CURRENT APPROACHES TO SYSTEMS OF Achieve ASSESSMENTS IN SCIENCE: THEMES AND MODELS

These resources are part of a series of reports about challenges facing statewide science assessments and innovative solutions states are enacting to meet those challenges.

Transforming Science Assessment: Systems for Innovation is a series of resources designed to provide state education leaders with 1) information about **how states are currently pursuing statewide assessment systems in science**; 2) **analyses of what features influence different approaches**, with an eye to supporting state leaders as they make their own decisions regarding science assessment systems; 3) **detailed state profiles** that highlight how and why some states have made decisions regarding designing and enacting different examples of systems of assessment; and 4) **a how-to guide for policymakers** looking to enact systems of assessment in science. Some readers may find that it is helpful to review all the resources in this series; others might be particularly interested in a specific component of this report.

The suite of resources is organized in the following sections:

- A high-level introduction to science standards and assessment, the need for systems of assessments in science, and two major styles of approaches that are emerging from state efforts to turn the vision for a system of assessments in science into a reality (you are here)
- Deep dive into state-led assessment systems in science
- Deep dive into distributed assessment systems in science
- State Spotlights on systems of assessment in Nebraska, Kentucky, and Michigan
- A guide for policymakers to help consider how to develop and implement assessment systems

Introduction

The release of *A Framework for K-12 Science Education* and the subsequent efforts to develop and adopt science standards that embody it—such as the Next Generation Science Standards (NGSS)—have revolutionized science education, prioritizing a system that more closely mirrors science as it is experienced in the real world, raises expectations for U.S. students in science, and intentionally supports all learners meeting those expectations. This shift has led to sweeping changes in state and district policies and school and classroom practice; teachers are using different approaches to teaching science, districts are adopting new instructional materials and professional learning systems, and states are providing new guidance about what science should look like across their states. How do we—teachers, parents, students, and policymakers—know if those changes are working? Stakeholders rely on various assessments to provide indicators of student and program performance and progress, with the statewide summative assessment frequently regarded as the guiding signal from the state about 1) what student performance should look like, and 2) whether students are meeting expectations. Three-dimensional standards based on the *Framework* pose a challenge for most states' current approach to science assessment because they are not easily assessed in a single, on-demand statewide summative assessment administered once per grade band¹.

One response to the challenge of assessing the NGSS in a single summative assessment is the development of a coherent system of assessments that includes multiple, varied assessment opportunities that range from those designed to support teaching and learning in the classroom to those designed to support programmatic and policy decisions². While many leaders in the science education community have embraced the idea that a system of assessments is necessary to support student progress toward the NGSS and similar standards, states and districts are grappling with moving from concept to reality.

Coherence: that different components of the system of assessments offer distinct but complementary evidence of student progress that can be used *together* to describe student performance—is a distinguishing hallmark of systems of assessment designed for the NGSS. This contrasts with sets of assessments that are not designed to elicit different kinds of information (e.g., interim assessments that are primarily designed to mirror the summative).

¹ Most states administer summative assessments once per grade band to meet the minimum federal requirements described in the Every Student Succeeds Act (ESSA).

² Board on Testing and Assessment Report: Developing Assessments for the Next Generation Science Standards.

This brief describes some of the ongoing efforts in states across the country to develop and enact assessment systems in science and to provide state and district leaders with assessment system models to consider as they implement new science standards. The brief focuses on two primary models that are emerging across state and district efforts:

- 1) State-led assessment systems. In a small subset of states including Kentucky, Delaware, and Nebraska, the state education agency has taken on a leading role in the development and implementation of the assessment systems. This means that the state is defining the components of the system, taking a leadership role in developing the multiple components, and creating the structures to incentivize or require the administration of different components of the system as well as supporting effective use of the information.
- **2) Distributed assessment systems** are established in concert with state support, but are led primarily by district and partner efforts. In these models, statewide assessment efforts are focused on the large scale summative assessment; in some cases, states might be involved in supporting local assessment system efforts, but these supports are frequently limited to providing professional learning and infrastructure supports for local decisions. The design and development of the assessment system components are distributed across multiple stakeholders; state science leaders are focused on the state assessment while statewide and local resources are leveraged to better enable schools, districts, and regions to enact high-quality and aligned science assessments that complement and are coherent with state efforts. Some of these efforts are happening primarily within individual states, while other nascent efforts at cross-state collaboration are also emerging to support parts of the assessment system by developing and sharing joint specifications, common resources and professional learning, and perhaps in the future, common tasks.

What features of three-dimensional standards make assessment systems so enticing?

- Doing Science. Three-dimensional standards—those that emphasize students using science and engineering practices, disciplinary core ideas, and crosscutting concepts to make sense of phenomena and solve problems—emphasize demonstrating science achievement by doing science. Authentic scientific investigations—such as those that involve multi-day observations, developing and revising models based on new information, and constructing arguments based on multiple investigations—can be difficult to assess on a restricted on-demand, once-per-grade band assessment, and are much more conducive to multiple, varied assessments that give students the opportunity to demonstrate their progress toward the standards validly and more comprehensively.
- Wide range of targets associated with the three dimensions. Standards like the NGSS include several core ideas, science and engineering practices, and crosscutting concepts in each grade band, with the expectation that students can demonstrate multiple aspects of all of these targets by the end of instruction. Single 1-3 hour assessment opportunities, irrespective of their richness and innovative designs, simply cannot elicit sufficient evidence to support educators and students as they move toward the standards.
- A range of "flavors" for three-dimensional assessments. In many states, coherent teaching, learning, and assessment goals for three-dimensional standards transcend the 'letter' of the standards. To embody the intent of the standards, they include:
 - Higher-level goals, such as scientific literacy, student identity with and agency in science, and student inclination to engage in scientific endeavors to solve problems; and
 - Specific priorities for the application of the standards themselves, such as applying science in both familiar and increasingly unfamiliar contexts; the range of sophistication of specific practices, core ideas, and crosscutting concepts; the level of support students need to engage in meaningful ways; and the relative emphasis placed on each dimension within multi-dimensional performances.

Given such variety, the claims for and resulting design and evidence from any one assessment that is given to every student are unlikely to encompass the full range of targeted student performance, forcing states to pick and choose among these goals. In the absence of a system, this limits the internal coherence of a state's assessment system by leading to disconnects between teaching, learning, and assessment, and makes collaboration across states difficult because of the differences in goals pursued by each state.

It should be noted that to date, a relatively small number of states have committed to a particular approach to coherent assessment systems, with most state assessment efforts focused entirely on the statewide summative assessments without any intentional support for other assessment system components. In these cases, it's entirely possible that some districts are pursuing other assessment system components on their own; the distinction is an emphasis on intentional coherence.

What distinguishes the two approaches?

Both state-led and distributed approaches to assessment systems in science emphasize the importance of multiple, varied assessment opportunities that are specifically designed for particular purposes. Current efforts across approaches focus on three primary components of the assessment systems:

- Classroom assessments. These assessments are used as part of daily instruction in every classroom. These assessments are both formative in nature and used to help teachers and students make positive instructional decisions that move students toward learning goals, as well as summative, used to monitor progress at the classroom level. These assessments are most relevant locally, and provide parents, teachers, and students with ongoing information about student performance.
- "Interim" assessments. While 'interim' has many connotations associated with it, here we use the term in the most general sense: to refer to those assessments that fall in between classroom formative assessments and statewide summative assessments. These assessments can provide more instructionally relevant information than the statewide summative assessment while still providing common opportunities to monitor progress across different classrooms, schools, and/or districts, and are designed for a range of purposes in different contexts (e.g., growth, to complement other assessments, to signal performance on summative, etc). They can be administered as classroom-embedded performance tasks, on-demand assessments, portfolios of student work relative to similar assessment targets, common final exams, etc. These assessments can be used by parents, teachers, and students to complement classroom assessments, and can be used by state and local leaders to monitor progress over time and through multiple, varied assessment avenues. In some cases, these assessments require all students to take similar assessments on similar timelines; in other states, these assessments are more flexible, in allow local decisions about which specific assessments to administer (e.g., from a state-developed pool), and when and how students see them. Importantly, in all cases, interim assessments (like any other assessment) should be used for the purpose for which they are designed and intended. This brief focuses on how states are using this component with science; for a more general discussion of the role of interim assessments within comprehensive systems, please see this brief.
- Statewide summative assessments. These assessments are common assessments taken by all students at the end of instruction at specified grades within each state. They are developed and administered by the state, can be used to meet federal testing requirements for science, provide district and school-level progress monitoring information, and provide students with one data point about their progress toward science learning goals established by the state. While these assessments signal students' overall progress at the end of instruction, they are not designed to influence individual student progress, nor will they be able to provide the kind of detailed and contextualized information other system components can. They can, however, provide information about progress at higher levels of aggregation and can be used to support programmatic and policy decisions about funding and resource allocation and program selection, provided that they are intentionally designed to reflect the standards and provide the intended type of information.

Within these common components across both system approaches, the major difference between the two lies with 1) who bears the responsibility for development or the assessment (Figure 1 below), 2) who receives and is expected to use that assessment information (Figure 2 below), and 3) resulting implications for the content of the assessments (Table 1 below). State-led assessment systems are characterized by a common vision developed at the state level, and state-led development of assessments that go beyond the statewide summative assessment. In distributed systems, while the state-developed summative assessments and resources to support assessments are important, components of the system other than the statewide summative assessment are coordinated primarily by districts and other local entities. Other resources in this suite include information about state-led systems, distributed systems, and spotlights on how Kentucky, Michigan, and Nebraska are pursuing different system models.

Figure 1: Design and Implementation of Different Assessment Systems

	State-led	Distributed
Statewide summative		
Interim component		
Classroom assessments		

SEA-led design, development, and implementation Locally-led design, development, and implementation State support for locally-led design, development, and implementation

Figure 2: Information Flow Within Assessment Systems Models

	State-led	Distributed
Statewide summative		
Interim component		
Classroom assessments	Varies	

SEA and local stakeholders receive information about student performance Districts and local stakeholders receive information about student performance, but SEA does not see any resulting information unless the district volunteers this information

Table 1: Content Distributions on Different Assessments Within Two Approaches to Assessment Systems

	State-led	Distributed
Statewide summative	Narrower, targeted focus. Because the state is directly designing the whole system, states have some flexibility with what appears on the summative. In states pursuing this model, this generally involves limiting the number of performance expectations (e.g., to those within a grade level rather than a grade band; to those practices that are most conducive to on demand testing).	Wider sampling. Because the state has limited influence on exactly what is included in other parts of the system, the quality of those pieces, and the breadth of use across the state, there is more pressure for the statewide summative assessment to include a wider sample of performance expectations as well as practices core ideas, and crosscutting concepts.
Interim component	Targeted, complementary focus. In state-led systems, the interim component can be designed to complement the content on the summative assessment in three important ways: 1) to target the performance expectations, practices, core ideas, and crosscutting concepts that were not included on the summative; 2) to signal the importance of features of the standards relative to the state goals that are difficult to include in short, on-demand summative assessments (e.g., in-depth reasoning performance tasks that emphasize the practices and crosscutting concepts; tasks that emphasize student decisionmaking and problem solving); and 3) reinforce common features that appear throughout the assessment system.	Locally determined—wide range of possibilities. In distributed systems, the targets for the interim component are locally determined, and can reflect the priorities and needs of a given districts or network of districts. Depending on the design, they may overlap or complement the statewide summative assessment with regard to content included on the assessment
Classroom assessments	Wide range of assessment targets covering the expectations, practices, core ideas, and crossculn both approaches, it is expected that classroon standards.	itting concepts.

What state and district contexts and characteristics are conducive to state-led systems?

State-led efforts to enact science assessment systems require capacity, infrastructure, and support across the state education agency to be successful. While each state pursuing state-led assessment systems has specific contextual features that shape their particular design decisions, some common trends that allow state-led assessment systems to succeed include:

- **SEA leadership engagement.** In states where state-led assessment systems have moved forward, there is clear buy-in to the importance of science assessment systems for effective teaching and learning throughout the range of decisionmakers in a state. This buy-in enables science leadership to access the capacity and resources needed to develop and implement the system.
- Intentional design. State-led efforts have capitalized on a centrally-developed system to intentionally design the system and its components (summative, interim, classroom/formative assessment) to complement and support one another. This allows state efforts to focus on a range of priorities for assessing student and program progress; specific claims and intended uses for each component; and using feedback from each component to inform and influence state work on the other components.
- **State-coordinated interim component.** The major feature that differentiates state-led assessment systems from distributed assessment systems is the state involvement in the design, quality control, and coordination of the interim component of the system. Often considered the "lynchpin" of the system, state leadership for this component allows more intentional support for coherence and systemic feedback.
- Incentive structures. Centrally-developed assessment systems provide reasons for intended users—districts, schools, and teachers—to engage with all components of the system. In some cases, states require participation in various pieces of the system; in others, they incentivize engaging with the system through professional learning or creating tools and resources that educators can use to improve teaching and learning and as a window into what is expected of student performance at the end of instruction. In many cases, states use a combination of both approaches.
- **Professional learning.** State-led assessment efforts emphasize professional learning. This takes several forms across states: in most states, professional learning for both three-dimensional expectations and assessment literacy is embedded in the development of different assessment, as states recruit teachers to be part of the process to varying degrees. In some states, this extends to coordinated professional learning efforts to support selecting, using, and interpreting different assessments. In many states, there is also an emphasis on supporting good classroom formative and summative assessment use. The emphasis on professional learning allows states to engender buy-in to the state-led system by both involving educators as well as showing the value of the system, while also allowing the state to influence coherence of the system in one more way—in most states, an underlying goal of assessment professional learning is reinforcing common messages about what is important to know about student performance.

These contextual factors have implications for the strengths and limitations of this approach, including the following:

Table 2: Strengths and Challenges Associated with State-Led Assessment Systems

Strengths and Opportunities

- Intentional coherence. A centrally-designed system can use a principled design approach for the whole system, clearly defining the claims for the system and sub-claims for components; specify uses and content targets for each component; ensure the range of student performances and targeted content are appropriately distributed throughout the system; and that the components are designed to complement, signal, and feedback on one another.
- 2. Connected professional learning. There are clear opportunities to embed professional learning in the design and implementation of different pieces of the system. This can help promote needed assessment literacy throughout the state and as well as allow all components of the assessment have a clear connection to improving instruction and instructional shifts.
- 3. Consistency and quality. Through centrally-developed systems, states can help ensure that there are consistent features of high-quality, three-dimensional assessments throughout all components of the system, and that the assessments made available to educators are vetted and quality designations as well as recommendations for how assessment information should be used are clearly communicated.
- **4. Access.** State-developed resources that are part of the assessment system will be available to all districts, schools, and teachers in the state.

Challenges and Tradeoffs

- 1. Stakeholder engagement. A top-down approach can distance some stakeholders in schools and districts who might feel like additional assessments are being thrust upon them. States pursuing centrally-developed assessment systems should plan for stakeholder engagement early and often, in determining vision, designing assessment components, item writing, professional learning, etc. States should also carefully consider the range of stakeholders that can and should be engaged—educators are an important top priority, but consider engaging higher education and research partners; district and regional coaches and administrators; third-party community partners; and colleagues and partners across content areas.
- 2. Capacity and resources. An intentionally-designed, centrally-administered assessment system requires a great deal of capacity and resources (including money, time, expertise, and personnel). States should carefully consider the resources they have available, and make assessment system plans that focus on a long-term vision and achievable, short-term next steps that move toward that vision. This will require prioritizing and making difficult decisions about tradeoffs in the short term, but will help states ensure that their resources are spent as effectively as possible, and that they are getting the best outcomes possible.
- Aligning vision and goals with practical considerations. Three-dimensional expectations require rethinking many traditional approaches and technical models for assessment. This can be particularly frustrating when trying to operationalize a vision for a science assessment system. States should consider working with colleagues with technical expertise who will be helpful thought partners early and throughout the process—not to compromise on their vision, but to collaborative develop ways to move forward, prioritize decisions/design features, and to creatively problem solve. Try to have a diversity of content and technical expertise involved in the process to reach the most effective outcomes for a particular state vision and context.

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Table 2: Strengths and Challenges Associated with State-Led Assessment Systems (continued)

Strengths and Opportunities	Challenges and Tradeoffs
	4. Common internal vision. A lesson learned from states pursuing state-led assessment systems is the importance of within-SEA buy-in for the assessment system. In many states, there is a passionate belief in science assessment systems at the level of science leads, but this is likely to be insufficient to make effective progress toward a state-led system. State science leads should consider mechanisms to cultivate a common internal vision for the science assessment system not only with science colleagues, but with the assessment leads and director, chief academic/innovation officer, and state chief and deputies. While this process may extend an assessment timeline, it is more likely to result in a sustainable system and ensure that science assessment systems have a team of advocates within the SEA.

What state and district contexts and characteristics are conducive to distributed systems?

An alternative to state-led assessment systems are distributed assessment systems—those that still prioritize providing teachers, students, and possible schools and districts with more comprehensive and coherent information about student and program progress, but distribute the ownership and responsibility for components of the assessment system across the state and local entities. Some common features of distributed approaches to science assessment systems include:

- Specific needs of local communities. Distributed approaches to assessment systems are highly customizable to specific district and regional needs. In contrast to state-led assessment systems, in which several major components are designed by the state to meet many/generalized needs, local involvement in components of the assessment system can help ensure that the system is designed to address the specific implementation plans, high-need areas, and priorities of specific districts/regions.
- **Effective partnerships.** Distributed approaches to assessment systems are characterized in part by the involvement of additional partners in the process to provide local support, expertise, and additional capacity. The partners themselves can vary; science education organizations, research partners, professional learning providers, consultants, and vendors can all play a role.
- **Positive state-district relationships.** Distributed approaches to assessment systems are still intended to be coherent. This requires effective communication and collaboration between the state and district/region. This can take multiple formats—state-provided professional learning for assessment development, district involvement in statewide summative assessment, funding and collaborative opportunities—but generally requires open, two-way communication.

These contextual factors have implications for the strengths and limitations of this approach, including the following:

Table 3: Strengths and Challenges Associated with Distributed Assessment Systems

Strengths and Opportunities

- 1. Innovation proof points. Three-dimensional standards create more opportunity than ever for innovative approaches to assessments, and districts may be in a far better position than states to flexibly explore these options. Innovative local approaches to tasks, portfolios, common assessments, performance assessments, and analysis/effective use of the information could create proof points within a state of innovation that could then be shared and connected to other districts, and perhaps inform state assessment processes as well.
- Stakeholder engagement. By their very nature, distributed assessment systems involve more stakeholders in their development and implementation. This can be further leveraged to enhance stakeholder engagement and buy-in to the assessment system design.
- 3. Needs-instrument alignment. Distributed assessment systems that are largely developed or selected and implemented locally can be chosen to meet specific local needs; for example, if these assessment components are being developed locally, they can much more closely connect to local implementation plans, allowing districts to get more targeted information about their specific implementation interventions. Similarly, assessments can be implemented to support specific use cases, connect specifically to local phenomena and problems, etc.
- 4. Connecting the pieces close to the classroom. Districts and regional offices are ideally situated between the state and classroom levels to help connect the dots to support among different assessment instruments. In a distributed assessment system, this means that district-led components can build from and better inform instruction and classroom-embedded assessments, providing additional support to the primary audiences for assessment system information: districts, teachers, and students.

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Challenges and Tradeoffs

- 1. Coherence. Distributed assessment systems may face more challenges regarding coherence because the components are not necessarily designed based on a similar vision, design claims, or from common specifications. States can help support these efforts by clearly articulating the state theory of action regarding assessments and instruction, and transparently supporting districts in developing the specifications and design documentation that will connect in meaningful ways to state efforts.
- **Equity and access.** One challenge for distributed assessment systems is working toward a system in which all students have access to the components of the system. The reality is that the first districts that will likely be able to pursue assessment systems in science will be those with more resources and capacity; this means there will likely be a large number of districts in each state that will not be able to simply mimic the process. States can play an important role in connecting ongoing district assessment system work to districts with less capacity; supporting a wide range of districts in developing the assessment literacy and deep understanding of three-dimensional standards needed to move forward on this work; and connecting districts and regions with interested partners to support this work.
- 3. Quality control and consistency. Because assessment system components will be developed/ selected separately across the state, ensuring quality, alignment, and consistency may be a real challenge for distributed assessment systems. States can support these efforts by clearly articulating the necessary quality checks needed to use the locally-developed assessment information for different kinds of purposes; by providing professional learning opportunities targeted at quality and consistency throughout the system; and by recommending/ connecting ongoing efforts to partners who can support quality control. It should be noted that this caution is true for both district-developed and vendor-developed, district-selected assessments.

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Table 3: Strengths and Challenges Associated with Distributed Assessment Systems (continued)

Strengths and Opportunities	Challenges and Tradeoffs
5. Distributed capacity and resource needs. One of the major challenges associated with assessment systems at large are the major resource and capacity needs to support assessment systems. Distributed models effectively bring more resources to the table, by dividing the responsibility for different assessment components across states, districts, regions, networks, etc. This enables all parties to focus on doing some components well, rather than needing to address all aspects of the system.	4. Wider scope for statewide summative assessments. In states where assessment systems are more distributed, there tends to be wider sampling of the standards included on the statewide summative assessments. This poses challenges for sufficiently addressing both the range and depth of the standards included on the assessment.

Emerging hybrid models

Some early efforts at hybrid models—like Nebraska's plans for their system of assessments in science—are beginning to emerge. In these models, the SEA is the driving force behind the assessment system designs and development (like other state-led models), but intentionally encourages district-level innovation for particular purposes that complement state capacity and goals. This approach allows states to drive the vision and coherence across the full system while empowering districts to develop the components of the system that will best meet their needs.

As expected, states pursuing hybrid models share most of the contextual features of both models described above. One notable feature is that **states considering moving forward with hybrid models include a small number of high-capacity districts whose immediate needs differ from others.** In hybrid models, the primary priorities of the state might not fully satisfy the needs of a particular district; for example, the state might want to prioritize those interim tasks that will best support teaching and learning by providing examples, professional learning, and feedback mechanisms for the content associated with the biggest shifts in science. While this might be helpful to all districts, some may feel that they need data-driven processes associated with new science assessments to be part of their local accountability systems. In hybrid models, states and districts leverage distributed capacity to help meet both needs, staying within the coherent vision laid out by the state. States may offer districts support for their specific activities, or provide mechanisms for their work to be shared across the state, but districts own the development of these specific subcomponents. Over time, more hybrid models will likely emerge, emphasizing different state and district roles.

Recommendations for pursuing comprehensive assessment systems

Five years into the implementation of new science standards, several states and districts have begun pursuing systems of assessment to provide comprehensive and meaningful feedback about student and program progress. While the work is a moving target in many ways, several promising models are emerging that other states and districts can use to guide their assessment system vision and next steps.

As more states and districts pursue assessment systems, some recommendations based on lessons learned from those engaged in developing and implementing these models have emerged and are described here. For a more complete guide to designing and implementing systems of assessment, please see this guide.

- 1. Assess state and district context realistically. States and districts should consider internal and external support, resources, and capacity as well as goals for interpretative uses of information from an assessment system to support thinking about which models may be most appropriate.
- 2. Engage stakeholders. Buy-in—from those making decisions about whether the system can move forward as well as those involved in implementing and using the system—is critical for success. Consider bringing stakeholders into the conversations early and often, ensuring that they have a part in creating, developing, and sustaining the vision.
- 3. Intentionally design the system. States and districts should develop system-wide goals, determine how each component fits in and contributes evidence that is consistent with those goals, how resulting information should be used, and what kinds of evidence is needed to support those uses. Consider which features will remain consistent throughout the system, and which features will vary to give you a complete picture of student performance. In distributed assessment systems, districts and partners should use information provided by the state about goals, summative assessment blueprints, implementation plans, etc. to guide local decisions, ensuring coherence.
- **4. Leverage partnerships**—within the state, across states, and with research, practice, and policy partners.
- 5. Consider the technical recommendations early and often as they relate to goals and uses of various components of the assessment system. This will help prevent difficult conversations and help all involved stakeholders move forward with a common vision.
- **6. Develop, monitor, and celebrate milestones along the way.** Transformational systems of assessment will not happen overnight. It is important to have clear, achievable short term goals that can be monitored, used to help course-correct, and celebrated as progress toward the eventual goal.
- 7. Include quality control processes throughout development and implementation, for the vision as well as for each component. Consider criteria for high-quality and aligned assessments, tools for developing and evaluating high-quality assessments, approaches for selecting and using the right assessments, and processes and indicators for developing systems of assessment.
- **8. Communicate.** Regardless of approach, communication—internally within SEAs and districts, and between the SEA and districts—is necessary for a successful system. SEAs should make sure to communicate their vision, implementation plans, and any assessment system plans they are developing; districts should make sure to communicate their specific needs, system plans, etc.