Three-dimensional teaching and learning: Rebuilding and researching an online middle school curriculum (3DMSS)

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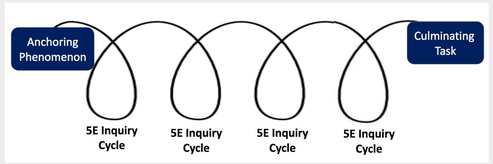
Project & Research Goals

The project aims to do the following:

- ❖ support teacher implementation of NGSS-aligned science instructional materials in the absence of face-to-face PD;
- ❖ enhancing teachers' PCK for 1) recognizing coherent science content storylines, and 2) revealing, supporting and challenging student thinking;
- ❖ enhance teachers' practice to engage students in science and engineering practices
- ❖ enhance teacher content knowledge about the unit-based DCIs and crosscutting concepts;
- ❖ enhance student science achievement at the nexus of the three dimensions of the NGSS.

Materials Development Approach



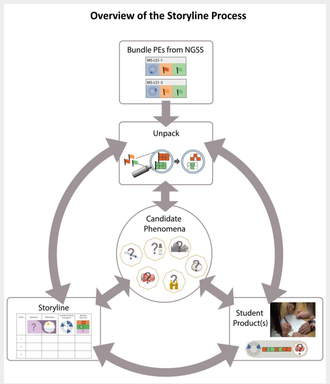
Anchored Inquiry

"inquiry learning meets project-based learning"

- ❖ Learning is motivated by an *anchor* that provides a purpose for learning and an opportunity to apply learning.
  - Purpose for learning: *Anchoring experience*
  - Opportunity to apply: *Culminating task*
- ❖ Inquiry Cycles are motivated by the need to explain something about the Anchoring Phenomenon.
  - Students revisit the anchor: What can we explain now? What do we still have questions about?

NGSS Storyline Design Approach

- ❖ Figuring out phenomenon (or designing a solution) drives learning across the unit.
- ❖ Student questions are elevated and leveraged throughout the unit.
- ❖ The integration of the three-dimensions is purposeful for figuring out the phenomenon.



Reiser, B. J. (2014). Designing coherent storylines aligned with NGSS for the K-12 classroom. National Science Education Leadership Association, Boston, MA.
Reiser, B. J., Novak, M., & Fumagalli, M. (2015). NGSS storylines: How to construct coherent instruction sequences driven by phenomena and motivated by student questions. Illinois Science Education Conference 2015, Tinley Park, IL.
www.nextgenstorylines.org

Funded by Award# 1502571 from the National Science Foundation. Any opinions, findings, conclusions or recommendations are only those of the presenters and do not necessarily reflect the views of the National Science Foundation.

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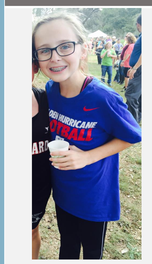
3D Storyline

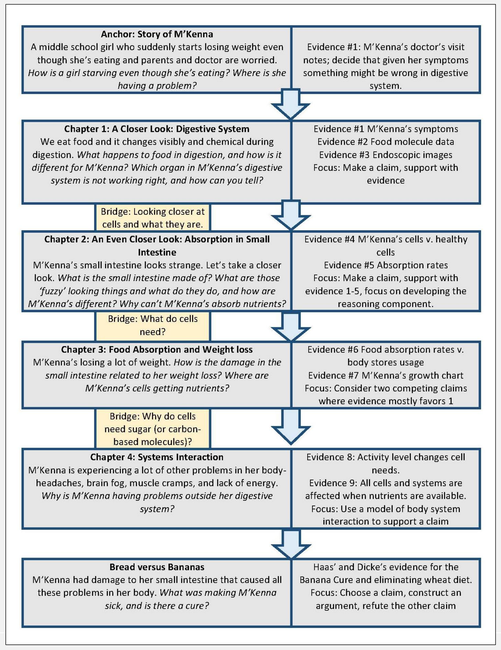


Anchoring Phenomenon:
A Medical Mystery

This is M'Kenna. When M'Kenna was 13, something strange started to happen. She started to lose weight even though she was trying to eat normally. Suddenly many foods were making her sick. She also started running out of breath all the time and couldn't play sports. Her heart would race when she did simple things, like climbing the stairs. She also couldn't concentrate on her school work.

Performance Expectations

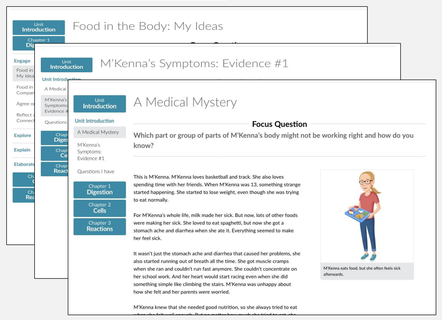
MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
MS-LS1-2. Develop and use a model to describe the function of a cell as a whole, and ways the parts of cells contribute to the function.
MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting sub-systems composed of groups of cells.
MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.



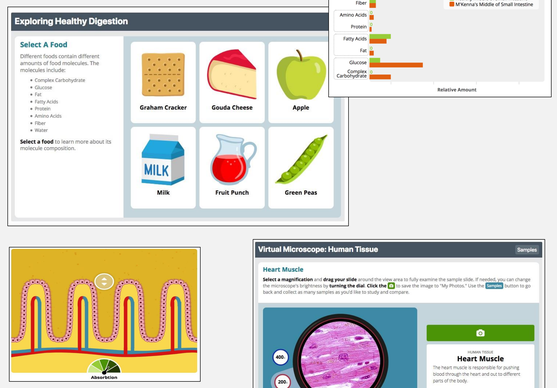
Chapter 1 · Chapter 2 · Chapter 3 · Chapter 4

Innovative web platform and media-enhanced materials

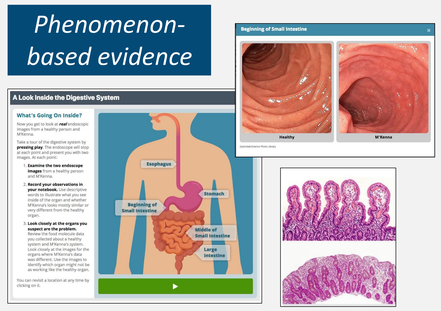
Online interface



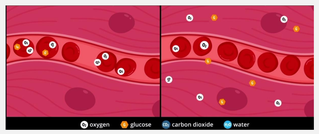
Virtual tools & interactives



Phenomenon-based evidence



Animations



Professional Development

The goal of the PD is to improve teacher content knowledge, PCK, and practice related to teaching middle school life science in support of three-dimensional learning. The PD is a curriculum-based PD with STeLLA elements.

Theoretical Underpinnings:

- ❖ Situated cognition—tight connections between professional learning experiences and classroom practice.
- ❖ Cognitive apprenticeship--opportunities to try out activities, get feedback and support during implementation.

Who is participating?

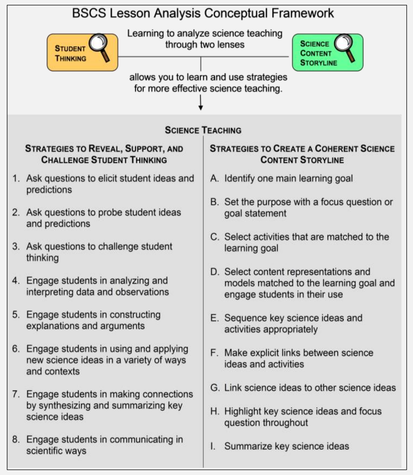
- ❖ 29 middle school science teachers from 12 states and diverse school contexts.

What will they learn?

- ❖ The STeLLA conceptual framework focusing on two two lenses of classroom practice (student thinking and science content storyline) and high leverage strategies related to both.

How will they learn it?.

- ❖ Weekly asynchronous and synchronous study groups around NGSS and STeLLA (summer).
- ❖ Five follow-up synchronous study group sessions during the school year (STeLLA and curriculum support).



Roth, K. J., Garnier, H. E., Chen, C., Lemmens, M., Schwille, K., & Wickler, N. I. (2011). Videobased lesson analysis: Effective science PD for teacher and student learning. *Journal of Research in Science Teaching*, *48*(2), 117-148.

Research Design

Formative research:

- ❖ Purpose: to inform revisions to the materials and PD experience.
- ❖ Data sources: teacher feedback surveys, feedback from external reviewers using the EQuIP rubric, data from quasi-experiment.

Summative research:

- ❖ Quasi-experiment to determine efficacy of the materials and PD.
- ❖ Field test teachers serve as their own comparison group using their own materials in Year 1 and the field test materials in Year 2.
- ❖ Data sources: 1) student assessments (mixed-item assessment, classroom assessment tasks), 2) teacher video analysis task, 3) teacher content knowledge assessment.