

Hi. I am **Don Glass**, the Director of Evaluation and Field Work at the **National Commission for Teaching and America's Future (NCTAF)**, an national education non-profit based in Washington, DC. This presentation is titled **STEM Curriculum Design and Evaluation Tools**

There is a growing consensus among school reformers that the implementation of the Next Generation Science Standards (NGSS) and the Common Core State Standards (CCSS) will require in-depth intellectual engagement and ongoing practical exploration of how cross-disciplinary content is translated into instruction for diverse learners. These new standards prompt for assessment and curriculum that make connections across STEM, ELA, Social Studies, and Arts practices and content. This requires educators from across subject areas to collaboratively design curriculum together.

Can evaluators play a developmental evaluative role in supporting this learning design and feedback? We think so. This presentation examines a set of curriculum design and evaluation tools that provide structure and formative feedback for this complex, interdisciplinary curriculum planning process. The tools were piloted last year with 25 professional learning teams of middle and high school educators in several school districts in MD.

This session will focus mainly on the methodology and format of the data collection tools, but will provide some snapshots of the rich formative data for monitoring by program staff, documentation for teacher-generated case studies on Project-Based Learning, and baseline data for additional focused work on assessment design and scoring.

Embedded Evaluation Design

- **Embed evaluation information gathering and reporting** into program routines and expectations
- Provide **design and evaluation capacity-building** for program participants at their level-of-use
- **Ground data collection and use** in relevant curriculum design and timely assessment feedback to reduce evaluation burden
- **Include teacher input and feedback** in design cycles for tools

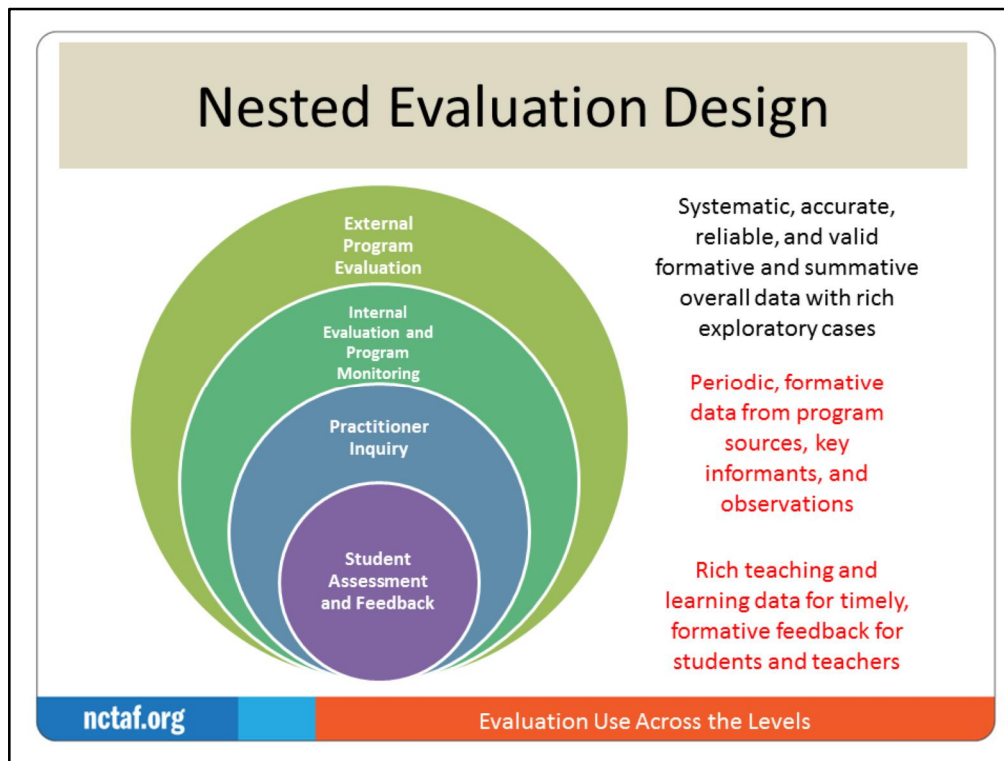
Expert-
User
Focus
Groups

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Evaluation Closer to Practice

As an internal evaluator for a non-profit school reform support organization, I am interested in **using the tools and processes of evaluation to improve the practice of teachers**. With funding from the Carnegie Corporation of New York, I have worked to design and test a series of data collection and analysis tools and protocols that would be helpful and useful for teachers. Here are some of the features of this evaluation orientation:

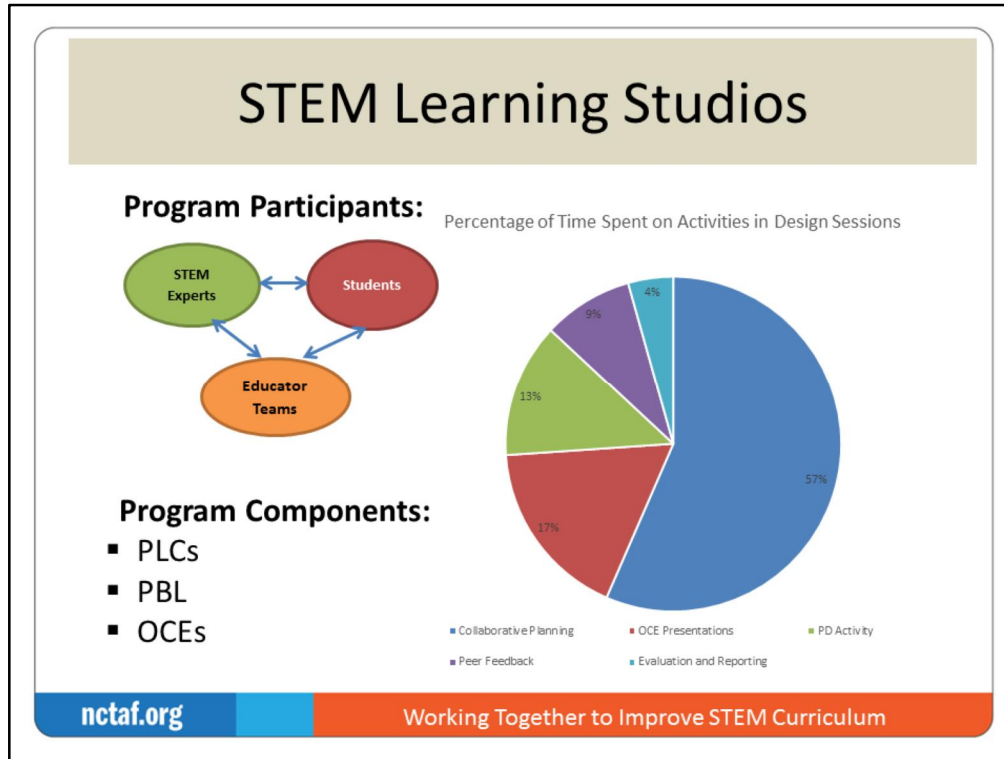
- “ **Embedded** evaluation information gathering and reporting in program routines and expectations
- “ Provision of design and evaluation **capacity-building** for program participants at their **level-of-use**
- “ **Grounded** data collection and use in relevant curriculum design and timely assessment feedback to **reduce evaluation burden**
- “ Teacher input and **expert-user feedback** in design cycles for tools



[Audio Describe Slide]

All of these nested levels can use evaluation concepts, methods, and tools to improve their work (i.e., students, teacher, program staff). **My role as an internal evaluator, required a shift to be an evaluation capacity-building coach** who works with practitioners during all phases of the project to use practical measurement to understand and improve practice.

You will see some **similarities to Participatory, Empowering, and Utilization-focused Approaches to Evaluation** (Fetterman, et. al., 2004, Patton, 2008). Similar to the steps Empowerment Evaluation, the tools and protocols helped educator teams to collaboratively take stock, set goals, and monitor progress for their collective work (project-based learning (PBL) units-of-study). The tools also helped building capacity for authentic assessment design. Several of the tools were embedded in reflective discussion protocols that prompted for the sharing and analysis of evidence of improvement, as well as for related further planning or action. The role of the evaluator was to validate the tools and data, build capacity for the use of the tools, and facilitate evidence-based feedback and action among teams.



NCTAF STEM Learning Studios

The program provided professional development supports for cross-curricular professional learning communities (PLC) focused on the collaborative design of project-based (PBL) units of study with outside content experts (OCE) who provided content expertise, resources, and curricular coaching. Our *theory of action* is that a high-functioning PLC with an instructional design focus on PBL *and* content, resource and coaching supports from an outside content expertise can accelerate the rate of improvement of collaborative work and learning design.

NCTAF facilitated summer and quarterly full-day Design Sessions that provided collaborative planning time (57%), OCE presentations of content and resources (17%), curriculum design and evaluation capacity-building (13%), and peer and program feedback routines (13%).

STEM Learning Studios

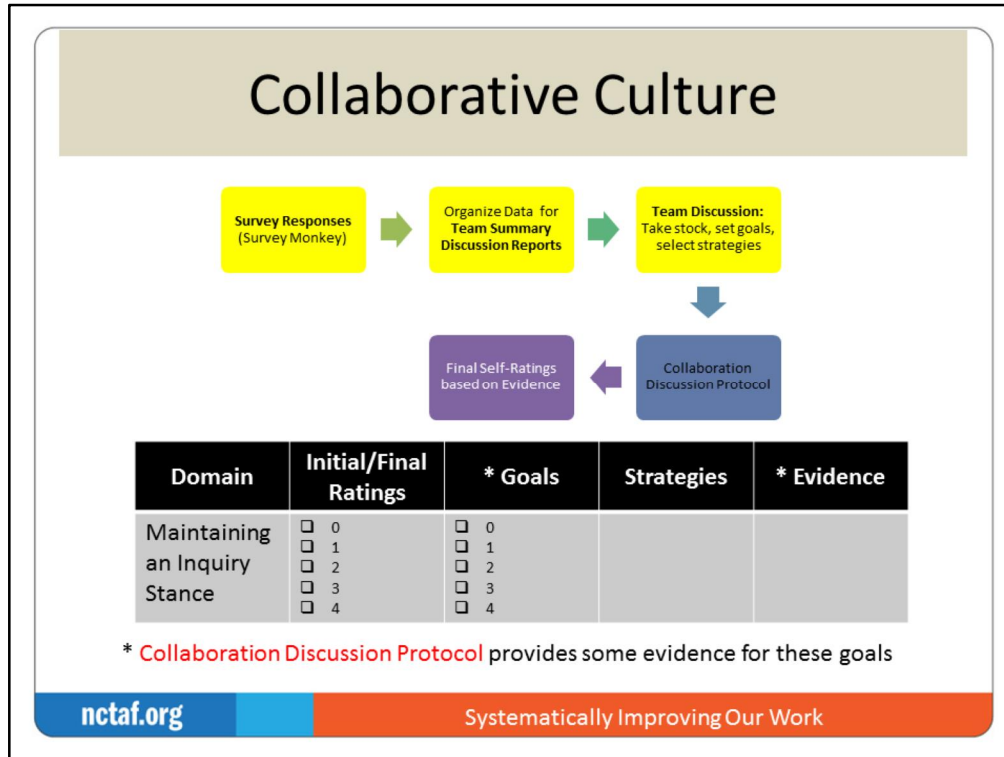
Team Member	Evaluation Focus	Tools
Teams of EDUCATORS	<ul style="list-style-type: none"> • Collaborative Culture (PLC) 	<ul style="list-style-type: none"> • Baseline and Interim Self-ratings • Collaboration Discussion Protocol
STEM Experts	<ul style="list-style-type: none"> • Curricular Improvement (PBL) 	<ul style="list-style-type: none"> • Curriculum Map • PBL Checklist • Teacher Final Survey
STUDENTS	<ul style="list-style-type: none"> • Student Learning • Student Interest 	<ul style="list-style-type: none"> • Student Retrospective Survey

Internal Formative Evaluation | External Third-Party Evaluation

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Internal and External Evaluation Working Together

This table shows how each participant group was supported through evaluation to improve their work. For the teacher teams and STEM experts, we focused on improving collaborative culture (PLC) and curriculum design (PBL). The tools labeled in red were designed, tested, and used to gather baseline and interim data to inform practice. The tools labeled in black were administered by our external evaluator WestEd as a summary evaluation on the focus areas--- which was especially helpful for getting summary student outcomes on learning and interest/engagement.




Collaborative Culture is one of the evaluation focus areas. The goal here was to improve the levels of collaboration of the cross-curricular teacher teams and OCE's, as well as increase their focus on improving curriculum and student learning. The basic flow of the evaluation work started with gathering baseline data in a survey with multiple items in six domains identified by several literature reviews. These scores were aggregated to the team level with some information of the range or spread of ratings on each item. A report of the scores were provided to the teams to discuss areas of strength, identify areas of growth, set some goals, and then propose some strategies to try out. Periodically at the quarterly design sessions, these goals and strategies were revisited. Evidence of growth was documented and discussed. At the end of the year the individual surveys were administered again and the results were presented to the teams to make new plans for improvement.

Collaborative Culture				
NCLE Collaborative Teams (2012)	STEM Teachers in PLCs (2011)	Team Up (2010)	EdWeek (2010)	Pearson LT Readiness Instrument (2009)
De-privatizing Practice	Collective Responsibility	Collective Responsibility	Perseverance	
Creating Collaborative Culture	Collective Responsibility Trust A Single School Subject	Collective responsibility	Job-alike teams Perseverance	Experience with collaboration
Maintaining an Inquiry Stance	Good Facilitation	Self-directed reflection	Protocols Trained peer facilitators Perseverance	Teacher Workgroup facilitator Coach/Content expert
Using Evidence Effectively	Use of Student Data and Student Work	Authentic assessment		
Shared Agreements	Shared Values and Goals	Shared Values and Goals		Potential Buy-in
Supporting Collaboration Systematically	Leadership Support Time	Strong leadership support Stable settings	Stable settings	Site administrator Available settings Timing/bandwidth
nctaf.org		Informing the Design of Tools with the Literature		

The survey instrument was adapted from a NCLE framework, survey tool, analysis report, and discussion protocol around Collaborative Culture that aligns well with the literature reviews conducted by NCTAF and its partners at Pearson.

Collaborative Culture



Cultivating Collaborative Culture

III. Maintaining an Inquiry Stance

4 / 7

How much do you agree with the following statements about the group with whom you are collaborating?

	N/A	1-Strongly Disagree	2-Disagree	3-Agree	4-Strongly Agree
We have a clear purpose that focuses our collaborative work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our collaboration focuses on core issues of student learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We are clear about the student outcomes we are working toward.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We work through a cycle of planning, acting, and reflecting on evidence about our practice.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We routinely monitor our progress toward our goals for	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Gathering Data to Inform Our Work

This is a screenshot of some ratings items for the domain of maintaining an inquiry stance. Teachers completed this survey in Survey Monkey at the initial Summer Design session and the 4th quarter Design Session.

Collaborative Culture

CULTIVATING COLLABORATIVE CULTURE

HS	SUM 2013	Q4
I. Deprivatizing Practice	3.25	
II. Creating Collaborative Culture	3.17	
III. Maintaining an Inquiry Stance	3.17	
IV. Using Evidence Effectively	3.38	
V. Shared Agreements	3.42	
VI. Supporting Collaboration Systemically	3.38	

Q2: Reflections, Evidence, and Strategies

- 1. Which domain(s) did you choose to work on?** Creating Collaborative Culture and Maintaining an Inquiry Stance
- 2. What progress have you made?** Collaborative Culture & Common Planning Time (the last 4 "A" Day). All teachers from the content areas (AFNR, Algebra, Biology, English, Environmental Science and FOT (Foundations of Technology) meet to elaborate on student progress as established this summer. The deadlines for assessments, submittal of evidence and workforce partnership meetings are listed in our "Mapping the Year" document per quarter. We've created a STEM Binder for our minutes and to include student artifacts.
- 3. What are you planning to do?** Continuing to meet weekly. Continued collaboration with our workforce partners and students. Reflection on student artifacts both future and present. Providing feedback to colleagues on lesson plans before they are presented to students. Differentiation of assessments for the different modalities of student learners.

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Using Evaluation to Inform Their Work

This is an example of the team survey results and a team's responses to the discussion protocol. The purpose was for teams to use data to self-evaluate themselves by taking stock, setting goals, exploring strategies, and then gathering evidence of improvement.

Collaborative Culture

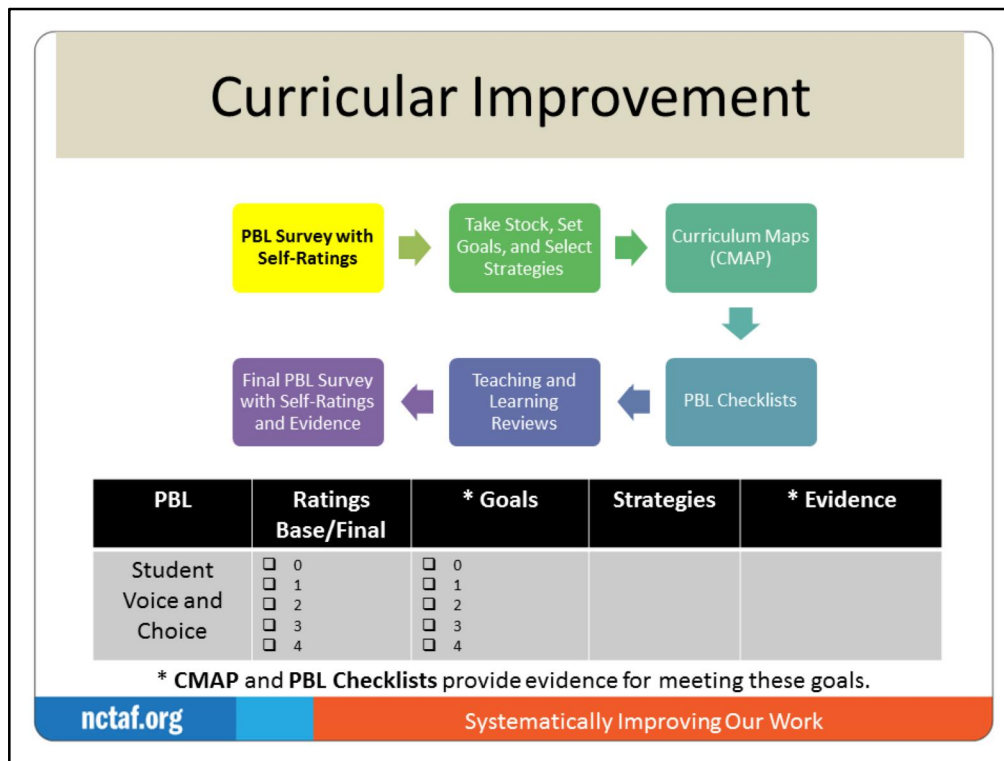
Collaborative Culture Survey Summer Design Sessions 2013

	# Teams	8	5	10	23
Total Team Members	59	33	50	142	
SUM of Team Scores	17.06	16.08	18.97		
PD Priority Rankine					
I. Deprivatizing Practice	1	2.60	2.41	2.89	7.90
We observe each other in the classroom and provide feedback to each other.		1.26	0.38	2.08	3.72
All members of the group stay engaged and accountable to each other.		2.56	2.52	2.65	7.72
We make commitments to try things in our classrooms and report back on the results.		2.90	2.60	3.13	8.62
We are comfortable sharing evidence about what is happening in our classrooms.		3.39	3.31	3.57	10.26
We share what we learn with others beyond our group.		2.56	2.73	2.88	8.17
Our group's work connects to the broader goals of the system in which we work.		2.94	2.91	3.03	8.88
IV. Using Evidence Effectively	2	2.63	2.43	3.04	8.10
Our collaboration stays grounded in evidence of student learning.		2.66	2.72	3.07	8.45
We have the skills in our group to use data effectively.		2.64	2.28	3.17	8.08
When we try something, we analyze the impact on student learning.		2.54	2.39	3.08	8.02
We examine and discuss student work with each other.		2.66	2.34	2.82	7.82

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Using Evaluation to Inform Our Work

This is a report that was run to get a summary of the average scores for teams across the districts. Conditional formatting was used to visually identify the strength or weakness of particular domains and items. Red is on the low end of the scale and green is on the high end of the scale. The sums of items were used to rank the priority of professional development or capacity-building supports. This information was used by staff to craft the capacity-building, tool design, and evaluation/feedback activities of the design sessions. In this case, peer observation and using student work evidence to evaluate work seemed to need the most support, which prompted the initial development in assessment design tools and looking at student work protocols.



This is another example from the **curricular improvement evaluation focus**. In this case a **survey** was designed and administered based on the Buck Institute’s PBL rubric to get baseline information about the team’s PBL knowledge and use. Team level information was used to set some goals and identify strategies like increase student voice and choice, provide a more public audience, or make the assessment task more closely mirror a real world problem.

For curricular improvement we used additional data collection tools. We had teams collaboratively **map their curriculum**, and then periodically review their PBL units of study using a **PBL checklist** that was based on the PBL Rubric. In response to the Collaborative Culture survey results, we also introduced a **protocol** for reviewing teaching and learning. Like for the collaborative culture program area, we ended the year by individually taking the survey again to provide ratings and qualitative evidence of improvement. We then reviewed the results as teams.

Curricular Improvement

Curriculum Map

Understanding by Design (UbD)	Project-Based Learning (PBL)
DESIRED RESULTS	Significant Content
	Driving Question
	Need to Know
ASSESSMENT EVIDENCE	Revision and Reflection
	Public Audience
LEARNING PLAN	21c Competencies
	In-Depth Inquiry
	Voice and Choice

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Informing the Design of Tools with the Literature

So again, here are some of the conceptual frameworks for designing the tools (e.g., Understanding by Design (Wiggins and McTighe, 2005), and Buck Institutes' PBL resources).

Curricular Improvement

Curriculum Design Survey

Assessment Evidence

75%

Please reflect on how often the items are TRUE about your CURRENT curriculum design practice, and then select a rating from 0-Never to 4-Almost Always.


How often are the following items true about your curriculum design?

	0-Never	1-Rarely	2-Sometimes	3-Often	4-
Students are provided with regular, structured opportunities to give and receive feedback about the quality of their work-in-progress.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students are taught how to constructively critique each other's work-in-progress.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students use feedback about the quality of their work to revise and improve it.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
At key checkpoints, students and the teacher engage in thoughtful, comprehensive reflection on what students are learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
At key checkpoints, students and the teacher engage in thoughtful, comprehensive reflection on the project's design and management.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students present or exhibit their work to an audience that includes other people from both within and outside the school, which may include online audiences.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students present culminating products and defend them in detail and in depth by explaining their reasoning behind choices they made, their inquiry process, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
After the project's culmination, students and the teacher engage in thoughtful, comprehensive reflection on what students learned.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
After the project's culmination, students and the teacher engage in thoughtful, comprehensive reflection on the project's design and management.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What assessment expertise can you offer your peers?

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Gathering Data to Inform Our Work

This is a screen-shot of the survey items in Survey Monkey. This page gathered ratings for assessment evidence and asked a few key open-ended questions to get information on current knowledge and practice.

DESIRED RESULTS	Big Idea Enduring Understanding				
	Driving Question Essential Question				
		NGSS: Science and Engineering Practices	NGSS: Disciplinary Core Ideas (DCI)	NGSS: Crosscutting Concepts	
		CCSS: Common Core Math/ELA Connections			
ASSESSMENT EVIDENCE	NGSS: Performance Expectations				
	Baseline/Diagnostic Assessment				
	Formative Assessments				
	Summative Assessment				
LEARNING PLAN		Workforce Partner	Science Technology	Math	ELA/Arts
	Week 1				
	Week 2...				

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Gathering Data to Inform Our Work

This is our Curriculum Map that features the NGSS dimensions for the desired results, the NGSS PE for the assessment evidence, and multiple columns for activities and resources across subject areas over time. It is basically an outcomes-based logic model or UbD template with the NGSS language embedded.

Curricular Improvement

The screenshot displays a Google Sheet titled "Curriculum Map" used for planning a 22-week course. The sheet is organized into columns for weeks (A-L) and rows for different components. A red box highlights the "PBL Design Checklist" section, which includes criteria like "Rating", "Essential Elements of PBL", and "Notes".

Curriculum Map Structure:

- Columns:** A, B, C, D, E, F, G, H, I, J, K, L
- Rows:** 1 to 22
- Section 1: Learning Studio** (Rows 1-3)
 - Row 1: Learning Studio
 - Row 2: Your Big Ideas / Enduring Understandings
 - Row 3: Your Driving Questions / Essential Question
- Section 2: Science and Engineering Practices** (Rows 4-6)
 - Row 4: Science and Engineering Practices
 - Row 5: Disciplinary Core Ideas
 - Row 6: Crosscutting Concepts
- Section 3: Next Generation Science Standards** (Rows 7-9)
 - Row 7: Next Generation Science Standards
 - Row 8: Performance Expectations
 - Row 9: Assessment Tasks and Evidence
- Section 4: Instructional Activities and Resources** (Rows 10-12)
 - Row 10: Baseline
 - Row 11: Formative
 - Row 12: Summative
- Section 5: Learning Plan** (Rows 13-22)
 - Row 13: Team Member
 - Row 14: Week 1
 - Row 15: Week 2
 - Row 16: Week 3
 - Row 17: Week 4
 - Row 18: Week 5
 - Row 19: Week 6
 - Row 20: Week 7
 - Row 21: Week 8
 - Row 22: Week 9

PBL Design Checklist (Highlighted in Red Box):

Rating	Essential Elements of PBL	Notes
VA Standards	Significant Content	
NGSS	Driving Question	
NGSS Search Tool	Need to Know	
CCSS Math	Revision and Reflection	Students are provided with regular, structured opportunities to give and receive feedback about the quality of their work-in-progress.
CCSS ELA	Public Audience	Students are taught to constructively critique each other's work-in-progress.
PBL Assessment	21c Competencies	
10 Tips for Assessing PBL	In-Depth Inquiry	
	Voice and Choice	

* Adapted from Buck Institute for Education (2011)
Project Design Rubric (PDF)

We then put this curriculum map into google docs to make it more **flexible and share-able**. Additional supports were added such as **hyperlinks** to NGSS resources/tools, and **just-in-time supports** like annotations to remind you what the aspects of an essential question are as you are working on it. Each subject area teacher had access to the shared planning document. The STEM expert and NCTAF coaching staff did as well. The Google doc revision feature allowed us to monitor changes over time. We also placed a **PBL checklist** in the same document to make it easier to complete the checklist and provide supportive evidence.

Curricular Improvement

		N=	ALL 87	SCIENCE 37	MATH 17	TECH 12	ELA 9	SS 5	OTHER 7
Desired Results									
Significant Content	standards		3.62	3.48	3.82	3.58	3.67	4.00	3.86
	big ideas		3.55	3.42	3.76	3.33	3.78	4.00	3.43
Driving Question	relevance		3.14	3.19	3.00	3.00	3.11	3.40	3.29
	essential questions		3.06	2.81	3.06	3.17	3.33	3.40	3.29
	AVG		3.34	3.23	3.41	3.27	3.47	3.70	3.46
Assessment Evidence									
Revision and Reflection	feedback-routines		3.02	3.13	2.88	2.75	3.13	3.00	2.83
	reflection-learning-formative		2.96	2.93	2.76	3.00	3.25	3.00	2.83
	feedback-use		2.84	2.70	2.76	3.17	3.13	2.80	2.67
	reflection-project-formative		2.73	2.77	2.44	3.08	2.88	2.40	2.83
	reflection-learning-summative		2.63	2.57	2.44	3.25	2.63	2.20	2.67
	feedback-peer-critiques		2.58	2.43	2.53	2.83	2.78	2.60	2.33
Public Audience	reflection-project-summative		2.54	2.33	2.38	3.27	2.63	2.40	2.50
	evidence-based presentations		2.37	2.27	2.31	2.67	2.38	2.00	2.67
	authentic audience		2.16	2.03	1.94	2.50	2.25	1.60	2.67
	AVG		2.65	2.57	2.49	2.95	2.78	2.44	2.67
Learning Plan									
21st Century Competencies	collaboration-group		3.08	3.07	3.19	3.08	3.00	2.80	3.17
In-Depth Inquiry	rigorous		3.08	3.07	3.06	2.83	3.13	2.80	3.50
21st Century Competencies	problem-solving		3.06	2.93	3.00	3.25	3.13	3.00	3.17
In-Depth Inquiry	inquiry		3.01	3.10	2.50	2.91	3.25	3.00	3.33
	analysis		2.99	3.20	2.81	2.92	2.88	2.60	2.83
	inquiry		2.91	2.90	2.81	2.83	2.75	3.20	3.33
Voice and Choice	independent work		2.88	2.73	2.88	3.25	3.38	2.60	3.00
In-Depth Inquiry	evidence-based solutions		2.80	2.93	2.75	2.75	3.00	2.60	2.83
Voice and Choice	voice and choice		2.62	2.57	2.50	2.92	3.00	2.20	2.83
21st Century Competencies	collaboration-community		2.73	1.90	2.19	2.58	2.63	1.80	3.00
	AVG		2.86	2.84	2.77	2.93	3.01	2.66	3.10
	< MEDIAN (2.91)								

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Using Data to Inform Our Work

Again, an example of a visual report that helped NCTAF staff see where the hotspots were in terms of providing professional development support for PBL curriculum design. An area of focus for improvement, based on this data, is in assessment literacy, design, and use.

Next Steps

Theory of Action: Project-Based Learning (PBL) units of study with a robust, authentic NGSS-aligned assessment feedback system will support greater student engagement and deeper lasting learning.

Year 1 ■ Year 2 ■ Year 3 ■ Balancing Measure ■

Aims

Teachers: By June 2016, teachers in STEM Learning Teams will provide effective feedback and appropriate differentiated supports and resources using a common NGSS rubric.

Students: By June 2017, students will be clear on the learning goals, performance levels, and appropriate strategies or resources they used to move at least one level of proficiency on the common NGSS rubric.

Primary Drivers

Professional Adult Learning on Assessment

Effective Use of Inside/Outside Content Experts and Resources

Resources and Strategies for Addressing Learning Variability and Instructional Differentiation

Effective Use of Professional Learning Communities

Secondary Drivers

Assessment Design and Development

Assessment Scoring

Teacher Assessment Use and Communication of Feedback

Student Use of Assessment Feedback

Changes in Core Practices

- Assessment literacy/NGSS orientation
- Assessment task design
- Rubric design and validation
- Student anchor work selection and annotation
- Assessment Review Protocol

- Assessment Scoring training and monitoring
- Assessment scoring procedure
- Assessment feedback reporting
- Student participation in assessment use and feedback

- Protocol-driven assessment discussions
- Focus on multiple data sources: student data, work, and other evidence
- Reliable predictions of high leverage instructional supports and resources for diverse learners.

- Use of instructional and professional time

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Using Improvement Science to Reliably Address Variability

This new area is guiding our decision-making for our next steps. We are now drawing from **developmental evaluation** (Patton, 2011) and **improvement science** (Bryk, Gomez, and Grunow, 2011) to think about systematic development and use of NGSS assessments. How do these processes address a specific problem of practice? Where do they fit into a larger complex system? How can we support rapid and practical measurement of our change ideas with tests in multiple contexts? How can we share data that help explain variation and support reliability rather than just fidelity?

Hopefully I will be back here next year to present on this work.



These tools, some improvement case studies, and rubrics are in development as an online interactive resource that should be available in early 2015 for STEM/NGSS coordinators and coaches www.nctaf.org