FOUR STICKERS: PLACE THE READING, WRITING, SPEAKING, LISTENING STICKER WHERE YOUR STUDENTS DO MOST, FREQUENTLY, SOMETIMES, OR NOT VERY OFTEN.

READING
WRITING
SPEAKING
LISTENING

| MOST OFTEN | FREQUENTLY | SOMETIMES | NOT OFTEN |
KLEWS to Language & Literacy Development
Through 3D Science Instruction in Early Grades

What are we investigating? What is our question?

<table>
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<th>What do we think we KNOW?</th>
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https://goo.gl/PbCHHp
MSTA Conference
Lansing 2018
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Every state, in response to new or emerging state standards and frameworks in math, English Language Arts and literacy, science, and social studies, is recognizing the timely need to revisit existing curricular, instructional, and assessment priorities and policies. Each set of standards emphasizes the critical role of developing the following career and college ready skills to facilitate literacy and disciplinary learning across all grade levels, among them:

- reasoning and arguing from evidence
- critiquing another’s argument
- making one’s thinking public
- interpreting increasingly complex text, including representations of information in multiple formats
- participating in and supporting a culture of talk

LINK for FULL REPORT
Science is for ALL students.

Doing science supports literacy practices.

Get science and literacy beyond the “blockers.”
KLEWS: Connecting Literacy and Science

Session Wonderings:

How do we teach science aligned to the K-12 Framework and Michigan Science Standards?

How do literacy and science practices intersect?

How can we leverage these intersections to improve learning in both science and literacy?
Our assumptions...

You have some understanding and experience with:
- Michigan Science Standards vs. GCLEs
- 3-Dimensional Science Instruction & Assessment
- Teaching Elementary Grades
- Claims–Evidence–Reasoning

You are willing to participate fully.

You are happy to be here and excited to learn!
What literacy practices do students use in science?

When and how do you use them?
Examining our practices

- Reading
- Writing
- Speaking
- Listening
Reading about, writing about, speaking about or listening in science instruction in isolation **does not** contribute to students’ **science** learning...
...UNLESS WE GO 3D!
1. Waves: Light and Sound

Students who demonstrate understanding can:

1-PS4-1. Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]

1-PS4-2. Make observations to construct an evidence-based account that objects in darkness can be seen only when illuminated. [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]

1-PS4-3. Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light. [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]

1-PS4-4. Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance. [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

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

**Science and Engineering Practices**
- Planning and Carrying Out Investigations
  - Planning and carrying out investigations to answer questions or test solutions to problems in K-2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.
  - Plan and conduct investigations collaboratively to produce evidence to answer a question. (1-PS4-1, 1-PS4-3)
- Constructing Explanations and Designing Solutions
  - Constructing explanations and designing solutions in K-2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
  - Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena. (1-PS4-3)
  - Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)

**Disciplinary Core Ideas**
- PS4.A: Wave Properties
  - Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)
- PS4.B: Electromagnetic Radiation
  - Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)
  - Some materials allow light to pass through them, others allow only some light through, and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to reflect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3)
- PS4.C: Information Technologies and Crosscutting Concepts
  - Cause and Effect
    - Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1, 1-PS4-2, 1-PS4-3)
  - Connections to Engineering, Technology, and Applications of Science
    - Influence of Engineering, Technology, and Science, on Society and the Natural World
      - People depend on various technologies in their lives, human life would be very different without technology. (1-PS4-4)

**Related Evidence Statements**
- 1-PS4-1 Evidence Statements
- 1-PS4-2 Evidence Statements
- 1-PS4-3 Evidence Statements
- 1-PS4-4 Evidence Statements

**How to Read the Standards**
The standards integrate three dimensions within each standard and have intentional connections across standards. More...
Can we design a test to figure out how sounds are made?

1-PS4.1 Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate. [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]
Qualities of a good anchor phenomenon for a coherent sequence of science lessons

First focus on phenomena

A vehicle for eliciting students’ ideas and supporting literacy practices
<table>
<thead>
<tr>
<th><strong>Magic School Bus</strong></th>
<th><strong>Use the Singing Bowl</strong></th>
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<tr>
<td>Watch Ms. Frizzle and the kids.</td>
<td>Use the Singing Bowl</td>
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<tr>
<td><img src="https://tinyurl.com/y76v5x33" alt="Image" /></td>
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What do you notice? What do you wonder?
Does it matter *how* we interact with phenomena?

What do you notice? What do you wonder?
Phenomena are used to elicit students’ ideas, interests and questions.

Crosscutting concepts focus questions into entry points for student-led science.
Speaking and Listening - to engage in discourse about findings and ideas

Reading - Connected to the work they are doing and to the work of other scientists

Writing - to communicate explanations based on evidence.

Dr. Jacqueline Barber, Lawrence Hall of Science
What is the scientific explanation the class is working toward?

*How are sounds made?*

**Claim(s):**

Vibrating materials can make sounds.

*Sounds can make material vibrate* (1-PS4-1).

**Evidence:** When we tapped the drum, it shook and made a sound. When we hit the tuning fork, it moved back and forth and made a sound. When we touched the moving tuning fork, it stopped shaking and stopped making sound.
Students engaged in multiple, authentic science and literacy practices

**Asking Questions:**
- What makes sound?

**Carrying Out Investigation Stations**
- tuning forks, guitar, drums, and computer

**Writing Observations**
- Gathering Data

**Speaking and Listening**
- Science conference – students presented about their station
Framework for Explanation Building

Claims < Evidence > Reasoning

- CER are the fundamental components of complete explanations in science.
- CER reflects the structure of an argument in that we “back-up”/support claims with evidence in science.
- Taken together, CER sequences explain the how/why of natural phenomena.
Talking to learn science = critiquing ideas

Share, expand and clarify thinking (individual)

— Time to think
— Say more
— So, are you saying…?

Listen to one another

— Who can rephrase or rethink?

Deepen reasoning

— Asking for evidence or reasoning
— Challenge or counter example

Think with others

— Agree/disagree and why
— Add on
— Explain what someone else means

Click here for TERC Talk Primer
Kid talk drives vocabulary/terminology in the service of DOING science.

Unless there is talk!
Where is the informational text in these lessons?
Where did it come from? Who created it? How was it used?
Expanding our notion of what counts as text in science to include data tables, graphs, argument maps/KLEWS charts, etc.
We saw vibrations on the computer when we clapped and talked.

The tuning fork vibrated because they waved the water and when they vibrated we heard the sound.

When the drum made a sound, we saw the rice move.
From Wonder Wall to Word Wall

- **Constructing explanations from evidence** requires a *SHIFT* in how we tie words to meaning.
- Activity Before Concept - Concept Before Vocabulary
- Introduction of “science words” should be:
  - No longer something to be introduced at the beginning of a lesson and memorized.
  - Embedded within learning experiences;
  - Anchored in making sense of phenomena; and
  - Revisited in meaningful ways with the active involvement of students.
3 Unless there authentic texts as well as “text sets”

Our notion of text extends to students’ scientific explanations (via talk, writing, drawing, etc.).
### KLEWS Chart

**K** – What do we *think* we know? (i.e., beginning ideas, predictions)

**L** – What are we *learning*? (i.e., claim)

**E** – What is our *evidence*?

**W** – What do we *wonder* about the phenomena? (i.e., testable and researchable questions)

**S** – What *science ideas* make our explanation stronger? (i.e., scientific principles and terminology)

Zembal-Saul et al., 2013
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What’s Your Evidence?

Engaging K-5 Students in Constructing Explanations in Science

Carla Zembal-Saul  Katherine L. McNeill  Kimberly Hershberger

Objective
Plan a science lesson about germination

Length
8 min

Questions to Consider
- How does the KLEVIS strategy differ from the traditional KWL chart?
- Why did Ms. Katsareas decide to revise her focus question?
- How does Ms. Hersberger help Ms. Katsareas develop her plans?

See the full playlist of videos in this series.

Guide  My Notes

Developed in Partnership with
Carnegie Corporation of New York
What's Your Evidence?
Engaging K-5 Students in Constructing Explanations in Science

Carla Zemba-Saul, Katherine L. McNeill, Kimberly Hersberger

Strategies & Tools for 3-Dimensional Science Learning

Using Classroom Displays of Science Learning

The Framework
The Michigan Science Standards and NRC Framework call on students to go public with their ideas and for teachers to help students keep track of important revisions to their science thinking. Conceptual change and socially constructed knowledge are at the heart of effective science teaching. Rather than merely touring the landscape of settled scientific facts, the three dimensions of the new standards require students to engage in the doing and thinking of science in order to construct evidence-based understanding. Equally important is a shift toward science instruction that reflects the social, collaborative nature of scientific explanation and/or engineering problem solving.

This guide includes three classroom strategies that provide students with visual tools to organize and record their prior knowledge, their on-going questions, and evidence-based progress toward deeper scientific understanding. Teachers may wish to tweak or combine the elements to customize a tool for their particular students.

“A coherent and consistent approach throughout grades K-12 is key to realizing the vision for science and engineering education embodied in the framework: that students, over multiple years of school, actively engage in science and engineering practices and apply conceptualizing concepts to deepen their understanding of each field’s disciplinary core ideas.”

Science is “...fundamentally a social enterprise, and scientific knowledge advances through collaboration and in the context of a social system with well-developed norms...”

National Research Council, 2012
Every state, in response to new or emerging state standards and frameworks in math, English Language Arts and literacy, science, and social studies, is recognizing the timely need to revisit existing curricular, instructional, and assessment priorities and policies. Each set of standards emphasizes the critical role of developing the following career and college ready skills to facilitate literacy and disciplinary learning across all grade levels, among them:

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**LINK for FULL REPORT**
Applying literacy practices in science instruction does **not** contribute to students’ science learning unless students...

Do, Speak, Listen, Talk
Literacy for science

Science as an “invitation” to engage in literacy practices.
Vocabulary is meaningless out of context.
Literacy in science is MORE than reading non-fiction.
  • Talking, writing, drawing
  • Data collection and visualization (e.g., graphs and data tables)
Construction explanations from evidence provides opportunities for sensemaking and language development.
Literacy for science every day throughout the day!
Thank you!

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