

# Using Curriculum Topic Study to Enhance Achievement in K-12 Mathematics and Science

The instructional practices, materials, and assessments were chosen to meet the needs of our program. Other options exist. The instructional practices and assessments discussed or shown in this presentation are not intended as an endorsement by the U. S. Department of Education.

# Goals

- Increase the academic achievement of students in math and science by enhancing the content knowledge, pedagogical content knowledge, and understanding and use of the NJ CCCS by classroom teachers
- Progression of science & mathematics topics through three years



# NJ MSP Partnership & Roles

- Stevens Institute of Technology, Center for Innovation in Engineering and Science Education (CIESE)
- Saint Peter's College
- Teachers College, Columbia University, Institute for Learning Technologies
- NJ regional network of 18 local education agencies
- 70 elementary, middle, and high school teachers (35 math, 35 science)
- Engage STEM faculty



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# Curriculum Topic Study (CTS)

- CTS is a method and index for linking curriculum topics to recognized authorities on curriculum content and pedagogy
- Developed by Page Keeley, Maine Math and Science Alliance
- Much of the substance of CTS takes the form of tables of references to the authoritative resources (e.g., *AAAS Benchmarks in Science Literacy*, *Atlas of Science Literacy*, *Science for All Americans*)

***“There is nothing in here!”***

- Participating STEM faculty member



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# Professional Development (PD) Program Structure

- Two-week summer institute
- 4 PD workshops during school year (3 f2f & 1 online)
- Monthly classroom visits
- Cross-grade Teacher Exchange Program
- Professional Learning Communities & online support
- Opportunity for graduate credit
- Total: 124 hrs PD for each participant



# Teacher and Student Evaluation: Quasi-experimental Study

## Teachers

- Pre-/post-assessments of content knowledge in treatment & comparison groups
- Approx. 25 questions taken from TIMSS, NAEP, and state assessments (validated)
- Survey of Enacted Curriculum for PCK
- Self-report surveys

## Students

- Pre-/post-assessments of student content knowledge for treatment & comparison teachers
- Approx. 25 questions taken from TIMSS, NAEP, and state assessments (validated)
- Student state assessment data (NJ ASK, 8<sup>th</sup> grade only) for each treatment teacher

# Teacher and Student Evaluation: Validated Outcomes

## Outcome

- 1) Does **teacher content knowledge** of the indicated subject areas improve as a result of the program
- 2) Does **teacher pedagogical content knowledge (PCK)** in the indicated subject areas improve as a result of the program
- 3) Does **student content knowledge** in the indicated subject areas, and achievement overall, improve as a result of the program

## Indicator of success

- Statistically significant increase pre- vs. post-assessment in the treatment group vs. comparison group
- Statistically significant increase in the mean scores of treatment teachers pre- vs. post-assessment of PCK
- Statistically significant increase pre- vs. post- for validated questions and for proficient/advanced levels in statewide and district-wide

# Teacher and Student Evaluation: Survey Instruments

## Outcome

- 1) Does **teacher content knowledge** of the indicated subject areas improve as a result of the program
  
- 2) Does **teacher pedagogical content knowledge (PCK)** in the indicated subject areas improve as a result of the program

## Indicator of success

Treatment group teachers' understanding of the NJCCCS for the indicated subject areas will increase significantly more than that of comparison group teachers, as reflected in project-level pre- and post-assessments

Demonstrated use of the Curriculum Topic Study, and a demonstrated use of technology



# Teacher Awareness of CTS

	Strongly Agree/Agree	Neutral/Disagree/Strongly Disag.
“I knew the purpose and objectives of the Institute [before coming]”	18%	82%
“I have a clear idea of how to do a Curriculum Topic Study.”	92%	8%

***“The CTS workshop inspired me to look at and approach my teaching in a whole new way”***

- Participating teacher



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# Teacher Adoption of CTS

	Strongly Agree/Agree	Neutral/Disagree/Strongly Disag.
“CTS will be helpful in meeting the State’s learning standards”	84%	16%
“Curriculum Topic Study will be helpful in meeting my goals for my classroom.”	70%	30%

***“I have gained a much better understanding how the standards support developmental learning across grade levels...I am more conscious of what concepts and skills need to be introduced and reinforced prior to my grade level, at my level, and what they need to know to progress to the next level.”***

- Participating teacher

# Workshop Structure: Horizontal Teams

- Identify a “thread” within the State Learning Progressions (a series of concepts that build through the K-12 progression)
- Ask the teachers to meet in horizontal grade level teams (K-2, 3-5, 6-8, 9-12) to discuss a concrete question

“What do you expect your students to learn about how cells and their organelles contribute to the functions of an organism? (Grade 6-8 question)
- Identify the applicable state standard
- Use CTS to access authoritative information on this question

# Workshop Structure: Vertical Teams

- Re-assemble as a vertical team (participants from all levels within a single district)
- Using the related questions and the pedagogical information from the horizontal group CTS study, examine articulation for K-12 using additional CTS authorities
- Identify student misconceptions

## Second thread questions

- Using a closely related topic, pose a problem for the vertical team to solve

“Do the national curriculum authorities agree with the timing of presentation of food webs suggested by the New Jersey Core Curriculum Content Standards?”

# Incorporating Hands-on Activities

- Design a hands-on activity related to the thread for the day
- Based on laboratory experiments, web-resources, K-12 interactive programs (CIESE), or visits/tours of high-tech research facilities
- Ask teachers to identify the NJCCCS relevant to the activity
- Ask teachers to distill/interpret the activity for their grade level

***After a hands-on activity related to diffusion, the Grade 3-5 team developed an explanation of diffusion based on how a child might feel in a crowded room.***



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# C-TEAMS MSP Workshop Impact

- Workshop participants asked to serve on district committees to update/realign curriculum
- Workshop participants are informing colleagues about the authoritative references and are framing curriculum discussions in terms of NJCCCS
- Administrators have expressed an interest in acquiring reference books for districts and schools
- Teachers have made avid use of on-line and print resources (especially from the NSTA and NCTM sites) to enrich classroom experiences

