How can the curriculum *Health in Our Hands: What controls my health* support students in figuring out phenomena?

Idit Adler & Renee Bayer  
CREATE for STEM Institute  
Michigan State University

Darlene McClendon  
Flint Community Schools

**Michigan Science Teacher Association (MSTA)**  
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CREATE for STEM Institute

• COLLABORATIVE research and innovation projects
• Partners in K-12 schools, higher education, research institutes, community organizations
• In Michigan, across the U.S., and worldwide
• Funding from MSU, NSF, NIH, Lucas Foundation, etc.

• Visit us at: create4stem.msu.edu
What will we do today?

1. Build understanding about the Next Generation of Science Standards (NGSS) and Project-based Learning (PBL)

2. Introduce the curriculum Health in Our Hands

3. Discuss how the curriculum is structured according to NGSS and PBL
What’s new in the Framework?

1. Focus on **figuring out** phenomena
2. **3-Dimensional** Learning
   - Organized around *Disciplinary Core Ideas* (DCI)
   - Central role of *scientific and engineering practices*
   - Use of *Cross Cutting Concepts* (CCC)
3. Instruction builds towards **Performance Expectations** (PEs)
4. **Coherence**: building and applying ideas across time
“Figuring Out” vs. “Learning About”

• **Explanatory ideas** are important so that students are figuring out phenomena and not just learning about facts and details.

• **Science and engineering practices** build explanatory ideas.

How are mountains formed?

How does salt affect snow melt?
# 3D Learning: How are DCIs different?

<table>
<thead>
<tr>
<th>Life Science</th>
<th>Physical Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS1: From Molecules to Organisms:</td>
<td>PS1: Matter and Its Interactions</td>
</tr>
<tr>
<td>Structures and Processes</td>
<td>PS2: Motion and Stability: Forces and Interactions</td>
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<tr>
<td>Dynamics</td>
<td>PS4: Waves and Their Applications in Technologies for Information Transfer</td>
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<td>LS3: Heredity: Inheritance and Variation of Traits</td>
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<td>LS4: Biological Evolution: Unity and Diversity</td>
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<tr>
<td>Earth &amp; Space Science</td>
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<tr>
<td>ESS1: Earth’s Place in the Universe</td>
<td>ETS1: Engineering Design</td>
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<td>ESS2: Earth’s Systems</td>
<td>ETS2: Links Among Engineering, Technology, Science, and Society</td>
</tr>
<tr>
<td>ESS3: Earth and Human Activity</td>
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</tbody>
</table>
3D Learning: What are crosscutting concepts (CCCs)?

Ideas that bridge across and are important to all the science disciplines

Provide different lens to examine phenomena

1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change
3D Learning: What are scientific and engineering practices (SEPs)?

The multiple ways of knowing and doing that scientists and engineers use to study the natural world and design world.

The practices work together – they are not separated!

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Developing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information
The Framework for K-12 Science Education – 3D learning

Knowing and doing **must work together** to form useable understanding that enables problem-solving, decisions making, explaining real-world phenomena, and integrating new idea.
From the Framework to Standards (NGSS)

- The *Framework for K-12 Science Education* serves as the foundation for the Next Generation Science Standards.

- The standards are structured as performance expectations (PEs) that purposefully combine the three dimensions together in a manner that requires students to demonstrate knowledge in use.
Example of PE from Health in Our Hands

Students who demonstrate understanding can:

**MS-LS1-5.** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]

[Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

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

**Science and Engineering Practices**

**Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6-8 builds on K-5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students’ own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the

**Disciplinary Core Ideas**

**LS1.B: Growth and Development of Organisms**

- Genetic factors as well as local conditions affect the growth of the adult plant.

**Crosscutting Concepts**

**Cause and Effect**

- Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.
What’s special about PEs?

Performance expectations:

- **are not** learning goals for instruction
- **are not** instructional strategies

Performance expectations **are**:

- guidance for designing instruction and curriculum materials
- specify assessment for students

Instruction BUILDS TOWARDS an understanding of a PE.
Coherence
Elements of Figuring Out (3D Learning)

Phenomena
What was the event(s) in the world that happened that we need to explain?

Question
What about the phenomena do we need to explain?

Science and Engineering Practices
How are we modeling, explaining, etc. the phenomena, or designing a solution to solve the problem?

New Ideas
What did we figure out using these practices?
What pieces of the DCIs or CCCs did we figure out?
What new ideas do we have?
What’s new in the Framework?

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6th grade unit
Health in Our Hands: What controls my health?
Which PEs does the unit build towards?

**MS-LS1-5** - Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

**MS-LS3-2** - Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

**MS-LS1-3** - Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

**MS-LS4-4** - Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals’ probability of surviving and reproducing in a specific environment.

**MS-LS4-6** - Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
HIOH is a Project-based Learning (PBL) curriculum

Project based learning is a comprehensive approach to classroom teaching and learning that is designed to engage students in investigation of authentic problems.

- Pursue solutions to a meaningful question
- Explore the question by participating in authentic, situated inquiry to “figure out” why phenomena occurs
- Engage in collaborative activities to find solutions
- Use learning technologies and other scaffolds to help students participate in activities
- Create artifacts that address the driving question and explain the phenomena

PBL curricula can support in achieving the goals of NGSS
<table>
<thead>
<tr>
<th>Lesson</th>
<th>Driving Questions</th>
<th>Learning Goal</th>
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</thead>
<tbody>
<tr>
<td>Lesson 1</td>
<td>Why does Monique have diabetes?</td>
<td>Introduction</td>
</tr>
<tr>
<td>Lesson 2</td>
<td>How can we describe Monique’s diabetes?</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Lesson 3</td>
<td>How does Monique’s family affect her diabetes?</td>
<td>Genetic component</td>
</tr>
<tr>
<td>Lesson 4</td>
<td>How does where Monique lives and what she does affect her health?</td>
<td>Environmental component</td>
</tr>
<tr>
<td>Lesson 5</td>
<td>How do Monique’s characteristics and environment affect her health?</td>
<td>Genes-environment interaction</td>
</tr>
<tr>
<td>Lesson 6</td>
<td>What can Monique do to make her environment healthier?</td>
<td>Individual action</td>
</tr>
<tr>
<td>Lesson 7</td>
<td>How can we work together to make our environment healthier?</td>
<td>Collective action</td>
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**Health in Our Hands: What controls my health?**
Pursue solutions to a meaningful question
Explore the question by participating in authentic, situated inquiry to “figure out” why phenomena occurs.

Plant simulation
Sand-rats simulation
Community projects
### Possible questions for the community action project

<table>
<thead>
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<tbody>
<tr>
<td>How does social pressure at school affect my eating habits / exercise habits / healthy lifestyle?</td>
</tr>
<tr>
<td>How do science / health exhibitions affect children’s / youth’s healthy lifestyle? (such as in museums or documentaries)</td>
</tr>
<tr>
<td>How does access to exercise facilities in the neighborhood affect children’s / youth / adults’ exercise habits?</td>
</tr>
<tr>
<td>How do commercial advertisements in my neighborhood affect my community’s food consumption / healthy lifestyle?</td>
</tr>
<tr>
<td>How does the town’s transportation facilities (roads for bicycle, safe sidewalk) affect my exercise habits?</td>
</tr>
<tr>
<td>How do school health, breakfast, or lunch programs affect the students’/ teachers’ eating habits?</td>
</tr>
</tbody>
</table>
Use *learning technologies and other scaffolds* to help students participate in activities.
Create artifacts that address the driving question and explain the phenomena

https://concord.org/projects/building-models
Your goal....

• Work in teams
• Each team will examine different lessons from Lessons 1-6:
  1. Collect evidence from the lesson architecture that show that they are NGSS aligned
  2. Collect evidence from the lessons that they are structured based on a PBL approach
• Present to other teams
Are the lessons REALLY NGSS aligned and based upon PBL??

**Shift in NGSS**

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**Characteristics of PBL**

1. Pursue solutions to a *meaningful question*
2. Explore the question by *participating in authentic, situated inquiry* to “figure out” why phenomena occurs
3. Engage in *collaborative activities* to find solutions
4. Use *learning technologies* and *other scaffolds* to help students participate in activities
5. *Create artifacts* that address the driving question and explain the phenomena
Thank you for joining us!

Idit Adler adleridi@msu.edu
Renee Bayer rbayer@msu.edu
Darlene McClendon dmccclendon@flintschools.org

CREATE for STEM Institute,
Michigan State University
Flint Community Schools

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