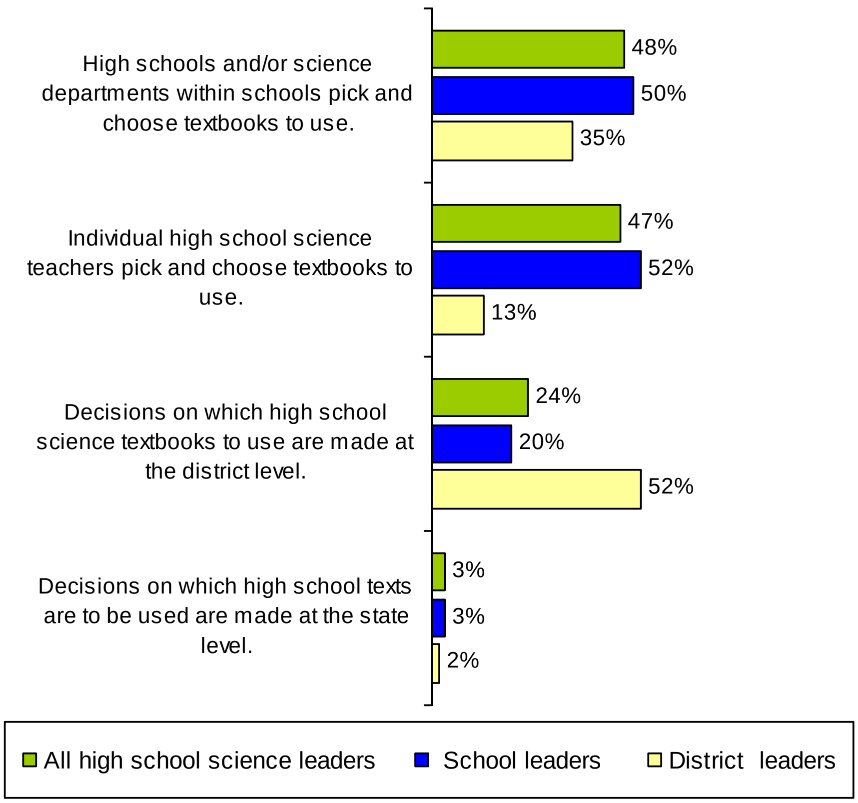


Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Very little role, if any," 3 = "Important advisory role," 4 = "major decision maker" and 5 = "Can approve or veto."

[11] In a background paper prepared for NSTA, BSCS reports that "approximately 23 states have adoption policies. Some provide districts and schools with lists of recommended texts from which they can choose, or they have various other guidelines directing the adoption process" (http://www.nsta.org/textbooks). BSCS staffs that are familiar with the changing national picture report that over half the states have state adoption processes that do not align with our survey findings on decision making and textbook selection.

Who chooses high school science textbooks? Our survey respondents reported that in their schools and districts, decisions are generally made at the school level – by departments and/or individual teachers, according to school leaders. Half of district leaders (52%), on the other hand, said that decisions are made at the district level; 24% of their school counterparts agree.[12] These patterns seem to hold for our respondent group regardless of district size or demographic context.

Who chooses high school science textbooks? (2005)



How do local science leaders describe the process by which they select and adopt instructional materials in high school science?

Nearly all local science leaders (94%) reported that they have a careful and thoughtful process for selecting and adopting instructional materials, and at the same time, nearly as many (86%) said that the process could be improved. They believe the process that they use involves the right people and reflects a coherent plan.

12 Note that respondents were asked to "check all that apply," resulting in totals greater than 100%.

Most respondents reported that the selection and adoption process could also be improved in numerous ways.

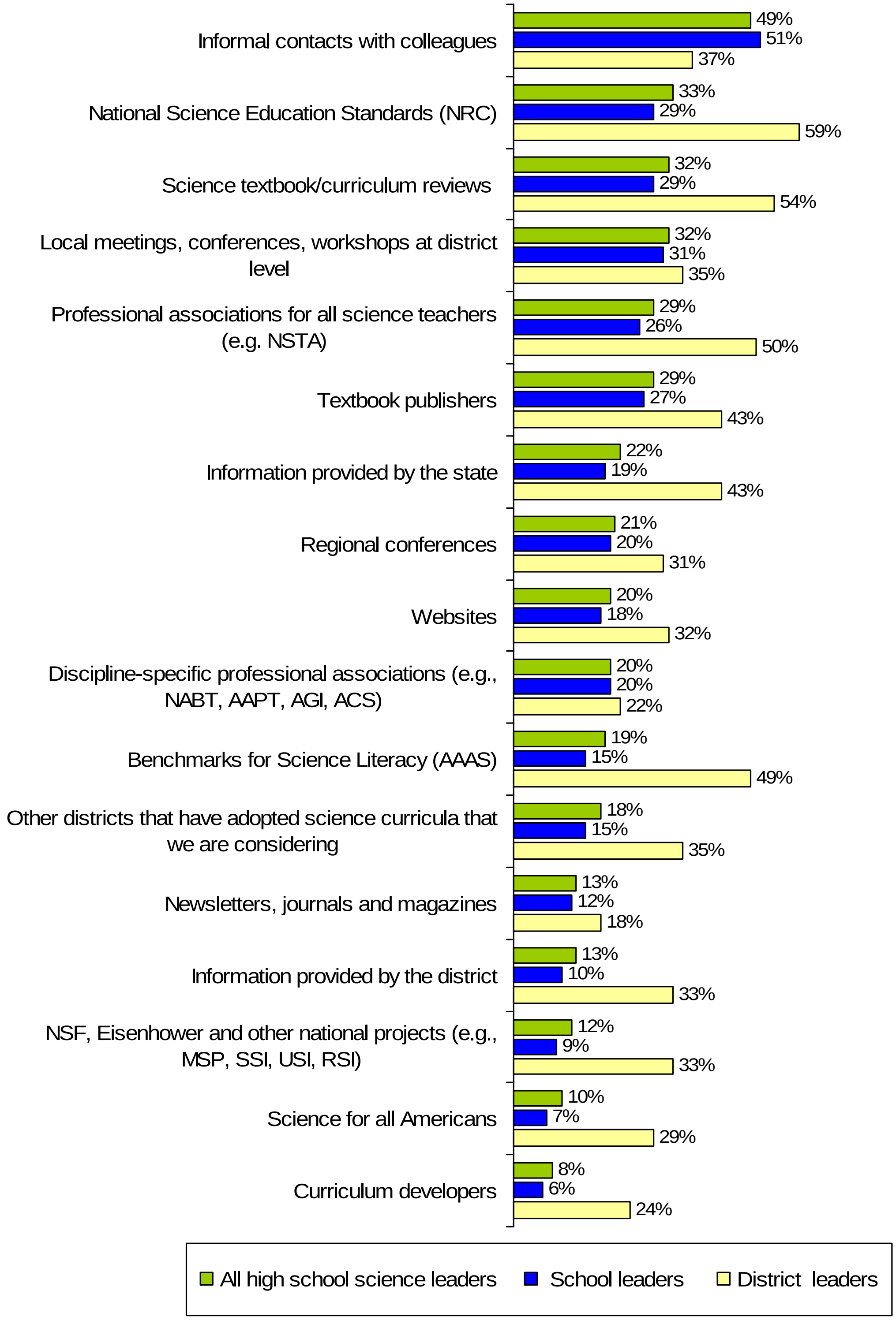
% Of schools and districts whose process for selecting and adopting instructional materials has desirable features, and % that said they could improve on each feature (2005)

	"This describes our process"	*"We could improve on this"*
Involvement of our most experienced and highly effective teachers in the selection	96%	81%
Opportunities for input from everyone who is interested	95%	85%
A collaborative process that builds consensus among teachers	93%	85%
Substantial time given to laying the groundwork for selection and adoption	88%	89%
Use of a structured, evidence-based set of criteria for selection	86%	90%
Piloting of materials under consideration	86%	89%
Access to and use of outside expertise if we need it during the selection process	86%	90%
A process designed so that selecting instructional materials is a professional development opportunity	85%	92%
Budgeting for professional development, release time, and new lab supplies in connection with materials implementation	84%	95%
Study of the effectiveness of new materials that are adopted, with adjustments as necessary	83%	95%
Creation of a long-term plan for professional development to support the implementation of new materials	82%	95%
Use of findings from piloting new materials to design professional development for other teachers	82%	94%
Systematic provision of professional development on new materials after they are selected	82%	94%
Examination of student work as part of the selection process	81%	94%

What resources do local science leaders use when looking for information related to selection, adoption and implementation of high school science curriculum materials?

Resources for information. High school science leaders say that they rely on a broad range of resources for learning about high school curriculum materials. Half (49%) of the science leaders who responded to our survey often use information shared informally by colleagues. About a third often use one or more of the following: the National Research Council's National Science Education Standards (33%); textbook and curriculum reviews, local meetings, workshops, etc. (32% each); professional associations for all science disciplines (29%); and textbook publishers (29%). Other resources, including AAAS, the state, the district, and curriculum developers are used often by less than a fifth of high school science leaders. (See the summary and comments at the end of this section for additional discussion of these results.)

% of high school leaders who rely often on various resources for information about high school science textbooks and instructional materials (2005)

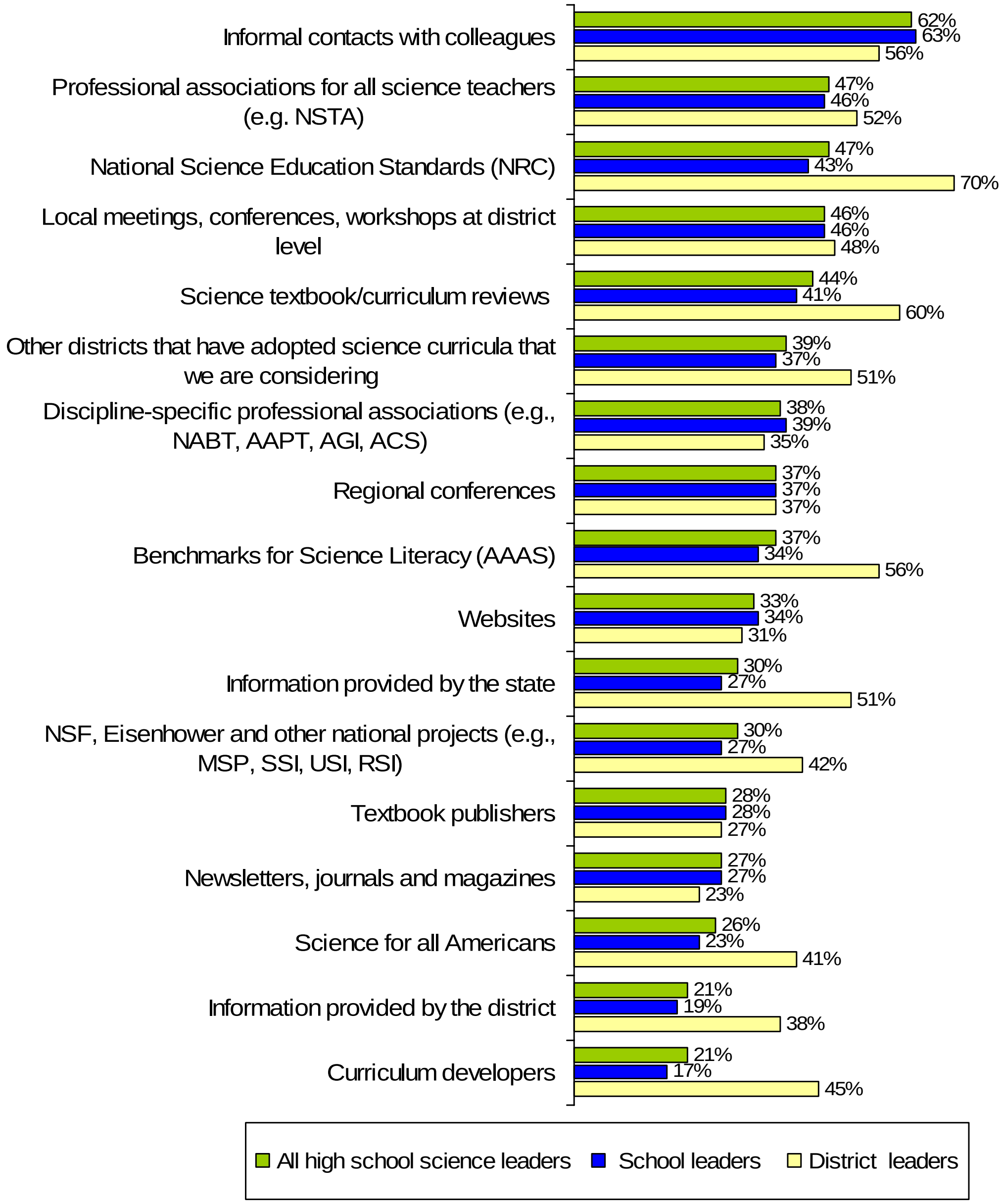


Percentages represent responses of "3" on a 3-point scale where 1 = "Never use," and 3 = "Often use."

How valuable do science leaders find various resources for information about high school science textbooks and instructional materials?

We wanted to distinguish between potential information resources not only on the basis of their usage, but also on the degree to which they were valued. Accordingly, we asked leaders who sometimes or often use each resource for information to rate the resource's value to them. Many said local sources are valuable or very valuable (for example, 62% said informal contacts are valuable, and 46% valued local meetings, conferences, and workshops). At the same time, about half also valued the opinion of "the field:" professional associations such as the NSTA (rated highly by 47%), the National Science Education Standards (NRC) (also rated highly by 47%), and science textbook/curriculum reviews (44%).

Value of various resources for information about textbooks and instructional materials (2005)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "No value," 3 = "Some value," and 5 = "Great value."

How familiar are science leaders with standards-based materials developed with NSF financial support? What are leaders' impressions of these materials?

Familiarity with NSF-funded materials. Seventy percent of the local science leaders said that they have heard of at least one of the instructional programs created by NSF-funded curriculum projects. In 2005, the best known were ChemCom and several BSCS biology books, both of which were recognized by over half the survey respondents familiar with at least one of the series we asked about. The table below lists the materials in order from those known by the most leaders to those that were familiar to the fewest.

% of science leaders who have heard of materials created by NSF-funded projects in high school science (2005)

Familiar to at least half of survey respondents	
ChemCom (Chemistry in the Community)	61%
BSCS Biology: A Human Approach	61%
BSCS Biology: A Molecular Approach	58%
BSCS Biology: An Ecological Approach	55%
Familiar to at least a quarter of survey respondents	
Physical Science - Active Physics	43%
Earth Science - Earth Comm	39%
BSCS Science: An Inquiry Approach	39%
SEPUP: Issues, Evidence, and You	31%
SEPUP: Science and Sustainability	30%
Active Chemistry	28%
Life Science - Biology: A Community Context	28%
Familiar to fewer than a quarter of survey respondents	
C3P	22%
Integrated Science - Ecology: A Systems Approach	21%
Insights in Biology	18%
Living By Chemistry	13%
Science in a Technical World	11%
Chem Discovery	11%
Prime Science	11%
Minds-On Physics	3%

Impression and use of these materials. We asked those who had heard of each of the above materials to indicate how interested they were in them, and whether they were using them already or moving towards using them. The best known curriculum, ChemCom, was also the most "widely" used, with usage in 11% of the schools and districts of leaders who answered this question.[13] Active Physics was used by 8%. No other NSF-funded curriculum materials were used in more than 4% of the schools and districts, and most were used in a small fraction of schools and districts represented in our study.

[13] A fair number of survey respondents did not answer this item as intended; some answered the second half of the question though they left the first half blank and others appear to have responded to questions about some instructional materials and not others they may have heard of.

% Of high school science leaders who were positively and negatively inclined to use NSF-funded curriculum materials or were already using them (2005)

		Negatively inclined to use curriculum			Positively inclined or already using curriculum			
	% who are familiar with this curriculum	Don't know much and not very interested	Know something - doesn't fit needs/ constraints are a barrier	**Total negatively inclined**	Don't know much but would like to know more	Moving toward using this curriculum	Implementing or are using this curriculum	**Total positively inclined or using this curriculum**
ChemCom (Chemistry in the Community)	**61%**	22%	36%	**58%**	28%	3%	11%	**42%**
BSCS Biology: A Human Approach	**61%**	24%	37%	**61%**	33%	4%	3%	**39%**
BSCS Biology: A Molecular Approach	**58%**	25%	37%	**62%**	33%	2%	3%	**38%**
BSCS Biology: An Ecological Approach	**55%**	24%	31%	**55%**	37%	4%	3%	**45%**
Active Physics	**43%**	28%	20%	**48%**	40%	4%	8%	**52%**
Earth Comm	**39%**	43%	17%	**60%**	33%	2%	4%	**40%**
BSCS Science: An Inquiry Approach	**39%**	26%	23%	**48%**	49%	3%	0%	**52%**
SEPUP: Issues, Evidence, and You	**31%**	41%	16%	**57%**	39%	2%	1%	**43%**
SEPUP: Science and Sustainability	**30%**	43%	16%	**58%**	38%	2%	1%	**42%**
Active Chemistry	**28%**	34%	14%	**48%**	49%	2%	0%	**52%**
Biology: A Community Context	**28%**	38%	18%	**55%**	40%	2%	2%	**45%**
Minds-On Physics	**23%**	41%	10%	**51%**	47%	2%	1%	**49%**
C3P (Comprehensive Conceptual Curriculum for Physics)	**22%**	40%	13%	**52%**	44%	2%	2%	**48%**
Ecology: A Systems Approach	**21%**	35%	17%	**51%**	44%	3%	1%	**49%**
Insights in Biology	**18%**	42%	13%	**55%**	43%	2%	1%	**45%**
Living By Chemistry	**13%**	40%	9%	**49%**	49%	1%	0%	**51%**
Science in a Technical World	**11%**	42%	8%	**51%**	49%	0%	0%	**49%**
Chem Discovery	**11%**	41%	7%	**49%**	51%	0%	0%	**51%**
Prime Science	**11%**	53%	9%	**62%**	38%	0%	1%	**38%**

Comparative findings in 2000

According to the data from our 2000 survey, when asked about their general familiarity with NSF-funded textbooks and related materials, 24% of the group that responded had never heard of them, 23% had heard of them, 29% reported knowing a little about them, 19% reported they were fairly familiar with them, and 5% said they were very familiar with them. Of the 53% who were at least somewhat familiar, 94% believed they were of high quality, 77% reported that it is realistic to think their district might ultimately adopt and use them, and 42% reported that they look for these materials, specifically. Similar to the current findings, the best known curriculum was BSCS Biology: A Molecular Approach (89%), followed by ChemCom (87%), BSCS Biology: An Ecological Approach, and BSCS Biology: A Human Approach (85%).

Summary and Comments

These data suggest that decision making is done largely at the local level by individuals within the schools, and that these individuals have sources of information that are both informal and professional in nature. Moreover, there does not seem to be much variation in this pattern among different sized districts or contexts. However, it is important to note that half of the states in the U.S. have an adoption process wherein the local decision comes after a state-level process that predetermines the books that teachers can choose from. We suspect that the discrepancy between our data and national data reflects in part some skewing of our response group to states that lack a state role in selection. It may also reflect an unintentional overstating by our respondents of their own autonomy in decision making.

Almost all the leaders surveyed believe that the processes by which they select and adopt instructional materials are careful, thoughtful, and involve the right people. However, they also reported that their process could be improved.

Professional contacts and organizations ranked highly as reliable resources for leaders when making curricular decisions. Therefore, the level and quality of information among teachers and within the professional organizations about instructional materials represents a significant input into the selection process of schools and districts.

While school-based leaders relied most often on informal contacts, district high school science leaders used five other resources more frequently. Greater numbers of district leaders used NRC's National Science Education Standards (59% used these often), textbook and curriculum reviews (54%), professional associations for all science teachers (50%), and textbook publishers and information provided by the state (each often used by 43%). In other words, district leaders are more likely to draw on national criteria and resources.

Not surprisingly, leaders today are most familiar with the NSF-funded materials that have been in existence the longest – BSCS Biology programs, and ChemComm. However, familiarity does not necessarily translate to positive impressions: leaders who were familiar with these materials were more negatively than positively inclined to use them in their schools and districts. For the remaining 15 NSF-funded curricula we asked about, the leaders who were familiar with specific materials were about split in terms of their inclination to use them, with a slightly positive leaning.

3. *What shapes curriculum decision making? What criteria do local science leaders use in selecting high school instructional materials?*

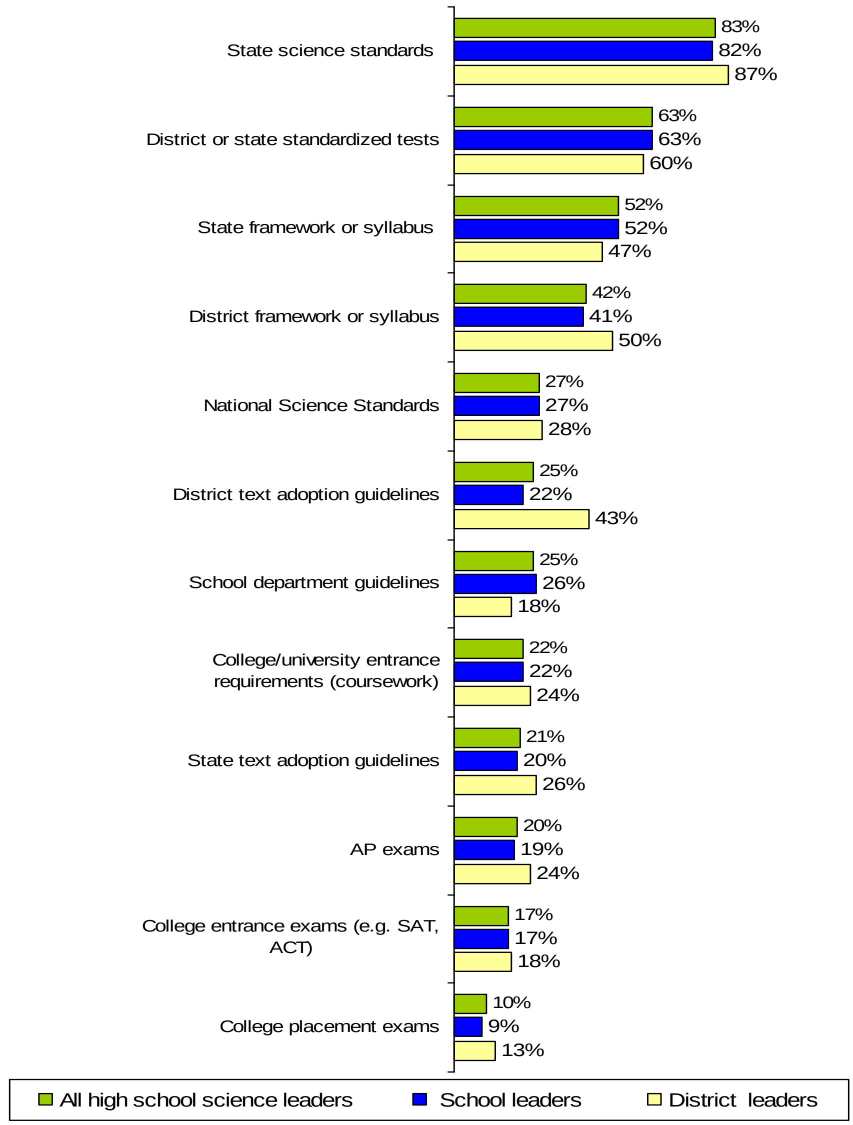
In this section, we present data related to both external and internal forces that shape curricular decision making. Specifically, we address the extent to which standards and tests influence decisions (external) and the design criteria leaders use when selecting materials.[14]

Which standards and tests influence the selection and use of high school science textbooks?

Eight in 10 high school science leaders (83%) said that state science standards were important influences on how high school science textbooks are selected and used in their schools and districts. District and state tests, frameworks, and syllabi were the next most common influences shaping selection and use in up to 63% of schools and districts. About a quarter of all schools and districts were influenced by one or more other standards and/or tests including the National Science Education Standards (an important influence for 27%), and district textbook adoption and school department guidelines (each important in 25% of schools and districts). Even fewer of our survey respondents said that college coursework requirements and entrance exams, state text adoption guidelines, and AP exams are important influences.

[14]Note that in the first section of this report, we summarize data related to external contextual problems and barriers that districts face.

% of science leaders who said that selected standards and tests have a significant influence on what high school science is taught and how it is taught, and on the selection and use of high school science textbooks (2005)



Percentages represent responses of "4" on a 4-point scale where 1 = "Not a factor," and 4 = "An important factor."

What design features are important in the selection of textbooks and instructional materials?

The high school science leaders who responded to our survey have high expectations for textbooks and instructional materials. On average they rated 11 different design features (of the 19 criteria they were asked to rate) as important or very important factors when they select textbooks and instructional materials. Nine factors were rated as important by at least two thirds of the leaders. Beyond these top criteria, each of the other 10 criteria was important to at least 30% of the science leaders who responded to the survey.

% of high school science leaders who said selected design criteria are important to them when selecting textbooks and instructional materials (2005)

Extent to which the textbooks and instructional materials	Total	School	District
...include strong supporting materials for teachers	85%	86%	76%
...have an age-appropriate reading level	83%	83%	84%
...are accessible to all students	80%	79%	85%
… have a coherent sequence of concepts or ideas	79%	78%	85%
...address real-world issues	74%	74%	78%
...promote inquiry	72%	70%	83%
...incorporate current research or topics of current interest (e.g., DNA extraction, astrobiology, etc.)	70%	69%	76%
...present concepts in depth	70%	68%	87%
...use a variety of pedagogical approaches	65%	64%	78%
...provide for multiple forms of assessment (e.g., performance assessments, portfolios)	57%	55%	72%
...include formative assessments that inform instruction	55%	52%	76%
...come with a computerized test bank	52%	52%	46%
...take advantage of and use the Internet	50%	49%	54%
...address common preconceptions that students might have	48%	48%	52%
...take an integrated approach to science	46%	48%	33%
...provide opportunities to study issues of Science, Technology, and Society (STS)	46%	44%	59%
...are rich in use of technology in science (e.g., CBL or other probe ware)	40%	38%	57%
...include technology design/engineering	30%	29%	37%

Percentages represent responses of "4" on a 4-point scale where 1 = 1 = Not a consideration and 5 = A central or key consideration.

Forty-three percent of the leaders (39% at the school level, and 70% at the district level) said that the extent to which professional development/teacher support related directly to the curriculum materials is available is also very important.

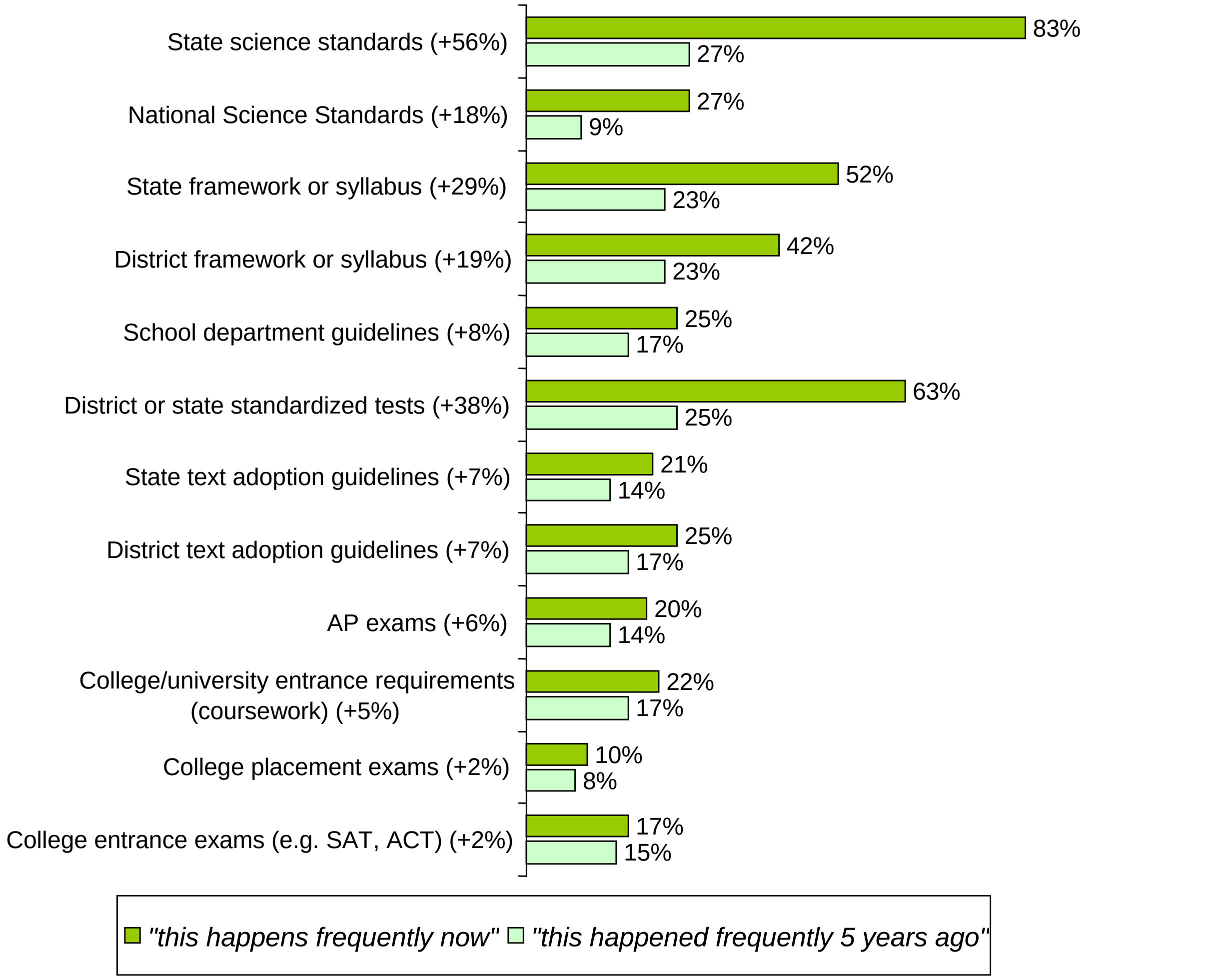
How have the factors that shape decision making in high school science changed over five years?

High school science leaders perceive a substantial increase in the influence of state and district standards, tests and frameworks on decision making. There is also an increase in the extent to which NCLB's influence is seen as an issue at the high school level.

Problems and barriers. Survey respondents said that the biggest change over the last five years is that NCLB requirements (signed into law in 2002) have become increasingly an issue for them (its requirements were a significant problem for 48% in 2005, up from 21% in 2000).

Influence of standards and tests in selection and use of high school science textbooks and related materials, and in what high school science is taught (and how). The percentage of science leaders for whom state science standards are a significant influence has *tripled* in the last five years (from 27% to 83%). The percentage of leaders for whom district or state standardized tests and state frameworks influenced materials and teaching has also more than doubled. There has been little change in the place of college requirements and tests, but the National Science Education Standards have risen somewhat in importance.

Standards and tests that have had a significant influence in the selection and actual use of high school science textbooks and related materials (and change over five years) (2005)



Percentages represent responses of "4" on a 4-point scale where 1 = "Not a factor," and 4 = "An important factor."

Summary and Comments

The most significant external factor that has influenced curricular decision making appears to be state science standards and district or state standardized tests. The large increase in the perceived impact of NCLB over the last five years is also striking, though not surprising. At the same time, design elements that reflect an accessible, inquiry-based program with strong instructional support materials were also important to both school and district leaders.

Some interesting differences also emerged between the responses of school- and district-level leaders. Leaders at the district level tend to be more interested than their school counterparts in several features of instructional materials: Do they present concepts in depth? (important to 87% of district leaders vs. 68% of school leaders); do they provide for multiple forms of assessment, including formative assessment? (district leaders, 76% vs. school leaders, 52%); are they rich in use of technology? (district leaders, 57% vs. school leaders, 38%). The one criterion that is dramatically more important to district leaders is whether professional development/teacher support related directly to curriculum materials is available (important to 39% at the school level, and 70% at the district level).

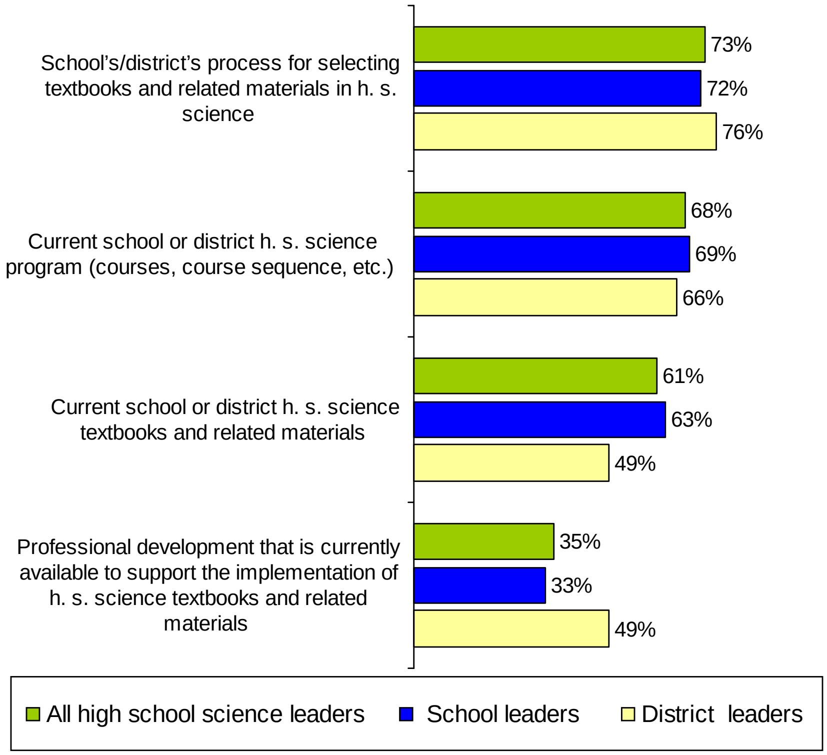
4. How satisfied are high school science leaders with instruction, instructional materials, assessment practices and professional development?

This section outlines data addressing the extent to which high school science leaders are satisfied with their current science programs and instruction, as well as their perception of need for new and improved instructional materials. In addition, leaders' perceptions of change over five years, as well as data from our 2000 survey are presented.

How satisfied are high school science leaders with the major components of their science programs?

In 2005, the majority of high school science leaders were satisfied or very satisfied with their current program (68%), materials (61%), and the process by which they choose those materials (73%). Only a minority (35%) was satisfied with the professional development currently available in 2005 to support the implementation of those materials.

% of high school science leaders who were satisfied or very satisfied with the major components of their high school science programs (2005)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not at all satisfied," 3 = "Somewhat satisfied," and 5 = "Satisfied to a very great extent."

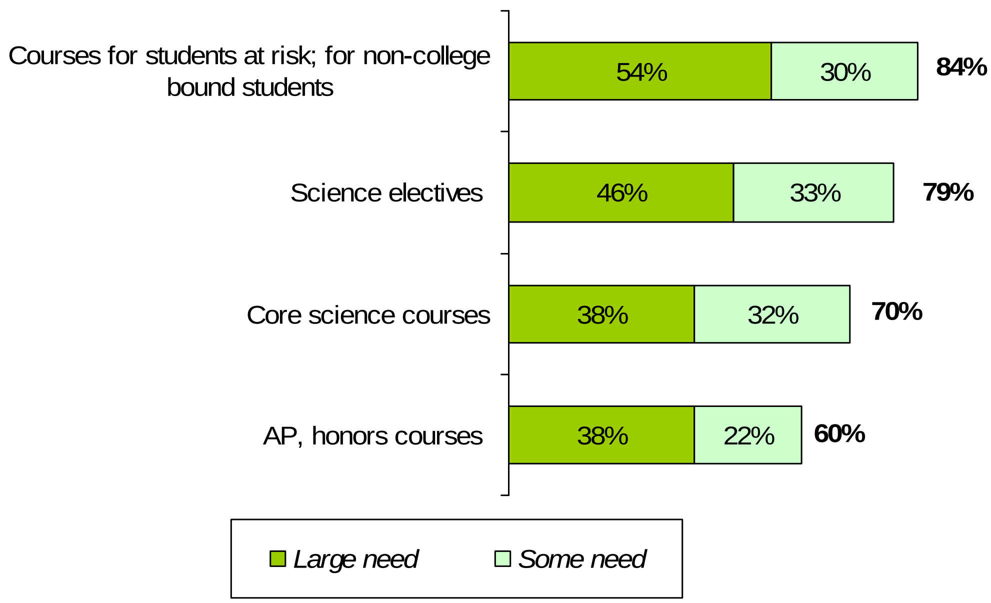
Put another way, three or four in 10 were only somewhat satisfied, at best, with their high school science program, materials, and or process for selecting the materials. And almost seven in 10 saw weaknesses in the professional development available in 2005 to support the implementation of high school science textbooks and related materials.

The district leaders who responded to the survey were slightly less satisfied with their materials and more satisfied with available professional development than were their school colleagues.

How much need is there for new instructional materials?

While their satisfaction levels with their own instructional materials and programs in 2005 were relatively high, the majority of high school science leaders who responded to our survey said there is a need for new and improved science materials across high school science. They saw the greatest need for new and improved textbooks and instructional materials for students at risk and students who are not bound for college (84% saw a need, including 54% who said the need is great) and for science electives (79% see a need, including 46% who say there is a great need).

% of high school science leaders who thought that there was a need in their school/district for new and improved textbooks and instructional materials for particular types of high school science courses (2005)

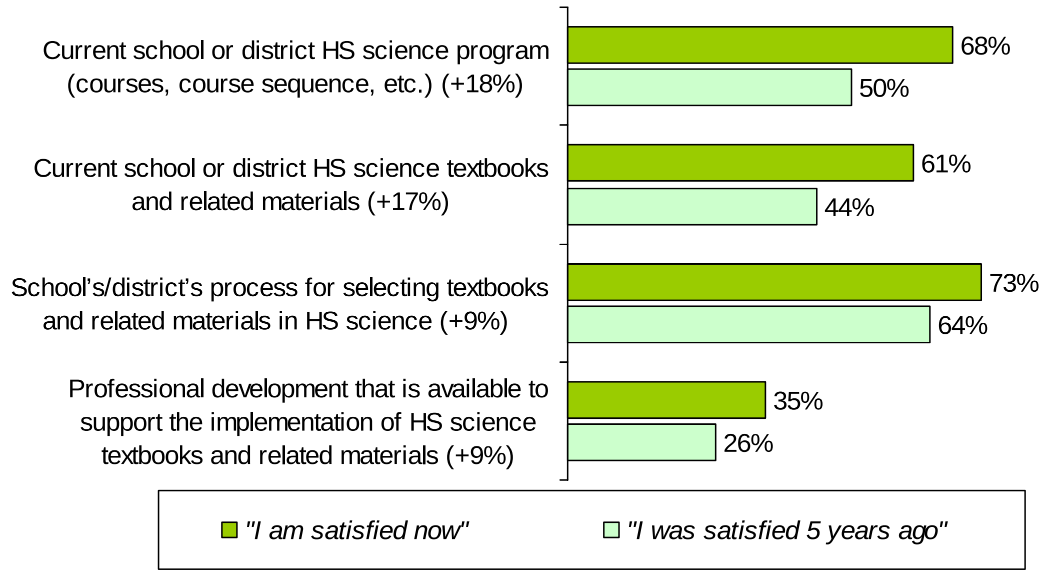


Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Little if any need," 3 = "Some need," and 5 = "Great need."

How has their level of satisfaction changed over five years?

Change in satisfaction with major components of high school science. Reflecting back five years, slightly more leaders reported they were satisfied with the various components of a high school science program in 2005 than in 2000. The greatest increases were in their satisfaction with their program and instructional materials. Over the same period, there was little change in their satisfaction with their textbook selection process or with professional development available to support implementation.

Percentage of leaders who were satisfied with the major components of high school science now (2005) and five years ago (2000)
(ranked by extent of change over five years)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Not at all satisfied," 3 = "Somewhat satisfied," and 5 = "Satisfied to a very great extent."

Comparisons with responses on 2000 Landscape Survey

We asked the same questions of a national sample in 2000. Below we present a table comparing their responses to the retrospective recollection of the current survey group.

Percentage of survey respondents to our two surveys who were satisfied with major components of their high school science program in 2000

	% of 2005 survey respondents who recollect that they were satisfied "*five years ago*"	% of survey respondents on 2000 high school landscape survey who were satisfied in 2000
Current school or district HS science program (courses, course sequence, etc.)	50%	59%
Current school or district HS science textbooks and related materials	44%	49%
School's/district's process for selecting textbooks and related materials in HS science	64%	NA
Professional development that is available to support the implementation of HS science textbooks and related materials	26%	16%

Summary and Comments

According to survey respondents, science leaders are generally satisfied with their science programs and curricular materials. This level of satisfaction remained relatively stable over five years. It is interesting to note, however, that leaders' recollections in 2005 were slightly less positive than what was actually reported by our respondents in 2000 on this issue. Also interesting is that while leaders were generally satisfied, they nonetheless perceived a need for new and improved science materials.

While leaders were mostly satisfied with their science programs, they were concerned about providing higher quality programs for particular student groups, such as at-risk students. Moreover, they reported a need for improved programs for both science electives and core courses. This signals that while programs are believed to be generally satisfactory, there are particular student needs that leaders do not believe are currently being met.

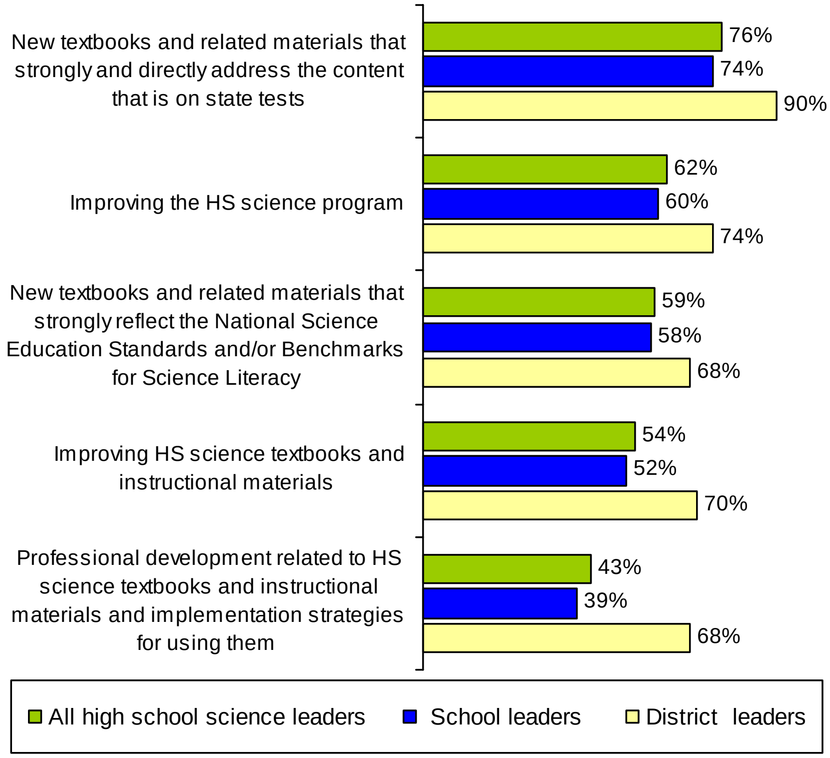
5. How much interest is there in changing instructional materials? How does change happen?

In this section, we highlight leaders' interest in changing components of high school science, as well as their interest in various strategies for change. We also outline current interest in change, how often change is likely to happen, and the likelihood that change will occur in the next several years. In addition, we ask if leaders believe that external funding sources are likely to be explored for supporting curricular change. Finally, we report data reflecting leaders' perception of change in interest over the last five years, as well as data from our 2000 survey on this issue.

How much interest is there in changing the major components of high school science?

Interest in changing components of high school science. In 2005, three fourths of the schools and districts (76%) were interested or very interested in new textbooks and instructional materials that strongly reflected the content on state tests. A majority (59%) were also interested in new textbooks and related materials that strongly reflected the National Science Education Standards and Benchmarks for Scientific Literacy, and in unspecified improvements to the high school science program (62%) and textbooks and instructional programs (54%). Forty-three percent were interested in changing professional development related to high school science textbooks and instructional materials. Note that district leaders were more interested than their school counterparts in professional development.

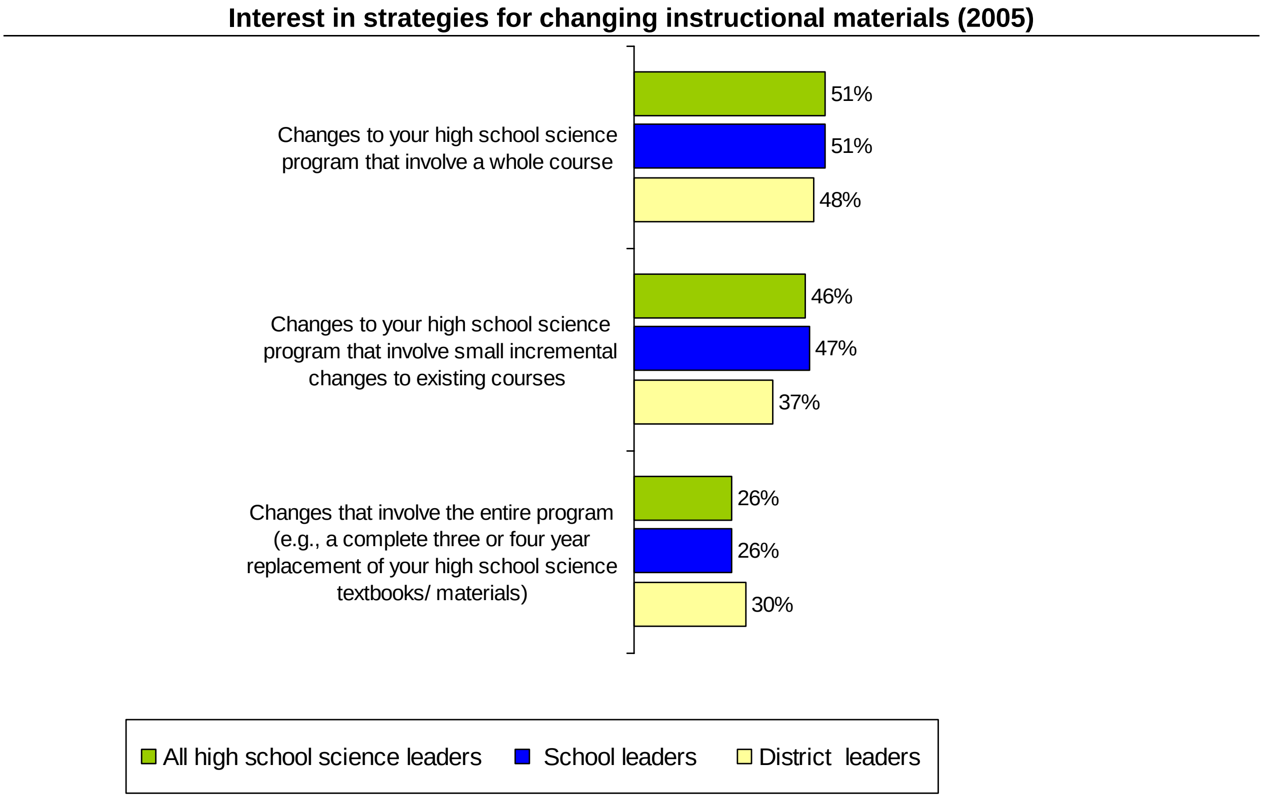
% of high school science leaders interested in changing components of high school science (2005)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Little if any interest," 3 ="Some interest," and 5 = "Strong interest."

How much interest is there in various strategies for changing instructional materials?

In 2005, about half of all high school science leaders said that there was currently considerable or strong interest in changing entire courses or making small incremental changes to existing courses. A quarter of the respondents said that there was at least considerable interest in changes that involve the entire program.

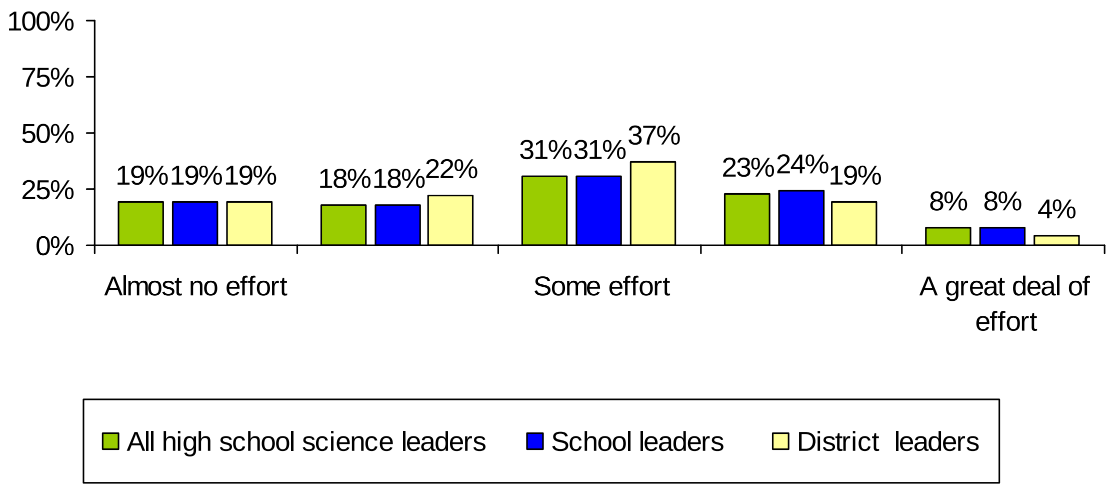


Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Little if any interest," 3 = "Some interest," and 5 = "Strong interest."

Is there a current effort to change instructional materials?

In a majority of districts there was at least some current effort in 2005 to make changes in high school science instructional materials. Three in 10 leaders reported that there was considerable to strong effort to change the high school science textbooks and related materials in their school or district. Another three in 10 said that there was some effort.

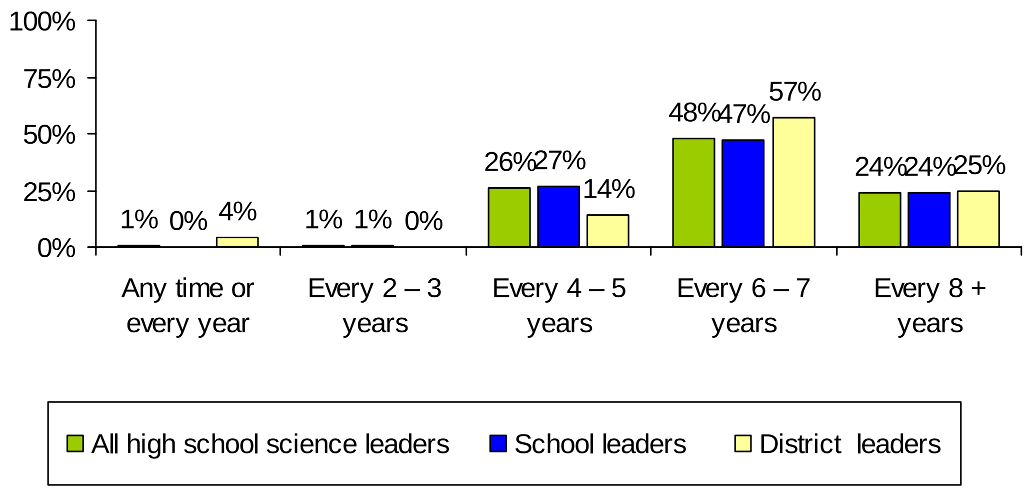
Current level of effort to change high school science instructional materials (2005)



How often is it possible to change high school science instructional materials?

Once high school instructional materials are adopted, they are used for a considerable length of time. In the majority of schools and districts, high school science instructional materials can be changed only every six years, if then. A quarter of the schools and districts can change them every eight years or more.

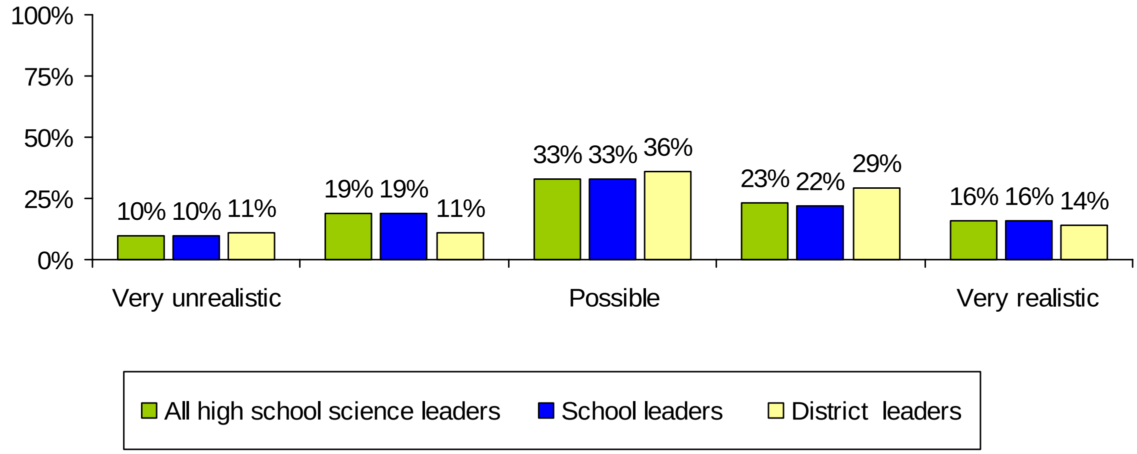
Frequency with which high school science instructional materials can be changed (2005)



Is it realistic to expect schools and districts to pursue significant changes in textbooks and related materials in the next five years?

In 2005, change was reported as being at least possible in about 2/3 of the schools and districts over the next five years, and could realistically be expected in about 39%. In only a minority of districts (16%) though, was it "very realistic" to expect the district to pursue significant changes in high school science instructional materials in the next five years.

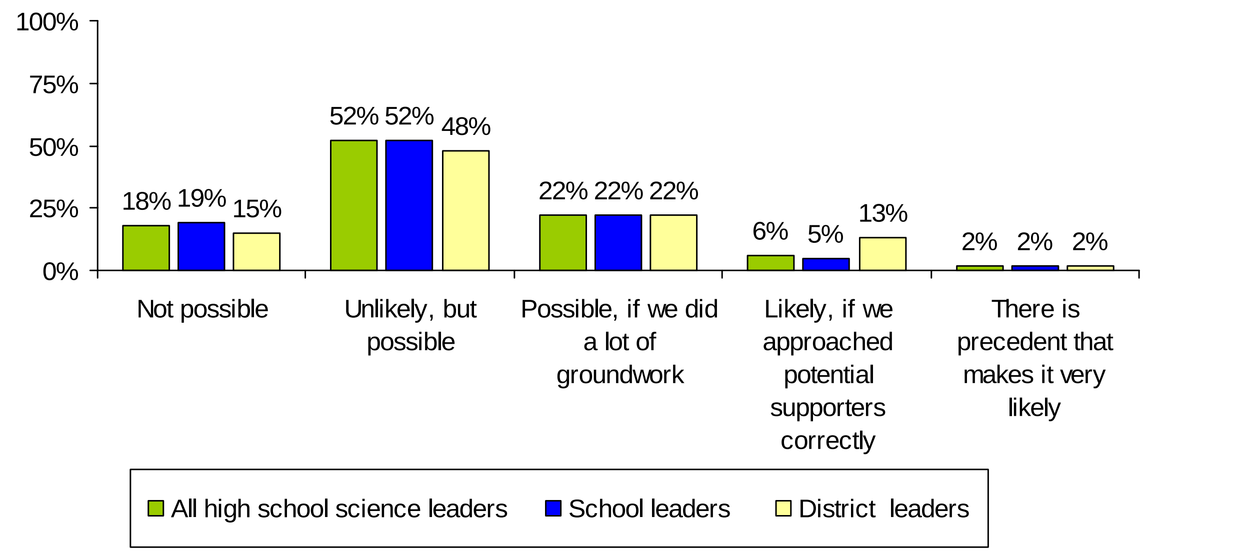
Extent to which it is realistic to expect change in the next five years (2005)



How likely is it that private foundations or local businesses would help provide support for the selection, adoption and optimal use of instructional materials?

In a climate of reduced federal support for professional development in science, BSCS wondered whether local schools and districts might use private funding to help support selection, adoption and optimal use of instructional materials. Most schools and districts (82%) said it was at least theoretically possible, with 22% saying it was possible if they did a lot of groundwork, and 2% saying it was likely or already in place.

Likelihood that private funding might help support selection, adoption and optimal use of instructional materials (2005)

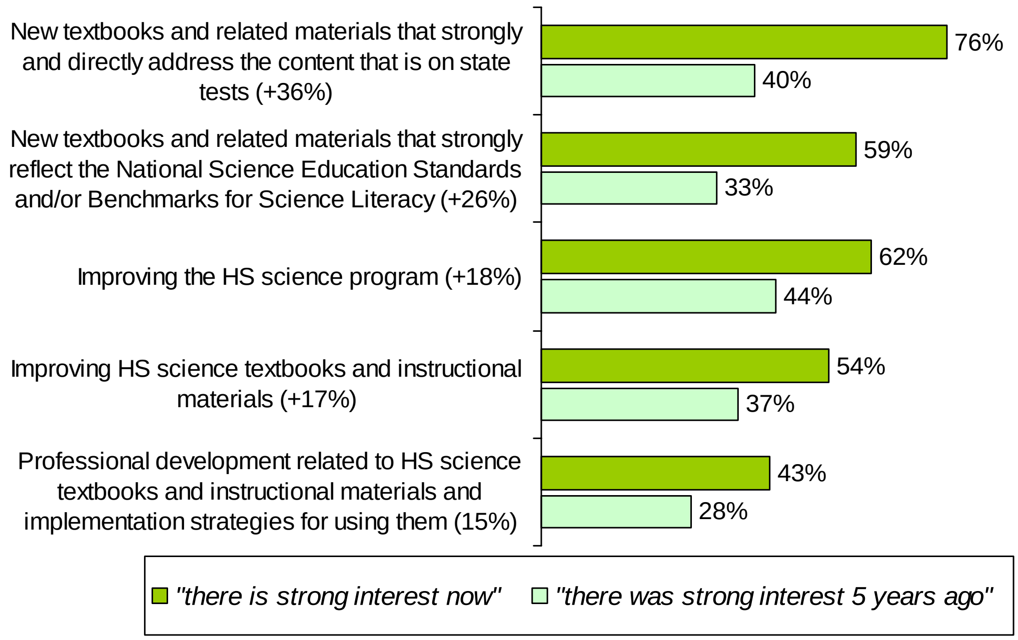


How has the perception of interest in change and the strategies for change shifted since 2000?

Effort to change high school textbooks and related materials. There has been a very slight increase in the reported level of effort to change instructional materials if we compare those who are making a considerable or strong effort in 2005 (31%) to those who said they were making the same substantial effort five years earlier (20%).

Interest in changing components of high school science. The percentage of schools and districts in which there is strong interest in textbooks and instructional materials that strongly reflect state standards has almost doubled, increasing to 76% of the schools and districts, up from 40% five years ago. The percentage of schools and districts where there is interest in materials that strongly reflect the National Science Education Standards and Benchmarks for Scientific Literacy has also almost doubled between 2000 and 2005 (from 33% to 59%). The number of schools and districts where there is more interest in an improved program or textbook in general, or in improved professional development has increased less in the last five years.

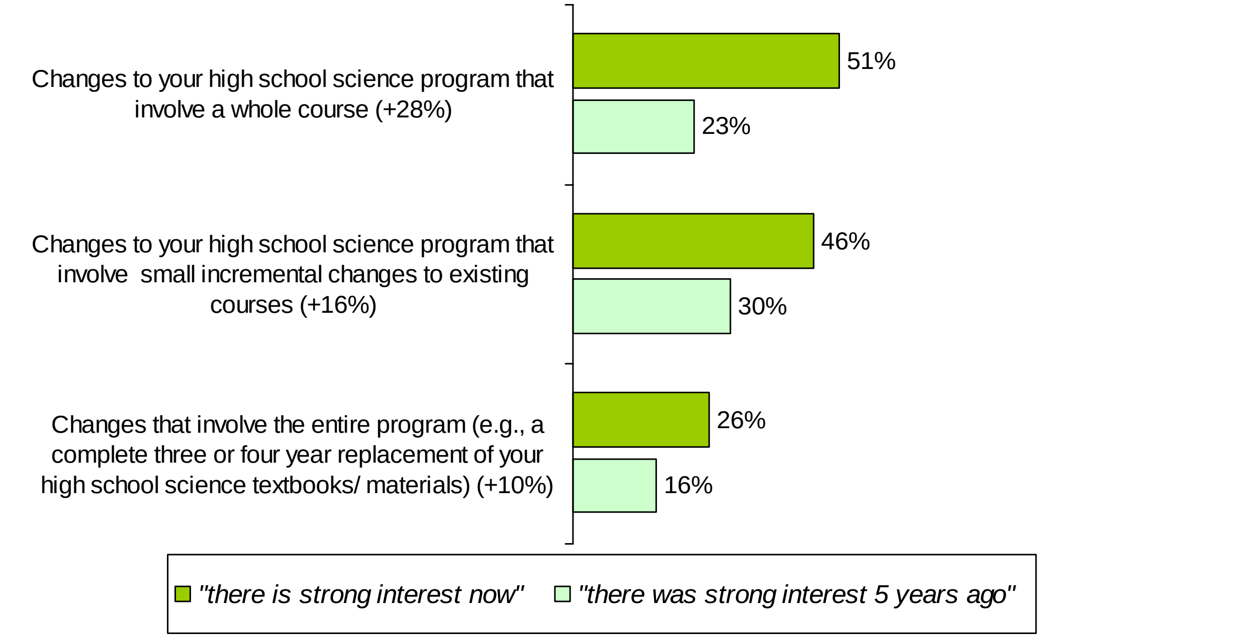
Interest in changing components of high school science (2005)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Little if any interest," 3 = "Some interest," and 5 = "Strong interest."

Change in interest in various strategies for changing high school science programs. Over the past five years, the greatest shift in terms of school and district interest in change strategies has been at the level of changing entire courses, i.e., not changing the entire program, but not merely modifying individual courses, either. The percentage of schools and districts where there is considerable interest in changes to the high school science program that involve whole courses has risen from 23% in 2000 to 51% in 2005. There is also greater interest in small incremental changes to existing courses.

Change in interest in various change strategies over the past five years (2005)



Percentages represent responses of "4" or "5" on a 5-point scale where 1 = "Little if any interest," 3 = "Some interest," and 5 = "Strong interest."

Comparisons with responses on 2000 Landscape Survey

In 2000, when we asked our first group of local high school science leaders how realistic it was to think that they would make changes in textbooks and related materials by 2005, 53% said it was realistic or very realistic for their school or district; this is a little higher than the 39% of the more recent sample who made the same assessment looking out to 2010. Additionally, the group we sampled in 2000 reported great interest in state or national standards, yet leaders surveyed in 2005 reported not being very interested five years earlier.

Interest of local high school science leaders in instructional materials that reflect state tests and national standards
(comparison of 2000 and 2005 survey results)

	2005 survey responses		2000 survey responses
	"My school or district is interested or very interested" *(2005)*	*"My school or district was interested or very interested 5 years ago"* *(2000, as recalled)*	*"My school or district is very interested"* *(2000, at the time)*
New textbooks and related materials that strongly and directly address the content that is on state tests	76%	41%	85%
New textbooks and related materials that strongly reflect the National Science Education Standards and/or Benchmarks for Science Literacy	62%	32%	82%

Summary and Comments

In 2005 and likewise five years earlier, there were a small number of people who were interested in and believed it was realistic to make significant changes in high school science. These changes are unlikely at the science program level; rather, the changes are more probable at the course level (whether for the entire course, or in incremental changes or small modifications to such a course). It is clear that over the five years, the influence of national and state science standards and assessments on what (and why) districts do with respect to change has increased. Finally, local external funding sources are unlikely to impact the pace or strategy of change in these districts, which suggests that large-scale changes that require a substantial influx of additional funds are unlikely to emerge without external support.

Although the survey respondents in 2005 do not recall being very interested in instructional materials that address state tests or reflect national standards five years earlier, the group that we surveyed in 2000 was already quite interested in such materials. It is not clear if this reflects differences in our survey respondent groups (with the earlier group more attuned to the ascendancy of testing and standards as a factor in decision making) or the tendency of educators to feel so pressed by the latest mandate that they forget that they were feeling similar pressures in the past.

IV. Reflections on the Broader Implications of the Landscape Survey

Introduction

In the final section of this report, we deviate from the simple reporting of data, and speculate about the broader lessons to be learned from this study. Our thinking is grounded in our studies of other Curriculum Dissemination and Implementation Centers,[15] similar surveys that we have conducted on the landscape of K-12 mathematics,[16] and on our years of experience studying a variety of approaches to improving mathematics and science teaching and learning.[17]

Our reflections focus on several ideas that we believe help put the survey results in perspective and provide a framework for a broader interpretation of the results.

- First, we make a distinction between choosing a curriculum as a way to support an existing program, and choosing a curriculum to serve as a catalyst and vehicle for making significant changes in science instruction.
- Second, we talk about the nature of and the reasons for the remarkable stability of the current high school science curriculum – and the thinking that shapes it.
- Finally, we draw on the survey results to suggest future opportunities for using an educative curriculum as a part of an overall improvement strategy.

We envision a number of audiences for these reflections. There are many policymakers and funders who are interested in understanding how curriculum and instructional materials can be a leading edge to the improvement of instruction. There are leaders of projects and initiatives who want to understand the role that curriculum can play in their overall reform efforts. There are individuals at the district and school level who are interested in promoting processes of improvement within their own settings. And there are designers and publishers of innovative curriculum who are interested in better understanding the audiences they are seeking to reach.

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[15] The NSF Implementation and Dissemination Centers: An Analytic Framework, Inverness Research Associates (2001).

[16] High School Mathematics Curricular Decision-Making: A National Study Of How Schools And Districts Select And Implement New Curricula (2000), Mathematics Curricular Decision-Making: The National Landscape--Survey Highlights (2004); Inverness Research Associates.

[17] Again, we invite the reader to visit http://www.inverness-research.org for further information about this work.

Curriculum as a leading edge of reform

Curriculum can be used to support the status quo operation of a high school science program and/or it can be used as a vehicle for improvement. When used for operational purposes, curricular choices tend to support a vision of teaching already held by the teacher, student and administrator. In this case any new instructional materials that are chosen are selected because they better support the implementation of the status quo program. They are not intended to fundamentally change the vision of teaching and learning science, but rather to better support the existing vision. But curriculum can also be used as a lever for change and to catalyze improvements in the way science is taught. In this case curriculum is selected deliberately not to support the current vision and practice of science teaching. The theory is that if a curricular program is sufficiently different from one used before, and if it is based on a different set of pedagogical assumptions, then that new curricular program can provide a new challenge for both students and teachers. In this way the introduction of a new and challenging curriculum can provide a strong impetus toward improving the way that the subject is taught. Hence, curricular programs can be chosen either to support the status quo – or to disturb it.

Well-designed curriculum and instructional materials can function as a lever for improvement, because they are "educative."[18] Not only can curriculum help students learn but a challenging curriculum can also help teachers learn. Following the path laid out by a new curricular program in a science classroom can be a learning experience for both teachers and students. The new activities – with a greater emphasis on current topics of science, inquiry, technology, societal issues, etc. – can force both teachers and students to look at the discipline anew. If new curricular programs are taught as designed, then the instructional materials become a vehicle for making concrete changes in classroom norms and practices. This change in classroom practice can be radical and involve shifts in the underlying relationship between the teacher, the students, and the discipline they are studying.

The NSF curriculum development and dissemination projects have made large investments in supporting the development of innovative curriculum materials. The theory behind this investment is that new curriculum materials are needed if classrooms are to reflect the vision of teaching and learning espoused by the national science and mathematics education standards.[19] It is simply not easy for teachers to teach in new ways if they are using old materials. The theory continues that teachers will improve their teaching through the implementation of new curricular programs. But also a part of the underlying theory is that teachers will need significant supports as

[18] Davis, E. A and Krajcik, J. S. *Designing Educative Curriculum Materials to Promote Teacher Learning*, Educational Researcher, Vol. 34, No. 3, pp. 3–14 (April 2005).
[19] National Science Education Standards (National Research Council). Washington, D.C.: National Academy Press, 1996.

they learn how to teach the new materials. The NSF curricula are designed, then, to be innovative, educative and challenging. In short, the NSF curricula were designed to drive improvement in equal measure to their providing the instructional materials for daily use.

The results of our landscape survey demonstrate that it is only a small minority of districts and high schools who are interested in pursuing a strategy of improvement that primarily uses curriculum as a leading edge strategy.

There are several specific findings on the survey that re-enforce this finding:

- Districts reported a lack of consensus about the need for improvement and/or its direction. The ambivalence within schools about the need for and nature of improvement is amplified when it comes to choosing a curriculum designed to change instruction in specific ways. Given the lack of clarity about improvement, it is not surprising that districts are reluctant to commit to a new curricular program that is engineered to move instruction in particular directions.

- Far less than half of the respondents are interested in innovative curriculum and in innovative features of the NSF curriculum. In the abstract they are interested in sound design features exemplified by NSF-funded curriculum materials. These design features include increased accessibility, coherent sequence, presentation of content in depth, and inclusion of inquiry. But, on a more concrete level, the majority of those who are familiar with specific NSF-supported are not positively inclined toward using them in their own districts.

- While over two-thirds of the leaders we surveyed were familiar with at least one of the instructional programs created by NSF-funded curriculum projects, only a small fraction of them are using even one of the programs.

- Respondents expressed strong doubts about their capability to find the professional development and other resources needed to support the implementation of a new challenging curriculum (whether NSF-funded or another).

The stability of high school science curriculum

Across the United States in high school science the curriculum that is taught, the processes by which curriculum is selected, and the landscape in which decisions about curriculum are made all appear to be remarkably stable.

This stability is made apparent by the following survey findings:

- Districts and schools continue to have high levels of satisfaction with their current curriculum and instruction.
- The most common course offerings in high school science – and the order in which they are offered – have not changed much over the past five years.
- Commercial textbooks and teacher-made materials persist as the dominant sources of instructional materials.
- Most districts and schools believe that their curriculum decision making processes are sound.
- The knowledge of, relative interest in and rating of NSF-funded curricula are low and have not changed much over five years.

All of this evidence suggests strongly that there do not appear to be major signs of significant changes in high school science curriculum in recent years. Nor are there strong signs that significant changes are likely in the near future.

This stability does not happen by chance. In fact, we believe there are many systemic factors and contextual conditions that tend to support the status quo and discourage experimentation and change.[20] There are many "restoring forces" that tend to move the system back to its equilibrium position once it is disturbed by the introduction of a new and challenging curriculum.

[20] For more on the stability of curriculum at the high school level, see a related report on the implementation of integrated high school mathematics curricular programs: Challenging The Gridlock: A Study Of High Schools Using Researched-Based Curricula To Improve Mathematics, Inverness Research Associates (2005).

The following factors, we believe, contribute to the stability of curriculum and instruction in high school science:

1) High school science curriculum decision making is highly decentralized and teacher-dependent.

Many districts and schools have considerable latitude and autonomy in choosing curriculum and instructional materials. Both sets of survey results show that curriculum decision making is decentralized down to the level of school and even down to the level of individual teachers and classrooms. The state may filter the range of options, but it is the local schools and teachers who end up having the strongest input into curriculum decision-making in high school science.

More specifically, the survey results confirm that individual high school science teachers have a large say in the adoption choices made by their schools and districts. They are on the committees that review the texts and make the decisions. Through professional development experiences some individual teachers may become interested in the NSF-funded curricular programs. But, as a group, high school science teachers are unlikely to adopt curricular programs that demand a radical change in their practice and values. Hence, the democratization of curricular choice in this case leads to a conservative bias and reluctance to adopt curriculum that would challenge current beliefs and alter current teaching practices.

2) Curriculum choice is seen as falling into the domain of individual teachers.

Districts that seek to use curriculum as a leading edge often have a goal of achieving more equity across the district in terms of offering all students a high-quality opportunity to learn science. In most districts the opportunity to learn science varies greatly depending on the ability of the school and teacher to create and deliver a high-quality curriculum. The adoption and implementation of a NSF-funded curricular program is often motivated by the desire to "level the playing field" by offering all students a well-designed set of activities and learning experiences.

While this goal may be noble, the idea of high school teachers all agreeing to adhere closely to a particular curricular program in the pursuit of achieving greater equity is a foreign notion. Rather, high school science faculty are a lot like university faculty – there is often strong resistance to what may be seen as the top-down imposition of a singular instructional program across the district. Curriculum decision-making is seen as an essential aspect of the expertise of high school science teachers and a cornerstone of their autonomy. They want the ability to pick and choose instructional materials that will, they believe, best meet the needs of their students (as well as match their own values and preferences).

The protection of the right to choose curriculum does not reside within science departments alone. The position and status of "the subjects" in high schools is deeply entrenched, and the knowledge and expertise of the teachers of their different subject areas "trumps" other mandates (including a more equitable opportunity to learn). Teachers are careful to guard what they see as the essential components of their instruction, and they do not want to "lose the rigor" of what they teach. Because the NSF-funded curriculum are different from what they have taught, and from the way they were taught, many high school science teachers are wary of new approaches. Thus, in addition to resisting uniformity and top-down change, high school teachers are very protective of their own vision of what comprises a good education in their own discipline. Consequently, the stability of high school science is part of a larger, very complex and historical stability of the entire high school enterprise.

3) <u>The incentives for innovation and risk taking are largely absent compared to the incentives for maintaining the status quo or incremental change</u>.

There are a number of reasons for the systemic bias toward maintaining the status quo:

- The curricular leaders who responded to our survey perceive that their instructional materials in high school science – as well as the processes by which instructional materials are selected – are satisfactory or better. Given this mindset, it follows that district leaders and teachers are more interested in maintaining and strengthening their current programs than in selecting materials that are meant to foster significant changes.

- The age of accountability has now begun to permeate high school teaching and policymaking. The focus on scores on course exams and graduation exit exams makes it more difficult for high schools to choose curricular programs that are designed to support a wider vision of student learning.

- While we did not ask specifically about budget constraints, we can presume that there are financial constraints on the extent and nature of the curricular changes that can be made. New technologies, professional development, and new materials are all costly. And there are constraints on the time that teachers are willing to spend in preparing themselves to teach curriculum that is very different from what they have known in the past.

4) <u>Leaders choose other strategies to foster improvement.</u>

Another reason for the stability of curriculum at the high school level may reside in the choice of improvement strategies. Many district leaders may well believe that using curriculum as a leading edge is not the optimal way to foster improvement in instruction. At least a significant minority of the leaders who responded to our surveys have made other kinds of changes over the last five years to improve their programs. Many districts may prefer an approach that focuses on professional development.[21] Rather than changing materials the theory here is to help teachers use current materials in more effective ways.

Other districts may focus on different approaches. A quarter of the respondents, for example, have increased the amount of science required and a third say that teaching strategies and instructional styles have changed substantially. By keeping current with the latest teaching trends leaders may feel that they are doing enough to stay up to date.

Summary

In summary then, most districts are not feeling a strong need to make dramatic changes to their high school science programs. And for those that do want to improve their programs, there are many possible strategies besides using curriculum as a leading edge.

If a district wants to choose a curriculum as way to support current instructional programs, then the district need only pick a new textbook. If, on the other hand, a district is interested in engaging in an improvement process that uses curriculum as the leading edge, the process is very different and much more intensive and demanding. Curriculum then becomes one aspect of a broader improvement effort. Both for the district as a whole, and for the individual teachers, the task of choosing and implementing an educative curriculum has a fundamentally different goal and requires strong leadership and commitment. Hence, it is not surprising that only a minority of schools and districts are interested in pursuing this route to improvement.

The Opportunities for Curricular-led Improvement

The discussion above illustrates that for the most part high school science curriculum leaders are not interested in radical program change. However, most curricular leaders are interested in incremental improvement in the science instructional materials available to their teachers and students. For example, district and department leaders are interested in helping teachers stay up to date on current science research topics; they want to help teachers become more adept at using technology in appropriate and effective ways; and they want to help teachers augment their repertoires so that they become more effective in reaching more of their students.

There is then a role for curriculum to play in the overall effort to improve high school science teaching. The following survey results may help funders and curriculum

[21] For a discussion of different strategies see the MARS toolkit for change website at http://www.toolkitforchange.org.

developers to begin to define this role and to identify the most promising "entry points" for future curriculum work.

Focusing on historically underrepresented students

Both in the current and past surveys the area of most concern of district leaders is to be found in the challenge of teaching the student who is not college-bound and who does poorly in science. District curriculum leaders want to find materials that will work with students who are struggling with science because of their lack of mathematics proficiency, their weak academic backgrounds, their lack of interest, and/or their language issues.

Traditionally, it is only a minority of high school students who succeed in science. Leaders recognize that they need to do something different if their science courses are to be more inclusive of "non-traditional students" (e.g., girls and students of color) who may possess plenty of intelligence, but are, for myriad reasons, do not want to continue taking science courses beyond those that are required to graduate.

For these reasons there is more openness to innovation in the lower level science courses. The advanced and AP courses are the most closely guarded; the courses for students at the introductory level and/or alternative science courses are the ones in which teachers are willing to try less traditional approaches. Hence, both in terms of need and accessibility, the lower level science courses are the most likely to be amenable to new curricular approaches.

Working with smaller grain sizes

In elementary science and mathematics the NSF-funded programs have achieved some successes both in terms of market share and use of the curriculum as a means to overall improvement.[22] At the elementary and to some extent at the middle school level, there has been a willingness to adopt and implement multi-year programs. In high school science there is clearly a reluctance to pursue multi-year programs; most districts consider science course by course. There is also considerable interest in change at smaller "grain sizes" than the whole course which implies a set of curricular materials that can supplement existing textbooks and other materials already in use.

[22] See, for example, Seattle Partnership For Inquiry-Based Science: A Local Systemic Change Initiative - End-Of-Project Report (2002), Reforming Elementary Science Education in Urban Districts: Reflections on a Conference in Inverness, California (1994), and Critical Supports For Elementary Science Reform: The Top Ten Action Items For Superintendents (1999); Inverness Research Associates.

At the high school level teachers seem to be more interested in finding instructional materials that they can use to infuse into their own teaching programs and syllabi. They are less interested in finding a whole course that they can teach as designed. They trust their own abilities to craft instruction more than they trust the designers of NSF and other curricular programs. Hence, they are looking for instructional materials that they can use as a tool to achieve their own ends, as opposed to seeking a broader well-defined curricular program that they can implement drawing on their knowledge and skills to make it good. For these reasons instructional materials that are designed and packaged at a smaller grain size are more likely to be implemented than materials that are designed for multiple years or even a full-year course.

The mathematics curriculum community has developed the notion of "replacement units" as a way to insert small bits of coherent and innovative curriculum into a teacher's current practice. One developer summed it up this way:

> *This summarizes the dilemma faced by many communities in the midst of systemic reform. New curriculum is vital in order to insure a coherent learning experience for students, to provide the best current knowledge about children's thinking, and to offer rich, significant mathematics. Yet, it is equally critical that teachers' experience and judgment be respected, that they are offered opportunities to continue their learning, and that they are given enough time to work with the new materials. For this reason, many school systems use a "replacement unit" approach that capitalizes on the unit structure of many of the new curricula and encourages teachers to choose one or two or three units to try out. In the past, when many traditional textbooks were very similar in content and structure, it was not so difficult to change from one curriculum to another. However, the change from a textbook to an innovative curriculum is quite different. Teachers are being asked to implement an unfamiliar model that they did not experience in their own education and have had little opportunity to see in action….*[23]

Thus, in high school science there may well be a role for replacement units as well as full-year courses.

Teacher Networks and Curriculum Implementation

Projects such as the Physics Teachers Resource Agents (PTRA) program, the Urban Math Collaboratives, and the National Writing Project show the potential power of high school teacher networks. High school teachers listen to and tend to trust other high school science teachers. Both our past and current surveys show that for most science teachers it is most often other science teachers that comprise the most used and valued source of information about curriculum.

[23] Russell, Susan Jo. Mathematics Curriculum Implementation: Not a Beginning, Not an End. *Hands On!* (Volume 21, No. 1), online at http://www2.terc.edu/handsonIssues/s98/russell.html.

There may be an approach that combines teacher networks and curriculum as a leading edge. The NSF-funded COME ON program supports a high school teacher network that has as its common focus the IMP curriculum.[24] Teachers use the IMP curriculum to provide a common currency for their exploration of underlying mathematical, pedagogical and political issues.

The combination of teacher network and curriculum implementation can be a powerful one. The shared focus of implementing a common curriculum can provide a strong nucleus in a teacher network; similarly, the network can provide a wide range of supports for the successful implementation and adoption of the innovative curriculum. In its work with leadership teams across the country the BSCS SCI Center found that the challenge of implementing new curriculum was an "educative" one for the district teachers and administrators who worked together to make it happen. The curriculum helped them learn and to become cohesive as a group; their work as a leadership helped to advance the curriculum. Savvy leaders applied the process to one core course at a time, using what they learned while supporting one group of teachers one year, and then using the first group to assist in working with another group the next year. Curriculum leadership opportunities afforded teachers an opportunity to gain skills and interests, which then made them more valuable assets in their districts.

In a similar way the COMPASS project, an implementation center for innovative high school mathematics curricula, is developing a national network of schools involved in the challenging work of implementing the NSF-funded curricular programs. The support that the network provides local teams helps them in their challenges, and they in turn contribute their experience and insights to help build the collective wisdom of the network.

Hence, there may be a good opportunity at the high school level to combine the work of implementing innovative curriculum with the work of developing supportive teacher networks.

Developing curricular leadership

We end this series of reflections with a few thoughts about the symbiotic relationship between the implementation of an innovative curriculum and the development of leadership. In an earlier conference report that summarized the lessons learned from the Curriculum and Implementation Centers we wrote:

> *Centers are well-positioned to help develop, and also to benefit from local curricular leadership. Such leadership is both a necessary ingredient for the implementation of a*

[24] The project description can be found at http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0101997.

> *new curriculum, but it is also a very important outcome of the process as well. That is, by helping local schools and districts engage in a thoughtful and careful process of reviewing, selecting and implementing anew curriculum, the Centers are very much in the business of developing local curricular leadership.*[25]

For the high school science community we saw strong leadership emerge out of the work of the SCI Center with its leadership teams. And strong leadership is a sine qua non for an improvement strategy that focuses on curriculum as a leading edge. Because there are so many restoring forces within the system the successful implementation of an innovative high school curriculum requires distributed leadership that is knowledgeable about, committed to, and able to make the case for the curriculum.

Hence we would argue that in the future funders invest in efforts that simultaneously build leadership and use curriculum as a shared focal point for improving instruction. One without the other is insufficient.

Finally, it is worth reiterating that the improvement strategies that have worked at the elementary and middle school levels probably won't work on a large scale at high schools. More experimentation is needed that combines teacher professional development, leadership development, networks and community building, and curriculum improvement.

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[25] The NSF Implementation and Dissemination Centers: An Analytic Framework, Inverness Research Associates (2001).