EVERY CHILD

PROFICIENT & PREPARED FOR SUCCESS

KENTUCKY DEPARTMENT OF EDUCATION

CKEC ISLN Instructional Support Leadership Network September 2013

ckec

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Kentucky Leadership Networks – 2013-2014

The system of Leadership Networks in Kentucky has been designed to support the quality implementation of the requirements set forth in **Senate Bill 1 (2009)**. Specifically, the networks are intended to ***build the capacity of each district*** in the Commonwealth as they implement Kentucky's new Core Academic Standards, develop assessment literacy among all educators, and work toward ensuring that **every student is college and career ready**. To that end, the vision for these networks is: *Every school district in the Commonwealth of Kentucky has a knowledgeable and cohesive leadership team that guides the professional learning and practice of all administrators, teachers, and staff so that every student experiences highly effective teaching, learning, and assessment practices in every classroom, every day. (Result:* ***Proficient and Prepared for Success****!)*

Participants in each of the Leadership Networks have a responsibility to:

- collaborate with other leaders throughout the region to hone practice/knowledge, and
- work collaboratively with the district leadership team to scale up highly effective practices in every classroom.

Four major components form the foundation of every Leadership Network in the state. Those components are:

- Kentucky's Core Academic Standards (KCAS)
- Assessment Literacy (utilizing the *Classroom Assessment for Student Learning* [CASL] text)
- Kentucky Framework for Teaching (FfT)/Characteristics of Highly Effective Teaching and Learning (CHETL)
- Leadership (around the above components, for scaling up)

In an effort to achieve statewide P16 coherency, each network will be facilitated by a team consisting of regional and state content specialists from the KDE, faculty members from institutions of higher learning, and local education leaders.

Teacher Leaders participating in content leadership networks will be learning and practicing new processes and strategies. They will be asked to **create and share models/examples** of their work. Some of the specific processes/skills Teacher Leaders will be expected to learn and products they will be asked to eventually produce (collectively) include:

- Reaching consensus with colleagues on the meaning of the standards/performance expectations in terms of expected depth and breadth, and the related progressions, by engaging in/modeling processes to deconstruct Kentucky's Core Academic Standards into clear learning targets;

- Planning and reflecting on your own/others' teaching using the Characteristics of Highly Effective Teaching and Learning/Kentucky Framework for Teaching as a guide;

- Utilizing data effectively to improve teaching and learning by designing/selecting/implementing high-quality classroom/local assessments;

- Planning/selecting rigorous and congruent (i.e., completely aligned) learning experiences for instruction;

- Working collaboratively within and across networks to populate our online repository for instructional resources- CIITS- (i.e., learning targets and suggested sequences of learning, sample aligned units and assessments, common formative and summative assessments based on Kentucky's Core Academic Standards) for all Kentucky teachers/leaders to access;

- Utilizing provided resources, tools, protocols and other network products in your own and your districts' schools to facilitate growth as part of your district's leadership team;

- Working with your district leadership team in supporting other educators as they move toward full implementation of these same processes/strategies in their own classrooms;

- Participating in/modeling/designing/implementing highly effective professional learning.

School level leaders and district level leaders will focus on the same major components in each of their meetings. Additionally, their work will be tailored to reflect their positions as school or district leaders. For example, principals will not spend as much time on 'meaning-making' related to the individual standards, but instead will focus on how to remove barriers or facilitate ways

for teachers to implement effective teaching and learning practices and how to provide them with descriptive feedback so that they are able to grow as professionals. District level leaders will focus on structuring district wide discussions-especially transitions from elementary to middle to high school- around the standards for the sake of curriculum development, as well as how to ensure quality implementation of highly effective practices that result in student success.

District level leaders will hold the responsibility for organizing the **district leadership team**. Those members, at a minimum, should include:

- Science and Social Studies (beg. Jan 2014) Teacher Leaders attending Content Leadership Networks
- School-level Administrators attending ISLN
- District-level Administrators attending ISLN
- Superintendent
- ELA/Math Teacher Leaders who participated in those Content Leadership Networks

Rationale/Supporting Research for the Design of the Leadership Networks

The system of Networks has been created around some of the most recent findings regarding professional learning that results in student achievement. In a 2009 report*, the Council of Chief State School Officers (CCSSO) reviewed 16 well-designed studies of professional development programs that documented enhanced student achievement and identified the following common elements for success:

- The program designs included strong emphasis on **teachers learning specific subject content as well as pedagogical content** for how to teach the content to students. *(Our focus on KCAS, CASL, and FfT/CHETL)*
- The implementation of professional learning included **multiple activities to provide follow-up reinforcement of learning, assistance with implementation, and support for teachers from mentors and colleagues** in their schools. *(Our SYSTEM is intentionally designed for support—including our Regional Content Specialists offering field-based support to teachers, schools, and districts)*
- In terms of duration of development activities, 14 of the 16 **programs continued for six months or more**. The mean contact time with teachers in program activities was *91 hours.* *(Our system is designed to build capacity over the next several years—with an average of 48 hours of direct professional learning per year)*
  *(http://www.ccsso.org/Resources/Publications/Effects_of_Teacher_Professional_Development_Gains_in_Student_Achievement_How_Meta_Analysis_Provides_Evidence_Useful_to_Education_Leaders_.html)

Senate Bill 1 (2009) specifically calls for the development of assessment literacy, especially the effective use of formative assessment strategies within every classroom. The research is clear that effective implementation of formative assessment at the classroom level has dramatic results on student achievement. In such classrooms, all students experience greater success and motivation, with lower achievers making the most dramatic gains (Black and Wiliam, 1998, Thompson, Paek, Goe, and Ponte, 2004, Ruiz-Primo and Furtak, 2006).

Richard Stiggins (2005) stated that "to use assessment productively to help achieve maximum student success, certain conditions need to be satisfied." Thus, Stiggins and others at the Assessment Training Institute have developed a strategic framework for building assessment literacy. The *Classroom Assessment for Student Learning: Using it Right, Doing it Well* text has been selected to be the foundational and consistent framework for use in the leadership networks to enhance educators' skill at evaluating, selecting, and/or designing effective formative and summative assessment tasks. School level and district level leaders will utilize the companion text *Assessment Balance and Quality: An Action Guide for School Leaders* in their respective networks to maintain fidelity of strategy and skill development and implementation.

The **Characteristics of Highly Effective Teaching and Learning/Kentucky Framework for Teaching** provide lenses for looking at what happens in highly effective classrooms. Further, every characteristic has been supported and aligned to current research on teaching and learning, offering both characteristics for teachers and students, as well as being fully aligned and 'crosswalked' to the KY Framework for Teaching (FfT) which underpins the PGES. This focus will enable teachers and leaders throughout the state to communicate around a common set of best practice strategies and focus on specific strategies for improvement as they implement the new Core Academic Standards. To access the Characteristics, go to:
http://www.education.ky.gov/KDE/Instructional+Resources/Highly+Effective+Teaching+and+Learning/

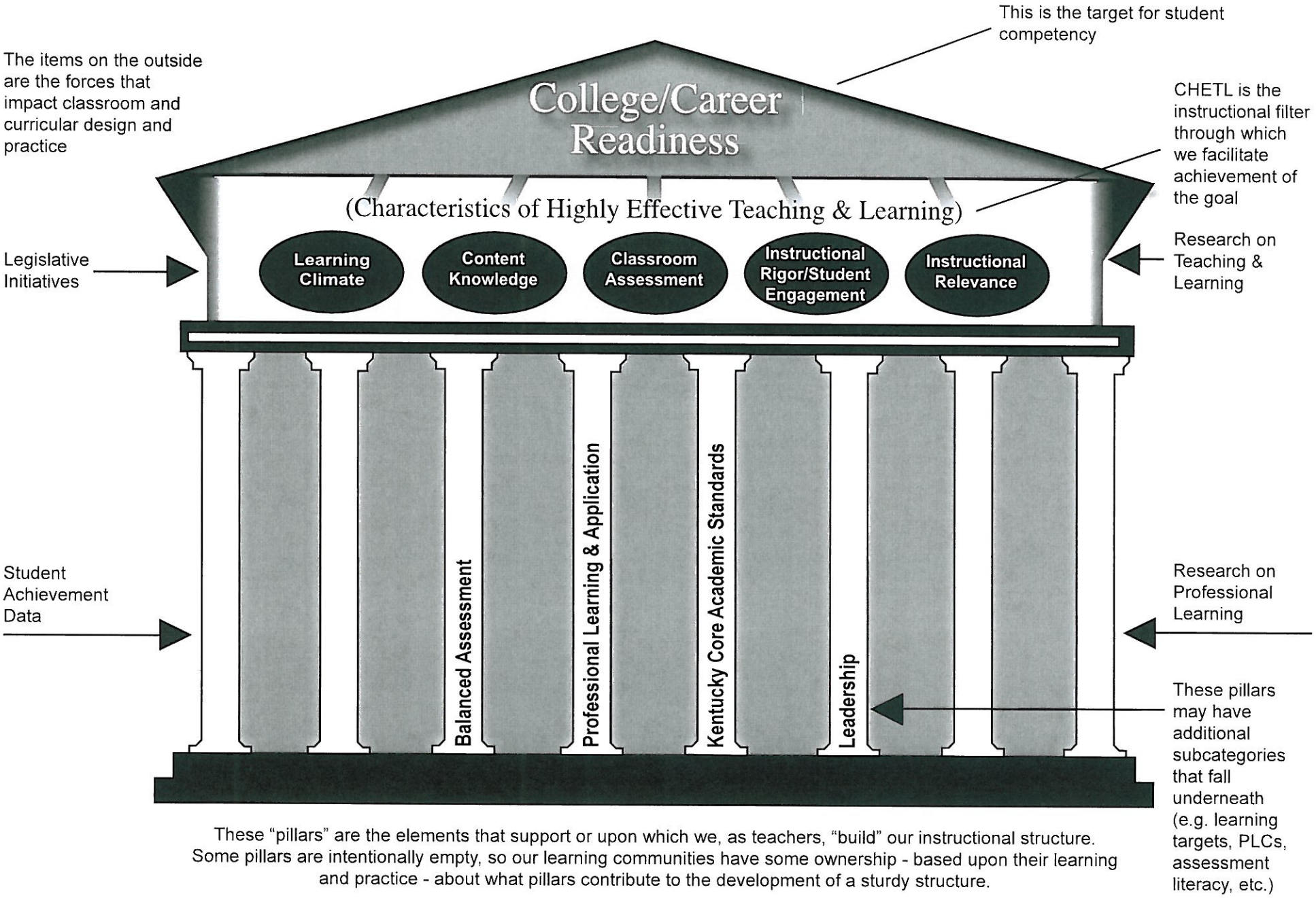
Additional Information at: http://education.ky.gov/curriculum/docs/Pages/KLN.aspx
http://education.ky.gov/school/Pages/Leadership-Networks---Deliverables.aspx

Leadership Network Facilitator NORMS

1. **Be an ambassador of 'lifelong learning' (i.e., show your enthusiasm and enjoyment for the work--and try to make others happy, be willing to take risks/admit you have learning to do).**
2. **Come to meetings prepared (i.e., on time, any preparations/readings completed, with necessary materials).**
3. **Be focused during meetings (i.e., stick to Network goals/targets, use technology to enhance work at hand vs check email/facebook, etc.).**
4. **Work collaboratively (i.e., all members' contributions are valued and honored, there are no 'bosses', seek first to understand and then be understood).**
5. **Set the 'standard' of a facilitator for all Leadership Network partners and as KDE representatives (i.e., use appropriate language/grammar, dress appropriately, present the KDE 'message' on issues, be prepared and knowledgeable for all presentations).**
6. **Prioritize team/facilitator planning meetings (i.e., make every effort to be present, plan to put routine work aside during meetings).**
7. **Seek to solve problems/address issues with colleagues in a private and professional manner before involving others.**

Procedure for addressing "Norm Violations"

1. Hold up the 'Norm' card
2. Shout "NORM!" a la "Cheers"
3. Make a motion for the group to revisit the Norms



These "pillars" are the elements that support or upon which we, as teachers, "build" our instructional structure. Some pillars are intentionally empty, so our learning communities have some ownership - based upon their learning and practice - about what pillars contribute to the development of a sturdy structure.

Characteristics of Highly Effective Teaching and Learning ~ Common to all Content Areas

The following statements represent characteristics that are common to all content areas.

Instructional Rigor and Student Engagement: a teacher supports and encourages a student's commitment to initiate and complete complex, inquiry-based learning requiring creative and critical thinking with attention to problem solving

Teacher Characteristics:

___A - Teacher instructs the complex processes, concepts and principles contained in state and national standards using differentiated strategies that make instruction accessible to all students.

___B – Teacher scaffolds instruction to help students reason and develop problem-solving strategies.

___C - Teacher orchestrates effective classroom discussions, questioning, and learning tasks that promote higher-order thinking skills.

___D -Teacher provides meaningful learning opportunities for students.

___E -Teacher challenges students to think deeply about problems and encourages/models a variety of approaches to a solution.

___F -Teacher integrates a variety of learning resources with classroom instruction to increase learning options.

___G -Teacher structures and facilitates ongoing formal and informal discussions based on a shared understanding of rules and discourse.

___H -Teacher integrates the application of inquiry skills into learning experiences.

___I -Teacher clarifies and shares with students learning intentions/targets and criteria for success.

Student Characteristics:

___A -Student articulates and understands learning intentions/targets and criteria for success.

___B - Student reads with understanding a variety of texts.

___C -Student applies and refines inquiry skills.

Instructional Relevance: a teacher's ability to facilitate learning experiences that are meaningful to students and prepare them for their futures.

Teacher Characteristics:

___A-Teacher designs learning opportunities that allow students to participate in empowering activities in which they understand that learning is a process and mistakes are a natural part of the learning.

___B-Teacher links concepts and key ideas to students' prior experiences and understandings, uses multiple representations, examples and explanations.

___C-Teacher incorporates student experiences, interests and real-life situations in instruction.

___D-Teacher selects and utilizes a variety of technology that support student learning.

___E-Teacher effectively incorporates 21st Century Learning Skills that prepare students to meet future challenges.

___F-Teacher works with other teachers to make connections between and among disciplines.

___G-Teacher makes lesson connections to community, society, and current events.

Student Characteristics:

___A-Student poses and responds to meaningful questions.

___B-Student uses appropriate tools and techniques to gather, analyze and interpret information from quantitative and qualitative evidence.

___C-Student develops descriptions, explanation, predictions, and models using evidence.

___D-Student works collaboratively to address complex, authentic problems, which require innovative approaches to solve.

___E-Student communicates knowledge and understanding in a variety of real-world forms.

___F-Student communicates knowledge and understanding for a variety of purposes.

Knowledge of Content: a teacher's understanding and application of the current theories, principles, concepts and skills of a discipline.

Teacher Characteristics:

___A- Teacher demonstrates an understanding and in-depth knowledge of content and maintains an ability to convey this content to students.

___B- Teacher maintains on-going knowledge and awareness of current content developments.

___C- Teacher designs and implements standards-based courses/lessons/units using state and national standards.

___D- Teacher uses and promotes the understanding of appropriate content vocabulary.

___E- Teacher provides essential supports for students who are struggling with the content.

___F- Teacher accesses a rich repertoire of instructional practices, strategies, resources and applies them appropriately.

Student Characteristics:

___A- Student demonstrates growth in content knowledge.

___B-Student uses and seeks to expand appropriate content vocabulary.

___C-Student connects ideas across content areas.

___D- Student uses ideas in realistic problem solving situations.

http://www.education.ky.gov/KDE/Instructional+Resources/Highly+Effective+Teaching+and+Learning/HETL+Common+Characteristics.htm

Characteristics of Highly Effective Teaching and Learning ~ Common to all Content Areas

The following statements represent characteristics that are common to all content areas.

Learning Climate: a safe environment supported by the teacher in which high, clear expectations and positive relationships are fostered; active learning is promoted	**Classroom Assessment and Reflection:** the teacher and student collaboratively gather information and reflect on learning through a systematic process that informs instruction
Teacher Characteristics: ___A. creates learning environments where students are active participants as individuals and as members of collaborative groups ___B. motivates students and nurtures their desire to learn in a safe, healthy and supportive environment which develops compassion and mutual respect ___C. cultivates cross cultural understandings and the value of diversity ___D. encourages students to accept responsibility for their own learning and accommodates the diverse learning needs of all students ___E. displays effective and efficient classroom management that includes classroom routines that promote comfort, order and appropriate student behaviors ___F. provides students equitable access to technology, space, tools and time ___G. effectively allocates time for students to engage in hands-on experiences, discuss and process content, and make meaningful connections ___H. designs lessons that allow students to participate in empowering activities in which they understand that learning is a process and mistakes are a natural part of learning ___I. creates an environment where student work is valued, appreciated and used as a learning tool **Student Characteristics:** ___A. accepts responsibility for his/her own learning ___B. actively participates and is authentically engaged ___C. collaborates/teams with other students ___D. exhibits a sense of accomplishment and confidence ___E. takes educational risks in class ___F. Practices and engages in safe, responsible and ethical use of technology	**Teacher Characteristics:** ___A. Uses multiple methods to systematically gather data about student understanding and ability ___B. Uses student work/data, observations of instruction, assignments and interactions with colleagues to reflect on and improve teaching practice ___C. Revises instructional strategies based upon student achievement data ___D. Uncovers students' prior understanding of the concepts to be addressed and addresses students' misconceptions/incomplete conceptions ___E. Co-develops scoring guides/rubrics with students and provides adequate modeling to make clear the expectations for quality performance ___F. Guides students to apply rubrics to assess their performance and identify improvement strategies ___G. Provides regular and timely feedback to students and parents that moves learners forward ___H. Allows students to use feedback to improve their work before a grade is assigned ___I. Facilitates students in self- and peer-assessment ___J. Reflects on instruction and makes adjustments as student learning occurs **Student Characteristics:** ___A. Recognizes what proficient work looks like and determines steps necessary for improving his/her work ___B. Monitors progress toward reaching learning targets ___C. Develops and/or uses scoring guides periodically to assess his/her own work or that of peers ___D. Uses teacher and peer feedback to improve his/her work ___E. Reflects on work and makes adjustments as learning occurs

http://www.education.ky.gov/KDE/Instructional+Resources/Highly+Effective+Teaching+and+Learning/HETL+Common+Characteristics.htm

Kentucky Leadership Networks: 2013-2014 Year-at-a-Glance

Month	Instructional Support (School + District Leaders)		Science Teacher Leaders		Social Studies Teacher Leaders	
	Focus	Follow-up	Focus	Follow-up	Focus	Follow-up
Sept	Clarify role/expectations of the District Leadership Team (DLT) in support of the overall goals of the ISLN and in support of teacher leaders. Support the implementation of KCAS, PGES, and professional learning* in my school/district to provide students with the experiences necessary to become college and/or career ready. Build an infrastructure to support PGES for full scale. Identify what resources are available to support PGES implementation and how to access them. ○ I know what supports are available and understand the training requirements for peer observation. ○ I can support teachers in the professional growth planning process. Use the guiding questions to coach a teacher through the student growth goal setting process. Identify necessary shifts (changes) in teaching and learning needed to fully implement the Next Generation Science Standards. *Discuss recent changes to KYs definition of Professional Learning/revision of Standards for Professional Learning	Set District Leadership Team meeting calendar for year; plan first meeting agenda Bring samples of SGGs Review of infrastructure for full scale implementation (need guide)	Clarify roles/responsibilities/expectations for Teacher Leaders in the Science Leadership Network and as members of a District Leadership Team. Understand the goal of the Leadership Networks as a capacity building approach that focuses on professional learning around KCAS, CHETL, Assessment Literacy, and Leadership in order to support CCR for all students. Analyze the structure and intent of the Next Generation Science Standards to transform teaching and learning. Identify key shifts in teaching and learning that will be necessary to fully and effectively implement the NGSS.	Determine who is on the District Leadership Team Read/review the Framework for K-12 Science Education and the NGSS Explain your role in the Network to one or more of your colleagues		

Oct	Support the implementation of KCAS, PGES, and professional learning in my school/district to provide students with the experiences necessary to become college and/or career ready.
	
	Use the District Innovation Configuration Maps to identify current status of district efforts; identify key goals/outcomes/next steps for DLT.
	
	Study a sample progression within the NGSS and recognize implications for curriculum development; begin to plan for curriculum development in district (noting interdependency with ELA and Mathematics KCAS).
	
	Identify what resources are available to support PGES implementation and how to access them.
	• Feedback SGGs
	• Conferencing
	  ○ Student Voice
	  ○ PGP
	  ○ Observation
	  ○ SGG
		Bring Sample PGGs
		
		Review of infrastructure for full scale implementation (need guide)
			Study sample progressions within the NGSS and recognize implications for teaching and learning as well as curriculum development (noting interdependency with ELA/Math KCAS).
			
			Analyze the science and engineering practices and crosscutting concepts to understand their significance when combined with the disciplinary core ideas on student performance expectations.
			
			Identify connections between NGSS implications for teaching and learning and the Framework for Teaching and Learning (FTL)/CHETL.
			
			Explore the District Innovation Configuration (IC) Maps; identify current status of district efforts; construct 2-3 questions to take to the next DLT meeting.
				Read/review the Framework for Teaching and Learning and CHETL
				
				Read/review the District Innovation Configuration Map
				
				Point one or more of your colleagues to the NGSS/Framework for K-12 Science Education
				
				Take your questions from the IC map task to the DLT meeting
				
				*Bring a lesson to November meeting to analyze for congruency to KCAS		

Nov	Support the implementation of KCAS, PGES, and professional learning in my school/district to provide students with the experiences necessary to become college and/or career ready. Analyze a model instructional plan that emphasizes the intersection of science and literacy standards (disciplinary literacy); discuss implications for professional learning around instructional planning/design/materials selection. Identify what resources are available to support PGES implementation and how	Prepare for Student Perception Round Table Review of infrastructure for full scale implementation (need guide)	Engage in self-analysis of assessment literacy; set goal(s)/targets for growth in that area (using language from FTL and CHETL). Reach consensus with colleagues on the meaning of the standards/performance expectations in terms of expected depth and breadth, and the related progressions, by engaging in/modeling processes to deconstruct Kentucky's Core Academic Standards into clear learning targets. Analyze a model instructional plan that emphasizes the intersection of science	Identify Assessment Literacy resources (e.g., via CIITS) based on your identified goal/target Practice deconstructing a standard/perfor mance expectation using the process from the network		

	to access them. • PGP Review • SGG progress • Peer Observation Reflect on previous/plan for upcoming District Leadership Team meetings.		and literacy standards (disciplinary literacy); discuss implications for instructional planning/design/materials selection. **Teacher Leaders should bring a lesson to analyze* Explore roles of Teacher Leadership and connections to FTL; set personal targets for next 3 months and identify success criteria/evidence. Discuss progress/challenges of DLT meetings.	Refine your personal Teacher Leadership target(s)/ evidence *Bring a sample assessment item/task to Jan meeting		

Jan	Support the implementation of KCAS, PGES, and professional learning in my school/district to provide students with the experiences necessary to become college and/or career ready.
	
	Analyze examples of assessment designs that align to the NGSS to inform selection/design at local level and implications for curriculum development.
	
	Explore the College, Career, and Civic Life (C3) Framework for Social Studies and its intended impact on teaching, learning and standards development in KY
	
	Identify what resources are available to support PGES implementation and how to access them.
	• Conferencing
	  ○ Student Voice
	  ○ PGP
	  ○ Observation
	  ○ SGG
	
	Reflect on previous/plan for upcoming District Leadership Team meetings.
		Review of infrastructure for full scale implementation (need guide)	Engage in learning to deepen assessment literacy based on individual goals.
			
			Reach consensus with colleagues on the meaning of the standards/performance expectations in terms of expected depth and breadth, and the related progressions, by engaging in/modeling processes to deconstruct Kentucky's Core Academic Standards into clear learning targets.
			
			Deepen understanding of the science and engineering practices and crosscutting concepts and explore strategies for effectively translating them into practice.
			
			Analyze examples of assessment designs that align to the NGSS; discuss implications for planning/designing local assessments. **Teacher Leaders should bring a sample assessment/task to analyze*
			
			Reflect on/provide feedback to others on Teacher Leadership targets/efforts.
			
			Discuss progress/challenges of DLT meetings.
				Conduct a status check on your personal Teacher Leadership target(s)/ evidence
				
				Continue to build assessment literacy
					Clarify roles/responsibilities/expectations for Teacher Leaders in the Social Studies Leadership Network and as members of a District Leadership Team.
					
					Understand the goal of the Leadership Networks as a capacity building approach that focuses on professional learning around KCAS, CHETL, Assessment Literacy, and Leadership in order to support CCR for all students.
					
					Analyze the structure and intent of the College, Career, and Civic Life (C3) Framework for Social Studies to transform teaching and learning.
					
					Identify key shifts in teaching and learning that will be necessary to fully and effectively implement the C3 Framework/related standards.
						TBD

Feb	Support the implementation of KCAS, PGES, and professional learning in my school/district to provide students with the experiences necessary to become college and/or career ready. Share/discuss/analyze critical attributes and elements of curriculum maps/guides for NGSS. Identify what resources are available to support PGES implementation and how to access them. • Systems to support Student Growth Goals	Review of infrastructure for full scale implementation (need guide)	Engage in learning to deepen assessment literacy based on individual goals. Deepen understanding of the science and engineering practices and crosscutting concepts and explore strategies for effectively translating them into practice. Share/discuss/analyze critical attributes and elements of curriculum maps/guides for NGSS. Reflect on/provide feedback to others on Teacher Leadership targets/efforts. Discuss progress/challenges of DLT meetings.	TBD	Identify connections between C3 implications for teaching and learning and the Framework for Teaching and Learning (FTL)/CHETL. Analyze the 4 dimensions of the C3 Framework to understand the "Instructional/Inquiry Arc" Review DRAFT standards for social studies for structure, themes/threads; provide feedback. Explore the District Innovation Configuration (IC) Maps; identify current status of district efforts; construct 2-3 questions to take to the next DLT meeting.	TBD
March	Support the implementation of KCAS, PGES, and professional learning in my school/district to provide students with the experiences necessary to become college and/or career ready. Use the District Innovation Configuration Maps to identify current status of district efforts; compare current status to key goals/outcomes identified for DLT against status in October; identify next steps/goals. Identify what resources are available to support PGES implementation and how to access them. • Develop systems to support full scale implementation Reflect on previous/plan for upcoming District Leadership Team meetings.	Review of infrastructure for full scale implementation (need guide)	Use the District Innovation Configuration Maps to identify current status of district efforts; compare current status to key goals/outcomes identified for DLT against status in October; identify next steps/goals. Reflect on/provide feedback to others on Teacher Leadership targets/efforts. Spotlight/showcase on effectively translating into practice the science and engineering practices and crosscutting concepts (teaching, learning, assessment). Identify desired next steps for the Network (summer learning/coming year).	TBD	Analyze a model instructional plan that emphasizes the intersection of C3 Framework/draft standards and literacy standards (disciplinary literacy); discuss implications for instructional planning/design/materials selection. Explore roles of Teacher Leadership and connections to FTL; set personal targets for next 3 months and identify success criteria/evidence. Discuss progress/challenges of DLT meetings. Identify desired next steps for the Network (summer learning/coming year).	TBD
Summer 2014	ISLN Convening TBA		TBD		TBD	

Characteristics of the "Right" Network Participants

Commits to the Work -

- volunteers – someone who finds this work engaging and exciting
- completes tasks, readings or homework assignments in order to engage fully in network
- focuses on the goals -- learning, implementing, reflecting and guiding others

Displays Leadership Skills -

- has the ability and the opportunity to lead a professional learning team
- is viewed as a leader in the school/department/district
- influences and inspires others
- knows how to do the "right thing," not just how to do the thing right
- knows how to facilitate learning

Exhibits effective interpersonal skills -

- is trustworthy and dependable
- listens for understanding
- values the contributions and thinking of others
- is pleasant and comfortable interacting with others
- is not afraid of conflict and works toward resolution
- loves to read and learn
- adapts to situations -- even those that are challenging
- takes initiative to accomplish what must be done

Exemplifies Productive Team Membership -

- develops authentic relationships in order to facilitate real change
- works effectively with others and uses those strengths to accomplish group goals
- communicates with others without being intimidating or condescending
- shows professional respect for those with whom they work
- plans and organizes strategically based on group needs

Seeks to Enhance Pedagogical Skills -

- has a strong background in content knowledge and knowledge of the standards
- desires to improve their own practices
- has instructional competence (recognizes/implements highly effective teaching & learning)
- accesses current research in pedagogical content knowledge
- has been a special education collaborator/co-teacher

Advances Innovation and Creativity -

- is willing to try new approaches in the classroom
- has a vision for what education *can* be
- spends time thinking deeply about how to accomplish the vision
- is willing to take risks and to move forward beyond what is comfortable

- thinks critically and is able to solve problems
- is creative and thinks out of the box, refusing to be confined by tradition

So, who is **NOT** a good candidate?

- a person already overloaded with extra –curricular duties and responsibilities
- a person who is assigned to attend the meetings without consideration of the above characteristics
- a teacher *lacking an understanding of content knowledge or teaching to standards*
- a central office employee who is not involved in the routine of daily instruction and practice
- a person who typically resists change
- a teacher selected primarily because they happen to teach in an "assessment grade/course"
- ***be cautious of designating those specifically involved with the PGES Pilot work as doing that and the networks may be overwhelming.*

What must a network participant commit to do?

Each network participant (including teacher, school, and district reps) will be expected to attend all scheduled meetings (eight days per year — six during the academic year; two during the summer). Participants will be given readings and other 'assignments' (e.g., trying a new strategy, bringing examples of student/teacher work, collecting student data) that will need to be completed between face-to-face meetings. To support this work, network members will also be linked in electronic communities of practice. Finally, network members will be expected to participate on a **district leadership team*** that will figure out how to 'scale up' the practices that they are learning and honing and then actually bring them to scale in the district. Because it is systemic and intensive work, participants should be willing to commit to this process for at least three years.

It is important to keep in mind that each network is a community, but the power comes from the members also facilitating and participating in learning communities at the local level. As members learn in an authentic, social, action-oriented, ongoing team with their fellow network members, they will help other colleagues in their own schools and districts learn using those same strategies.

**The DISTRICT LEADERSHIP TEAM should be comprised of all teacher, school and district leader members—and it is recommended that the Mathematics and ELA Teacher Leaders who have worked in the previous 3 years CONTINUE to be included and involved as Science and Social Studies standards are implemented. After all, both Science and Social Studies are explicitly mentioned in the ELA Literacy standards, and ELA and Mathematics are explicitly linked in the new Science and Social Studies standards documents. Additionally, it is important to remember that the TEACHER LEADERS are only as effective as the SCHOOL and DISTRICT leaders that are supporting them. They need to be given prioritized and regular time to work with other teachers in their buildings and districts if capacity is to be built.*

Domain 1 Planning & Preparation	Domain 2 Classroom Environment	Domain 3 Instruction	Domain 4 Professional Responsibilities	Domain 5 Student Growth
A. Demonstrating Knowledge of Content and Pedagogy i. Knowledge of Content and the Structure of the Discipline ii. Knowledge of Prerequisite Relationships iii. Knowledge of Content-Related Pedagogy B. Demonstrating Knowledge of Students i. Knowledge of Child and Adolescent Development ii. Knowledge of the Learning Process iii. Knowledge of Students' Skills, Knowledge, and Language Proficiency iv. Knowledge of Students' Interests and Cultural Heritage v. Knowledge of Students' Special Needs C. Selecting Instructional Outcomes i. Value, Sequence, and Alignment ii. Clarity iii. Balance iv. Suitability for Diverse Learners D. Demonstrating Knowledge of Resources i. Resources for Classroom Use ii. Resources to Extend Content Knowledge and Pedagogy iii. Resources for Students E. Designing Coherent Instruction i. Learning Activities ii. Instructional Materials and Resources iii. Instructional Groups iv. Lesson and Unit Structure F. Designing Student Assessment i. Congruence with Instructional Outcomes ii. Criteria and Standards iii. Design of Formative Assessments iv. Use for Planning	A. Creating an Environment of Respect and Rapport i. Teacher Interaction with Students ii. Student Interactions with One Another B. Establishing a Culture for Learning i. Importance of the Content ii. Expectations for Learning and Achievement iii. Student Pride in Work C. Managing Classroom Procedures i. Management of Instructional Groups ii. Management of Transitions iii. Management of Materials and Supplies iv. Performance of Non-Instructional Duties v. Supervision of Volunteers and Paraprofessionals D. Managing Student Behavior i. Expectations ii. Monitoring of Student Behavior iii. Response to Student Misbehavior E. Organizing Physical Space i. Safety and Accessibility ii. Arrangement of Furniture and Use of Physical Resources	A. Communicating with Students i. Expectations for Learning ii. Directions and Procedures iii. Explanation of Content iv. Use of Oral and Written Language B. Using Questioning and Discussion Techniques i. Quality of Questions ii. Discussion Techniques iii. Student Participation C. Engaging Students in Learning i. Activities and Assignments ii. Grouping of Students iii. Instructional Materials and Resources iv. Structure and Pacing D. Using Assessment in Instruction i. Assessment Criteria ii. Monitoring of Student Learning iii. Feedback to Students iv. Student Self-Assessment and Monitoring of Progress E. Demonstrating Flexibility and Responsiveness i. Lesson Adjustment ii. Response to Students iii. Persistence	A. Reflecting on Teaching i. Accuracy ii. Use in Future Teaching B. Maintaining Accurate Records i. Student Completion of Assignments ii. Student Progress in Learning iii. Non-Instructional Records C. Communicating with Families i. Information About the Instructional Program ii. Information About Individual Students iii. Engagement of Families in the Instructional Program D. Participating in a Professional Community i. Relationships with Colleagues ii. Involvement in a Culture of Professional Inquiry iii. Service to the School iv. Participation in School and District Projects E. Growing and Developing Professionally i. Enhancement of Content Knowledge and Pedagogical Skill ii. Receptivity to Feedback from Colleagues iii. Service to the Profession F. Demonstrating Professionalism i. Integrity and Ethical Conduct ii. Service to Students iii. Advocacy iv. Decision Making v. Compliance with School and District Regulations	A. Student Growth i. Student Growth Goal Setting Results ii. Rigorous Student Growth Goals iii. Student Growth Goal Setting Process iv. Student Growth Percentiles

3D - Using Assessment in Instruction • Assessment Criteria • Monitoring of Student Learning • Feedback to Students • Student Self-Assessment and Monitoring of Progress	Assessment of student learning plays an important role in instruction; no longer does it signal the end of instruction; it is now recognized to be an integral part of instruction. While assessment for learning has always been and will continue to be an important aspect of teaching (It's important for teachers to know whether students have learned what was intended), assessment for learning has increasingly come to play an important role in classroom practice. And in order to assess student learning for the purposes of instruction, teachers must have their "fingers on the pulse" of a lesson, monitoring student understanding and, where appropriate, offering feedback to students.			
	Ineffective	***Developing***	***Accomplished***	***Exemplary***
	• There is little or no assessment or monitoring of student learning; feedback is absent or of poor quality. • Students do not appear to be aware of the assessment criteria and do not engage in self-assessment.	• Assessment is used sporadically by teacher and/or students to support instruction through some monitoring of progress in learning. • Feedback to students is general, students appear to be only partially aware of the assessment criteria used to evaluate their work, and few assess their own work.	• **Assessment is used regularly by teacher and/or students during the lesson through monitoring of learning progress and results in accurate, specific feedback that advances learning.** • **Students appear to be aware of the assessment criteria; some of them engage in self-assessment** • **Questions, prompts, assessments are used to diagnose evidence of learning.**	• Assessment is fully integrated into instruction through extensive use of formative assessment. • Students appear to be aware of, and there is some evidence that they have contributed to, the assessment criteria • Students self-assess and monitor their progress. • A variety of feedback, from both their teacher and their peers, is accurate, specific, and advances learning. • Questions, prompts, assessments are used regularly to diagnose evidence of learning by individual students.
Critical Attributes	• The teacher gives no indication of what high-quality work looks like. • The teacher makes no effort to determine whether students understand the lesson. • Feedback is only global. • The teacher does not ask students to evaluate their own classmates work.	• There is little evidence that the students understand how their work will be evaluated. • Teacher monitors understanding through a single method, or without eliciting evidence of understanding from all students. • Teacher requests global indications of student understanding. • Feedback to students is not uniformly specific and not oriented towards future improvement of the work. • The teacher makes only minor attempts to engage students in self-assessment or peer assessment.	• Students indicate that they clearly understand the characteristics of high-quality work. • The teacher elicits evidence of student understanding during the lesson. Students are invited to assess their own work and make improvements. • Feedback includes specific and timely guidance, at least for groups of students. • The teacher attempts to engage students in self-assessment or peer assessment.	In addition to the characteristics of "accomplished": • There is evidence that students have helped establish the evaluation criteria. • Teacher monitoring of student understanding is sophisticated and continuous: the teacher is constantly "taking the pulse" of the class. • Teacher makes frequent use of strategies to elicit information about individual student understanding. • Feedback to students is specific and timely, and is provided from many sources including other students. • Students monitor their own

				understanding, either on their own initiative or as a result of tasks set by their teacher.
Possible Examples	• A student asks: "How is this assignment going to be graded?" • A student asks, "Does this quiz count towards my grade?" • The teacher forges ahead with a presentation without checking for understanding. • The teacher says: "Good job, everyone."	• Teacher asks: "Does anyone have a question?" • When a student completes a problem on the board, the teacher corrects the student's work without explaining why. • The teacher, after receiving a correct response from one student, continues without ascertaining whether all students understand the concept.	• The teacher circulates during small group or independent work, offering suggestions to groups of students. • The teacher uses a specifically formulated question to elicit evidence of student understanding. • The teacher asks student to look over their papers to correct their errors	• The teacher reminds students of the characteristics of high-quality work (the assessment criteria), suggesting that the students themselves helped develop them. • While students are working, the teacher circulates, providing substantive feedback to individual students. • The teacher uses exit tickets to elicit evidence of individual student understanding. • Students offer feedback to their classmates on their work. • Students evaluate a piece of their writing rubric and confer with the teacher about how it could be improved.

Formative Assessment Strategies – Quick Reference Guide

Note: Remember that a strategy is not considered formative unless the teacher takes the information gained from the assessment to "inform" instruction in order to better meet the needs of his/her students. Also, remember that the true purpose of any formative assessment is not to "assign a grade" but to assess student learning of your intended daily learning targets. Student learning is the purpose of formative assessment - not the grade.

Name of Strategy	Description of Strategy – How does it work?
Pre-testing	Pre-testing conducted prior to a unit allows the teacher to know which students have already mastered the standards to be taught as well as those students who may need more intensive instruction and interventions.
Hand Signals	The use of hand signals is a low prep method of formatively assessing. Students are taught to reflect their varying levels of understanding during instruction by using hand signals. Two examples of this are **Fist of Five and Thumb It.**
Exit Slips	Exit slips allow the teacher to formatively assess the daily learning targets by giving them an activity to complete before they leave the class. The teacher takes the information and uses it to modify or adjust instruction based on student misconceptions.
Traffic Lights	During group work, student groups are given sets of colored cups to place at their workstations. To signal levels of understanding or levels of support needed, students display certain colors of cups. As the teacher facilitates the activity, he/she is able to ascertain group confidence in the work and identify potential problems by glancing around the room and looking at the cups and the color they have displayed. For example, Green Cup = All's Well, Yellow Cup = We have a question for the teacher, Red Cup = We have reached an impasse and need help immediately.
Graphic Organizers	Graphic organizers are effective tools in helping students organize their thinking. Some examples include: Venn Diagrams and T-Charts. There are a number of sources for different free graphic organizers available on the web.
K-W-L	K-W-L is a specific type of graphic organizer that allows the teacher to determine three ideas: What do my students already **KNOW** about the subject? What do I **WANT** to know more about? What have I **LEARNED** from the instruction?
Surveys	Student surveys are valuable yet often overlooked tools for teachers to use to formatively assess. To use these effectively, teachers design questions that gauge student interest, determine student prior knowledge and potentially identify misconceptions and errant thinking post-instruction.
Choral Response	Choral response is a type of questioning strategy in which students call out answers to specific questions in unison (choral).
I Think – We Think	I Think - We Think is an interpersonal formative assessment strategy that puts a group of students together, poses them a question or task, and then has them craft individual responses first and afterwards a collective response taking into consideration the thoughts of all group members. When sharing, a selected student from the group shares both their individual response (I Think) along with the group response (We Think).
Think-Pair-Share	Think-Pair-Share is an interpersonal formative assessment strategy activity that puts two students into a group and

	gives them the opportunity to think individually about a question and then pair up to share thoughts as a pair. Through sharing out, the teacher is able to determine if students understand the content.
Partner Speaks	Partner Speaks is an interpersonal formative assessment strategy that puts two students into a group, poses them a question, and then gives them time to share with each other their individual thoughts in regard to the question. The difference between Partner Speaks and the other interpersonal strategies is that in Partner Speaks, during sharing out time, a student shares his/her partner's thoughts instead of their own.
Concept Cartoons	Students are posed a question and then shown cartoons with individuals representing the various possible opinions. The teacher then has then answer the following two questions after moving to the area in the room with the choice they picked displayed there: • Which child do you agree with? • Why?
Four Corners	Four Corners is a formative assessment strategy that appeals to the kinesthetic as well as interpersonal learner. The teacher poses a question to the students with multiple possible answers. Students then move from their seats to respective parts of the rooms corresponding to one of the possible answers. It gives the teacher a quick visual perspective on student understanding.
Chain Notes	The use of Chain Notes is an effective way to formatively assess students by having them reflect on a question, compose some sentences/statements that answer the question. A paper is passed around the room on which students write their statements. When the paper comes to you, read the statements and add something new.
Analogy Prompt	The teacher present students with an analogy prompt: (A designated concept, principle, or process) is like _____ because _____. This allows students to see the relationships between vocabulary or other instructional concepts/standards.
Muddiest Point	Muddiest Point is typically used as an exit slip activity. Students are given a slip of paper and are asked to write the concept(s) that they are having the most difficulty understanding, thus the "Muddiest Point". The teacher reads these and adjusts instruction to clear up these misconceptions and address the needs of the students.
Sticky Bars	The use of Sticky Bars consists of students being posed a question either to individual students or to groups of students. As students determine their answer, they post their answer on chart paper using post it notes. The sticky notes are placed on the chart, creating a simple bar graph. No names are put on the post it's, allowing the teacher to get a quick visual idea of their students' level of understanding.
Card Sort	The use of Card Sort activities, either Open or Closed sorts, allow students to classify content specific vocabulary into categories, given either provided criteria or student generated criteria. This is closely aligned with Robert Marzano's "Identifying Similarities and Differences" strategy.
Odd One Out	To use Odd One Out, the teacher gives the students a list of concepts/vocabulary words. One or more of them do not match the others. Students must be able to identify the words that do not match the others and explain why. Multiple correct answers are possible when using this strategy.
3-2-1	3-2-1 is a strategy that is typically used as an exit slip activity but can be used in other contexts. Students are given a graphic organizer consisting of a triangle. At the three points of the triangle are individual content specific vocabulary words. Students indicate on the lines between the corners of the triangle, the relationship that the pairs

	of words have with each other.
Agreement Circles	In Agreement Circles, students form a circle in the classroom. The teacher gives a statement. They are asked to respond to the statement (Agree or Disagree). If they agree, they move to the center of the circle. Students who disagree stay on the outside of the circle. Groups/pairs discuss the statement and why they either agree or disagree. After they discuss, students are allowed to switch positions and move either to the outside or inside of the circle.
Numbered Heads Together	Each student is assigned a number. Members of a group work together to agree on an answer. The teacher randomly selects one number. Student with that number answers for the group.
Misconception Check	The teacher presents students with common or predictable misconceptions about a designated concept, principle, or process. The teacher then asks them whether they agree or disagree and explain why. The misconception check can also be presented in the form of a multiple-choice or other constructed response quiz.
Student Conference	The use of student conferences allows teachers to sit down with individual students and determine if any gaps exist in student understanding. The value of the student conference is only as good as the questions posed by the teacher.
Commit and Toss	This is another highly kinesthetic formative assessment strategy. Students are posed a question by their teacher. They then write the answer to their question on a piece of paper. Students then stand up and toss their response to another student. Students then toss it one additional time. The teacher gives an opportunity for the students to share out with the group what the paper that they ended up with has on it. This is a non-threatening strategy and allows the teacher to gauge student learning and possible misconceptions.
3 Minute Pause	The Three-Minute Pause provides a chance for students to stop, reflect on the concepts and ideas that have just been introduced, make connections to prior knowledge or experience, and seek clarification. • I changed my attitude about… • I became more aware of… • I was surprised about… • I felt… • I related to… • I empathized with…
Self Reflection/Journals/Logs	Self Reflection is a process in which students collect information about their own learning, analyze what it reveals about their progress toward the intended learning goals and plan the next steps in their learning.
Oral Q & A	Teachers asking students questions is a regular part of almost any classroom instruction. To be truly formative assessment, teachers should take the information gained from the Q&A to inform and adjust instruction. These questions should also reflect varied levels of rigor.
Human Graphs/Scatterplots	The classroom teacher gauges learning by posing students a multiple choice question. The students then move to an area of the room where they line up and form a visual representation of what the various answers were that the class had. The teacher is provided a visual idea of what the students know and do not know about the subject.
Quizzes/Homework/Tests	The easiest form of information to collect or analyze about your student's learning is their regular work in the form of homework, quizzes, and tests.
One Minute Papers	The teacher gives students an open-ended question and one to three minutes to write their answers. Some good questions include: What is the most important thing we discussed today? Or What was the most

	confusing idea presented today?
Concept Mapping	The teacher provides small groups of students with a list of about 15 related words that might fit well in an outline. The teacher gives them small sticky notes to write the words on. The teacher then asks them to create a concept map by moving the sticky notes around on a piece of paper until they have them in the right place. Model for them on the board how to draw connections between words and emphasize that theconnections should be labeled with words describing the nature of the relation (leads to, is an example of, sometimes goes with, can't happen without, etc.).
Observation	Teachers walk around the classroom and observe students as they work to check for learning. Strategies include: •Anecdotal Records •Conferences •Checklists
One Sentence Summary	Students are asked to write a summary sentence that answers the "who, what where, when, why, how" questions about the topic.
A-B-C Summaries	Each student in the class is assigned a different letter of the alphabet and they must select a word starting with that letter that is related to the topic being studied.
Debriefing	Debriefing is a form of reflection immediately following an activity.
Idea Spinner	The teacher creates a spinner marked into 4 quadrants and labeled "Predict, Explain, Summarize, Evaluate." After new material is presented, the teacher spins the spinner and asks students to answer a question based on the location of the spinner. For example, if the spinner lands in the "Summarize" quadrant, the teacher might say, "List the key concepts just presented."
Examples & Non-Examples	Students quickly understand understanding of content by drawing or identifying examples and non-examples of key topics/vocabulary from the day's lesson. This could easily be accomplished through the following steps: (1) Draw a T-chart, (2) Label the left column "Examples", (3) Label the right side "Non-Examples", (4) Draw pictures or make a list of examples on the left side, (5) Draw pictures or make a list of non-examples on right side.
Anecdotal Notes	Notes can be created by the teacher about what students are struggling with. Notes can be made during class discussions, reading groups, observations during group activities, or times when students are working on independent seat work. These anecdotal notes can be used for future planning and interventions.
Fan-N-Pick	Students are given pre-made cards with lesson content (vocabulary, discussion questions) to review. Student #1 fans cards and says, "Pick a card, any card!" Student #2 picks a card, reads the question aloud, and allows 5 seconds of think time. Student #3 answers the question. Student #4 responds to answer and checks right/wrong answers, praises or tutors; praises/paraphrases open-ended questions. The roles then rotate clockwise.
Agree & Disagree Statements	Students use A & D statements to analyze a set of "fact or fiction" statements. In the first part of A & D statements, students may choose to agree or disagree with the statement or identify whether they need more information. In addition, students are asked to justify their thinking about why they agree or disagree.
Annotated Student Drawings	Annotated student drawings encourage students to access their prior knowledge and visually represent their thinking. The act of drawing to explain a concept or phenomenon encourages sense making and awareness of one's own ideas.
Fact First Questioning	Quality questions provide insight into students' ideas and growing knowledge base. Fact First Questioning is a higher order questioning technique used to draw out student knowledge beyond recall level. It takes a factual

	"what" question and turns it into a deeper "how" or "why" question because you are stating the fact first and asking students to elaborate.
First Word – Last Word	This strategy is a variation of acrostics. Students construct statements about a concept or topic before and after instruction that begins with a designated letter of the alphabet. The acrostic format provides a structure for them to build up their idea statements off different starting letters that make up the topic word.
Fishbowl Think Aloud	The Fishbowl Think Aloud is a technique used to listen in on the thinking of a sampling of students in the class. Four or five students are selected to be in a "fishbowl," sitting together in a cluster or the front of the room. The rest of the class and teacher face or surround the students who are in the "fishbowl" and listen attentively to their conversation. The conversation is a response to a prompt in which the students "think aloud", discussing and defending their ideas as the teacher and other students listen in and reconcile their own thinking with that of their peers in the "fishbowl".
Focused Listing	This strategy asks students to recall ideas and experiences related to a topic they encountered in a prior instructional unit or grade. Students list as many concepts, facts and ideas as they can recall from prior instruction.
Give Me Five	This technique is to used to promote and publicly share personal reflections that collectively provide feedback from the group. Students are given a prompt and take a minute or two for a "quiet think". Five students then volunteer to publicly share their reflection.
I Used to Think … But Now I Know	This strategy asks students to compare verbally and in writing their ideas at the beginning of a lesson or instructional sequence to the ideas they have after completing the lesson. It differs from K-W-L because both parts of the reflection occur after instruction.
POMS – Point of Most Significance	POMS is the opposite of Muddiest Point. In this quick technique, students are asked to identify the most significant learning or idea they gained from a lesson.
Question Generating	This technique switches roles from the teacher as the generator of questions to the student as the question generator. The ability to formulate good questions about a topic can indicate the extent to which a student understands ideas that underlie the topic.
Ten - Two	After 10 minutes of instruction that involves a large amount of information, students take two minutes to reflect on and summarize what they have learned thus far.

The Bridgespan Group

Building the Missing Link between the Common Core and Improved Learning

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Executive Summary

The Common Core State Standards, adopted by 45 states and the District of Columbia, raise the bar for what students need to learn at each stage of their K-12 education. The goal is to better prepare students for college and careers. And the most important thing that education leaders can do to help the Common Core succeed is to support teachers in improving their practice.

While not all field leaders are grasping the opportunity presented by the Common Core to transform teaching and learning, three exemplars—Kentucky, Hillsborough County Public Schools in Florida, and Center for Inspired Teaching—are using the new standards to change the daily work of teachers and students.

They are doing this by:

1. Embracing and communicating how significantly the Common Core will raise the bar for student learning, and that this higher bar requires dramatic changes in instruction. For example, the Kentucky Department of Education launched ReadyKentucky, a public information initiative aimed at drumming up support by business, community, and parents for the new standards and the importance of staying the course.
2. Making sure teachers are at the front of the movement and working together to lead their own improvement toward shared, ambitious goals. Center for Inspired Teaching, a technical assistance provider, for example, works with districts to engage teachers as full collaborators in instructional improvement.
3. Providing teachers with the structures, time, and resources required to sustain the many years and many cycles of inquiry and improvement necessary to achieve the new bar for student learning. At Hillsborough County Public Schools in Florida, education leaders realized that teachers would need ongoing support to sustain the instructional improvement that the Common Core requires. As a result, the district is using their system of Professional Learning Communities, small groups of teachers who meet regularly to study effective teaching and learning methods, to help teachers regularly reflect on students' grasp of the new standards.

Related Content

- Download a PDF of the full article
- Read the *Education Week* blog based on our research, "Common Core: What Lies Between Standards and Tests?"

The type of systems change the Common Core requires is no easy task, but it is a critical one. The three case studies shared in this paper illustrate how leaders within the system can take steps to empower their best resource—teachers—to seize the opportunity of the Common Core to greatly improve teaching and learning nationwide.

Kentucky Goes First

Following the 2009 passage of Senate Bill 1, which mandated higher standards for student learning, Kentucky became the first state to adopt the Common Core and is now three years into an ambitious plan to use the new standards to improve teaching across the state.

Communicating a strong, consistent message

From the beginning, the Kentucky Department of Education (KDE) focused on getting out the message of change. In 2010, it convened the Unbridled Learning Summit at which university faculty, school district representatives, and other education stakeholders discussed the state's new education strategy—with Common Core plans as the centerpiece.

In parallel, KDE, the Kentucky Chamber of Commerce, and the Prichard Committee (a statewide education advocacy group focused on engaging parents) launched ReadyKentucky, a public information initiative. Supplying sample letters and other tools, the initiative urged business and community leaders and parents to speak out in support of the new standards and "the importance of staying the course." (See the sidebar "More on the ReadyKentucky Initiative.")

The consistent messages delivered through the Unbridled Learning Summit (to those in the education field) and the ReadyKentucky initiative (to the broader community) helped set the stage for implementation of the Common Core. KDE and its partners developed a shared understanding that Kentucky was seeking to dramatically improve student learning and that a great deal of change would be required to achieve this goal. Such deliberate communication efforts seem to be paying off. Results from the new Kentucky tests were announced in late 2012, and revealed that far fewer students were "proficient" or better in reading and math in both elementary and middle school. Yet, despite the big drop in scores (roughly a third or more), there has been no evident backlash in the state against the Common Core, nor any rush to ease the standards. Contrast that to the story in New York in early August 2013 when the state's first round of Common Core tests showed a similar drop, "unsettling parents, principals, and teachers."[12]

Leadership Networks draw strong teachers to lead change

KDE knew that the ability to drive unprecedented improvement in teacher practice and student learning through the Common Core would depend on what districts did across schools, principals did within schools, and teachers did within classrooms. The Department therefore put district leaders, principals, and teachers in charge of crafting the approach and developing supports for statewide implementation. It also built their capacity to lead the change. This strategy was embodied in a new system of Leadership Networks that brought together district, school, and classroom leaders.

More on the ReadyKentucky Initiative

Through ReadyKentucky, partner organizations played a key role in building a strong understanding of the Common Core amongst key education stakeholders, including parents and the business community. In informational pamphlets, ReadyKentucky is described as "an information initiative to help educators, parents, civic leaders, and other Kentuckians understand the state's public school standards, the tests that are given to measure student performance on those standards, and ways to use test scores to help students, schools, and districts improve." The Prichard Committee for Academic Excellence led outreach and communication with parents. It developed simple, intuitive materials and fact sheets, and sent representatives to meetings with parents and community members to present information on the Common Core and what it means for students. Similarly, the Kentucky Chamber of Commerce created toolkits to help businesses inform their employees about the new standards and their importance for Kentucky. The toolkits included talking points, sample emails, FAQ sheets, blurbs for company newsletters, and even paycheck stuffers with key points about the work underway in Kentucky schools. Through ReadyKentucky, stakeholders were informed and educated about the Common Core and its importance early and often, and through consistent, clear, intuitive messaging.

Sample presentation: ReadyKentucky—Building on progress for student success
http://www.washington.kyschools.us/doc/Title%20-Assessment/ReadyKY%2045-min%20presentation%20revised9-12(wAcc).pdf

Sample toolkits: ReadyKentucky—Building employer support for student success
http://kychamber.com/sites/default/files/EmployerKitWeb.pdf

ReadyKentucky—Building on progress for student success in college, career, and life
http://www.prichardcommittee.org/wp-content/uploads/2013/04/READYKY_document.pdf

"One thing we wanted to model was that districts needed to be able to solve their own problems," explained Karen Kidwell, KDE's director of program standards, who oversees the Networks. "We saw the Leadership Networks as a place to deepen understanding, try out some processes, and bring forward problems that superintendents, principals, and teachers were having in their districts and get feedback from peers."

The Leadership Networks were designed to enable multidimensional collaboration. Each of the state's 174 school districts selected a team (three math teachers, three English language arts (ELA) teachers, three principals or other school leaders, up to three district-level supervisors, and the superintendent) to participate in monthly full-day trainings the first two years of implementation and quarterly meetings since then. The Network meetings take place in each of the state's eight regions. Participants meet in three functional cross-district groups: math teachers with math teachers, ELA teachers with ELA teachers, and principals and superintendents together. Altogether, on a Network meeting day, 24 cross-district teams are meeting across the state. Following these discussions, the district teams come together to figure out how to bring what they've learned

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back to their districts. KDE also hired 16 content specialists to provide the hands-on coaching in the districts.

Over the past three years, the Leadership Networks have focused on the following:

Translating the standards and preparing for initial rollout (2010–11): "One thing that is often missing in state and district orientation sessions is a distinction between what instruction looked like before and what it will look like now," said Stephanie Hirsh, executive director of Learning Forward, an organization devoted to teacher professional learning that is working with Kentucky. The Leadership Network sessions looked closely at what teachers currently were teaching and students currently were learning, and the ways in which this would change under the Common Core. This meant that members collectively reviewed each standard and ensured that every educator could say, in plain English, what that standard required students to understand. Based on this translation, they developed clear learning targets for students that matched the standards.

Planning to effectively assess student learning based on the standards (2011–12): The Networks focused on developing assessment literacy, so that all participants could effectively analyze existing assessments and items for their relation to the new standards, develop new assessments, and use the information from assessments to improve teaching and learning.

Developing strategies and tools to ensure effective teaching and learning (2010–present): The Networks established an iterative process in which participants looked at best-practice strategies for teaching the content required by each standard, tried them out in their own classrooms, and then reported and reflected together on their experiences. For example, through Gates Foundation initiatives to build instructional tools to support the Common Core,[13] the Leadership Networks created and vetted rigorous learning experiences for teachers to use in their classrooms that are fully aligned with the standards.

Strengthening the ability of Network teachers, school leaders, and administrators to lead their local districts in improving teaching (2012–13): Over the past year, the Networks have reflected on how to continue to improve teaching and how to ensure that such improvement takes place in every school and classroom in the state. Their most recent work has focused on refining and revising instructional support tools (e.g., sample lessons and assessment items) through further field testing, populating an online platform and repository for instructional resources, and working with others in their home districts to address roadblocks or challenges.

This collaborative effort required a lot from state leaders. KDE Commissioner Terry Holliday visited all 174 school districts in the state, meeting with teachers, principals, and district leaders to understand how the process was unfolding. Associate Commissioner Felicia Smith had monthly calls with a group of superintendents to get feedback. The intensive training sessions and group work employed by the Leadership Networks met some resistance. Felicia Smith explained, "That first year we had some districts and schools saying, 'Just translate the standards into learning

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targets; just give us what you want us to do.' We held firmly that no, these Networks are our process; *this* is where the learning occurs."

> *"You need extended time if you're serious about going deep and solving together...You really need the leaders and teachers in each district to own the work, and then go back and make these changes happen."*
>
> KAREN KIDWELL, DIRECTOR OF PROGRAM STANDARDS, KENTUCKY DEPARTMENT OF EDUCATION

Many were persuaded. One principal later remarked: "I feel like this is the right work. It wasn't just, 'Here's the set of standards.' It was: Here's how you assess, here's how you instruct...' It was structured, it was organized, it was given to us in a way we could make manageable. Did it require a lot of change for me as an administrator and for teachers? Absolutely, but here's how: through an emphasis on highly effective teaching and learning."

Continuous improvement

KDE's Kidwell emphasized that time and continuity were essential to Kentucky's efforts to get Common Core implementation right. "You need extended time if you're serious about going deep and solving together. Our Leadership Network approach is really dependent on helping people recognize their strengths and their talents and skills. We wanted the same group of people for a solid three years because this is hard work, and it needs to be continuous. You really need the leaders and teachers in each district to own the work, and then go back and make these changes happen." Thus the Network approach not only helped districts and schools adapt effectively to the Common Core but is intended to help sustain that improvement over time.

One key element of Kentucky's sustainability strategy is the Continuous Instructional Improvement Technology System (CIITS), an online support center for all of Kentucky's teachers that brings together a variety of resources (e.g., videos, sample lesson plans, an assessment item bank) vetted and utilized by the more than 2,000 teachers who participated in the Leadership Networks. Many districts also are looking to use teacher teams and professional learning communities to bring the problem-solving work that began in the Leadership Networks to the school level.

In tandem with the work of the Networks, and supported by the Learning Forward Transforming Professional Learning Initiative (a national effort to support effective Common Core implementation), KDE continues to build a strong professional learning system to support continuous improvement. This effort includes convening a professional learning task force, contributing to a professional learning policy audit, and considering changes to state legislation and regulations.

The Kentucky story illustrates the powerful role a state education authority can play in catalyzing, enabling, and maintaining changes in instruction across an entire state. The call for change was clear, and the Leadership Networks brought the right implementers forward to lead the charge and develop tools and supports to enable continuous improvement.

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Next Generation Science Standards "Shifts"

The Next Generation Science Standards (NGSS) provide an important opportunity to improve not only science education but also student achievement. Based on the Framework for K–12 Science Education, the NGSS are intended to reflect a new vision for American science education. The following conceptual shifts in the NGSS demonstrate what is new and different about the NGSS:

		Shifts in Science Instruction
Shift 1	**Interconnected Nature of Science and the Real World**	Given the importance of science and engineering in the 21st century, students require a sense of contextual understanding with regard to scientific knowledge, how it is acquired and applied, and how science is connected through a series of concepts that help further our understanding of the world around us. Student performance expectations have to include a student's ability to apply a practice to content knowledge. Performance expectations thereby focus on understanding and application as opposed to memorization of facts devoid of context.
Shift 2	**Focus and Coherence**	The same ideas or details are not covered each year. Rather, a progression of knowledge occurs from grade band to grade band that gives students the opportunity to learn more complex material, leading to an overall understanding of science by the end of high school. Historically, science education was taught as a set of disjointed and isolated facts. The Framework and the NGSS provide a more coherent progression aimed at overall scientific literacy with instruction focused on a smaller set of ideas and an eye on what the student should have already learned and what they will learn at the next level.
Shift 3	**Deeper Understanding**	It is important that teachers and curriculum/assessment developers understand that the focus is on the core ideas—not necessarily the facts that are associated with them. The facts and details are important evidence, but not the sole focus of instruction.
Shift 4	**Science and Engineering**	Engineering and technology are integrated into the structure of science education. This integration is achieved by raising engineering design to the same level as scientific inquiry in classroom instruction when teaching science disciplines at all levels and by giving the core ideas of engineering and technology the same status as those in other major science disciplines.
Shift 5	**College, Career, and Citizenship Readiness**	There is no doubt that science and science education are central to the lives of all Americans. Never before has our world been so complex and science knowledge so critical to making sense of it all. When comprehending current events, choosing and using technology, or making informed decisions about one's healthcare, understanding science is key. Science is also at the heart of the United States' ability to continue to innovate, lead, and create the jobs of the future. All students, no matter what their future education and career path, must have a solid K–12 science education in order to be prepared for college, careers, and citizenship.
Shift 6	**Alignment to the Common Core**	The science standards and the Common Core Standards (math and ELA/Literacy) overlap in meaningful and substantive ways and offer an opportunity to give all students equitable access to learning standards.

Source: *Next Generation Science Standards* APPENDIX A – Conceptual Shifts in the Next Generation Science Standards

NGSS Appendices:

A. Conceptual Shifts

B. Responses to Public Drafts

C. College and Career Readiness

D. All Standards, All Students / Case Studies

- Case Study 1: Economically Disadvantaged
- Case Study 2: Race and Ethnicity
- Case Study 3: Students with Disabilities
- Case Study 4: English Language Learners
- Case Study 5: Girls
- Case Study 6: Alternative Education
- Case Study 7: Gifted and Talented Students

E. Disciplinary Core Idea Progressions

F. Science and Engineering Practices

G. Crosscutting Concepts

H. Nature of Science

I. Engineering Design in the NGSS

J. Science, Technology, Society, and the Environment

K. Model Course Mapping in Middle and High School

L. Connections to CCSS-Mathematics

M. Connections to CCSS-Literacy in Science and Technical Subjects

Inside the NGSS Box

Title and Code

Two sets of performance expectations at different grade levels may use the same same name if they focus on the same topic. The code, however, is a unique identifier for each set of performance expectations based on the grade level, content area, and topic of the set.

Performance Expectations

A statement that combines practices, core ideas, and crosscutting concepts together to describe how students can show what they have learned.

Clarification Statement

A statement that supplies examples or additional clarification to the performance expectation.

Assessment Boundary

A statement that provides guidance about the scope of the performance expectation at a particular grade level.

Lowercase Letters

Lowercase letters at the end of practices, core ideas, and crosscutting Concepts designate which Performance expectation incorporates them.

Scientific & Engineering Practices

Activities that scientists and engineers engage in to either understand the world or solve a problem

Disciplinary Core Ideas

Concepts in science and engineering that have broad importance within and across disciplines as well as relevance in people's lives.

Crosscutting Concepts

Ideas, such as *Patterns* and *Cause and Effect*, which are not specific to any one discipline but cut across them all.

What is Assessed

A collection of several performance expectations describing what students should be able to do to master this standard

Foundation Box

The practices, core disciplinary ideas, and crosscutting concepts from the *Framework for K-12 Science Education* that were used to form the performance expectations

Connection Box

Other standards in the *Next Generation Science Standards* or in the *Common Core State Standards* that are related to this standard

MS.PS-SPM Structure and Properties of Matter

Students who demonstrate understanding can:

a. **Construct and use models to explain that atoms combine to form new substances of varying complexity in terms of the number of atoms and repeating subunits.** [Clarification Statement: Examples of atoms combining can include hydrogen (H) and Oxygen (O) combining to form oxygen molecule (O2), or water (H2O); hydrogen molecule and carbon dioxide (CO2) molecule are to be assembled.]

b. **Plan investigations to generate evidence supporting the claim that one pure substance can be distinguished from another based on characteristic properties.** [Clarification Statement: Properties of substances can include melting and boiling points, density, solubility, reactivity, flammability, and pH.]

c. **Use a simulation or mechanical model to determine the effect on the temperature and motion of atoms and molecules of different substances when thermal energy is added to or removed from the substance.** [Assessment Boundary: Quantitative use of the model is not expected.]

d. **Construct an argument that explains the effect of adding or removing thermal energy to a pure substance in different phases and during a phase change in terms of atomic and molecular motion.** [Assessment Boundary: The use of mathematical formulas is not expected.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models
Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to explain, explore, and predict more abstract phenomena and design systems.
- Use and/or construct models to predict, explain, and/or collect data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs. (a),(c)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.
- Plan and carry out investigations individually and collaboratively, identifying independent and dependent variables, and controls. (b)
- Collect data and generate evidence to answer scientific questions or test design solutions under a range of conditions. (b)

Engaging in Argument from Evidence
Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.
- Use oral and written arguments supported by empirical evidence and reasoning to support or refute an explanation for a phenomenon or a solution to a problem. (d)

Disciplinary Core Ideas

PS1.A: Structure and Properties of Matter
- All substances are made from some 100 different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (a)
- Pure substances are made up of a single type of atom or molecule; each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (b)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (d)
- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced, [illegible] but they are change relative locations. (c),(d)
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (a)
- The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (c),(d)

PS3.A: Definitions of Energy
- The term "heat" as used in everyday language refers both to thermal motion (the motion of atoms or molecules within a substance) and radiation (particularly infrared and light). (c),(d)
- Temperature is not a measure of energy; the relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (c),(d)

Crosscutting Concepts

Patterns
Macroscopic patterns are related to the nature of microscopic and atomic-level structure. Patterns of change and other mathematical relationships can provide information about natural and human designed systems. Patterns can be used to identify cause and effect relationships. Graphs and charts can be used to identify patterns in data. (a)

Cause and Effect
Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. Cause and effect relationships may be used to predict phenomena in natural or designed systems. Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (c),(d)

Structure and Function
Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (b)

Connections to other DCIs in this grade-level: **MS.ESS-E&P, MS.ESS-SS, MS.LS-MEOE**

Articulation of DCIs across grade-levels: **3.1F, 5.SPM, HS.PS.SPM, HS.PS-NP, HS.PS-E**

Common Core State Standards Connections: [Note: these connections will be made more explicit and complete in future draft releases]

ELA –

W.5.2	Write informative/explanatory texts to examine a topic and convey ideas, and information clearly
W.6.1	Write arguments to support claims with clear reasons and relevant evidence
W.7.1	Write arguments to support claims with clear reasons and relevant evidence
SL.5.4	Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace
SL.6.4	Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation
SL.7.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.
WHST.6-8.1	Write arguments focused on discipline-specific content.
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks

Mathematics –

MP.4	Model with mathematics.
MP.8	Look for and express regularity in repeated reasoning.
6.SP	Develop understanding of statistical variability
	Summarize and describe distributions

NGSS Matrix Organized by Topics

		Life Science	Earth & Space Science	Physical Science
Elementary School	K	K. Interdependent Relationships in Ecosystems: Animals, Plants, and Their Environment	K. Weather and Climate	K. Structure and Properties of Matter
	1	1. Structure, Function, and Information Processing	1. Space Systems: Patterns and Cycles	1. Waves: Light and Sound
	2	2. Interdependent Relationships in Ecosystems	2. Earth's Surface Systems: Processes that Shape the Earth	2. Structure and Properties of Matter 2. Forces and Motion: Pushes and Pulls
	3	3. Interdependent Relationships in Ecosystems: Environmental Impacts on Organisms 3. Inheritance and Variation of Traits: Life Cycles and Traits	3. Weather and Climate	3. Forces and Interactions
	4	4. Structure, Function, and Information Processing	4. Earth's Surface Systems: Processes that Shape the Earth	4. Energy 4.W Waves
	5	5. Matter and Energy in Organisms and Ecosystems	5. Earth's Surface Systems 5. Space Systems: Stars and the Solar System	5. Structure and Properties of Matter
Middle School		MS. Structure, Function, and Information Processing MS. Growth, Development, and Reproduction of Organisms MS. Matter and Energy in Organisms and Ecosystems MS. Interdependent Relationships in Ecosystems MS. Natural Selection and Adaptations	MS. Space Systems MS. The History of Earth MS. Earth's Interior Systems MS. Earth's Surface Systems MS. Weather and Climate Systems MS. Human Impacts	MS. Structure and Properties of Matter MS. Chemical Reactions MS. Forces and Interactions MS. Energy MS. Waves and Electromagnetic Radiation
High School		HS. Structure, Function, and Information Processing HS. Inheritance and Variation of Traits HS. Matter and Energy in Organisms and Ecosystems HS. Interdependent Relationships in Ecosystems HS. Natural Selection and Evolution	HS. Space Systems HS. History of Earth HS. Earth's Systems HS. Weather and Climate HS. Human Sustainability	HS. Structure and Properties of Matter HS. Chemical Reactions HS. Forces and Interactions HS. Energy HS. Waves and Electromagnetic Radiation

Note: The core ideas for Engineering, Technology, and the Application of Science are integrated with the Life Science, Earth & Space Science, and Physical Science core ideas

Three Dimensions of the *Next Generation Science Standards* (NGSS)

Scientific and Engineering Practices

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world.

Both scientists and engineers also ask questions to clarify the ideas of others.

Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.

Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis.

Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.

Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.

Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions.

The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories.

The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached.

In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits.

Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.

Using Mathematics and Computational Thinking

In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information

Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and designs.

NGSS@ NSTA
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Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*

Disciplinary Core Ideas in Physical Science	Disciplinary Core Ideas in Life Science	Disciplinary Core Ideas in Earth and Space Science	Disciplinary Core Ideas in Engineering, Technology, and the Application of Science
PS1: Matter and Its Interactions PS1.A: Structure and Properties of Matter PS1.B: Chemical Reactions PS1.C: Nuclear Processes **PS2: Motion and Stability: Forces and Interactions** PS2.A: Forces and Motion PS2.B: Types of Interactions PS2.C: Stability and Instability in Physical Systems **PS3: Energy** PS3.A: Definitions of Energy PS3.B: Conservation of Energy and Energy Transfer PS3.C: Relationship Between Energy and Forces PS3.D: Energy in Chemical Processes and Everyday Life **PS4: Waves and Their Applications in Technologies for Information Transfer** PS4.A: Wave Properties PS4.B: Electromagnetic Radiation PS4.C: Information Technologies and Instrumentation	**LS1: From Molecules to Organisms: Structures and Processes** LS1.A: Structure and Function LS1.B: Growth and Development of Organisms LS1.C: Organization for Matter and Energy Flow in Organisms LS1.D: Information Processing **LS2: Ecosystems: Interactions, Energy, and Dynamics** LS2.A: Interdependent Relationships in Ecosystems LS2.B: Cycles of Matter and Energy Transfer in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience LS2.D: Social Interactions and Group Behavior **LS3: Heredity: Inheritance and Variation of Traits** LS3.A: Inheritance of Traits LS3.B: Variation of Traits **LS4: Biological Evolution: Unity and Diversity** LS4.A: Evidence of Common Ancestry and Diversity LS4.B: Natural Selection LS4.C: Adaptation LS4.D: Biodiversity and Humans	**ESS1: Earth's Place in the Universe** ESS1.A: The Universe and Its Stars ESS1.B: Earth and the Solar System ESS1.C: The History of Planet Earth **ESS2: Earth's Systems** ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions ESS2.C: The Roles of Water in Earth's Surface Processes ESS2.D: Weather and Climate ESS2.E: Biogeology **ESS3: Earth and Human Activity** ESS3.A: Natural Resources ESS3.B: Natural Hazards ESS3.C: Human Impacts on Earth Systems ESS3.D: Global Climate Change	**ETS1: Engineering Design** ETS1.A: Defining and Delimiting an Engineering Problem ETS1.B: Developing Possible Solutions ETS1.C: Optimizing the Design Solution **ETS2: Links Among Engineering, Technology, Science, and Society** ETS2.A: Interdependence of Science, Engineering, and Technology ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

Crosscutting Concepts

Patterns
Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

Cause and Effect: Mechanism and Explanation
Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Scale, Proportion, and Quantity
In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Systems and System Models
Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Energy and Matter: Flows, Cycles, and Conservation
Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Structure and Function
The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

Stability and Change
For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Developed by NSTA based on content from the *Framework for K-12 Science Education* and supporting documents for the *May 2012 Public Draft of the NGSS*