Phenomenal Science Core Principles

The Phenomenal Science Units are founded on research-backed beliefs about the process by which students construct their understanding of science. These beliefs and values underlie our instruction and curriculum development in the form of Core Principles. Here are the PS Core Principles in summary:

1. **Phenomena-Based Engagement**: In every instructional cycle, students encounter a puzzling event that really happens and are challenged to explain it. They develop their own explanation through intentional application of the Science and Engineering Practices, building understanding of core ideas, and consideration of the phenomena through the lens of a particular cross-cutting science concept. Through this active engagement, students must develop their own concept of the scientific phenomena under investigation.
   a. **Evidence is the heart of the scientific enterprise**. Students generate evidence and analyze patterns in data that help to construct scientific explanations around key questions.
   b. **Science Driven Integration of content areas** allows for a synergy that leads to greater understanding in all content areas. Students who read and write about science phenomena after engaging in hands-on investigation of the phenomena, have much greater understanding about both the phenomena and what they read or write about it. The Michigan Department of Education has identified the new science standards as an opportunity for [Supporting Early Literacy Development](#) and that science is an ideal vehicle for this integration.

2. **Student Centered / Student Driven** – Instruction begins with the student’s ideas and understanding and follows the growth of the student throughout the instructional cycle.
   a. It’s critical to **elicit prior knowledge** as a unit or lesson begins.
   b. **Key questions** about Real World Phenomena should be student focused and drive student explorations and investigations.
   c. **Assessment** of knowledge, skill, and reasoning should involve students throughout the learning process and be well aligned to the main objectives and activities of the unit.

3. **Students discover and develop concepts through inquiry**
   a. **Activity Before Concept** – Student inquiry-based explorations which give personal experience with phenomena and ideas should precede a presentation of science ideas.
   b. **Concept Before Vocabulary** – Attaching science vocabulary to concepts developed by student investigations yields more success than beginning a unit or lesson with a list of science vocabulary.
   c. **Application** of the ideas to explain phenomena and / or engineer solutions provides review, extends understanding, and reveals relevance of important ideas.
      i. Inquiry Model of Instruction

4. **Understanding is Constructed Socially** through discourse and processing activities.
   a. **Talk, argument and writing** are central to scientific practice and are among the most important activities that develop understanding.
   b. Development of a healthy **Classroom Culture** by setting classroom norms and teaching students how to engage in productive discourse is vital to engaging students science discourse for deep science learning.
Phenomenal Science Key Instructional Strategies

The following Key Instructional Strategies are supported by the Core Principles of Phenomenal Science. They are powerful teaching strategies because they engage students in constructing their own understanding about science phenomena.

**Doing Science to Learn Science** While actively engaged in practicing science process to learn content and build conceptual understanding, students are developing understanding of science as a way to solve problems and make sense of the world.

- **Anchoring Phenomena** Engaging learners in constructing their understanding of real puzzling phenomena causes them to build understanding in all three dimensions.

- **Multiple Iterations** Students require more than one opportunity to construct understanding of a phenomena. Revising their thinking becomes a natural part of the process and is a necessary step to learning.

- **Investigations** Hands on explorations of phenomena are critical for concrete elementary thinkers to develop their ideas. Investigations in Phenomenal Science are not intended to be “cookbook labs” in which students confirm understanding or get cookie-cutter results. Instead they strive to be more open-ended and enable students to gather evidence toward building understanding of the anchoring phenomenon.

- **Modeling** Engaging students in developing, using, and revising their own models is critical to developing their understanding of science concepts.

- **Summary Tables** Sometimes used in the form of “KLEWS Charts,” these tools allow a class to gather evidence over multiple investigations and iterations of the same phenomenon over the course of an Instructional Cycle. They will be posted in the class and may also be tracked in notebooks.

- **Scientific Method vs Methods of Scientists** Because it is our intention to engage students in developing understanding of phenomena the way scientists do, Phenomenal Science does not incorporate a specific step-by-step version of the scientific method. Rather, particular skills are introduced and applied as needed.

- **Science-Driven Integration of ELA / Math / Technology** What we find is that students understanding when developed in this synergistic way, is greater in ALL subjects than it would be in just spending more time on those subjects. As a result, Phenomenal Science has been very intentional about integrating speaking, listening, reading, writing, and math around real science, technology, and engineering experiences.

- **Exploration Stations** Also called Science Centers or Science Tables, these stations are employed in several Phenomenal Science units and can be incorporated into a regular rotation of learning centers. This is typically an opportunity for students to have more hands-on engagement with investigations, or more independent investigations of related phenomena.
Evidence-Based Thinking Making Thinking Visible / Audible Throughout each cycle, particularly while engaged in the Science and Engineering Practices, students will make their thinking visible to the teacher and especially for peers. Using these strategies, students are making their thinking visible / audible to build the teacher-student feedback loop.

Science Notebooking It is recommended that teachers require students to use an interactive science notebook to support learning in this unit. A major goal of a science notebook is for students to develop the ability to collect data, make sense of them and share with others.

Class Question Maps Also called “Driving Question Boards,” these are a tool for gathering students questions and co-developed answers to them. They are posted in the classroom and sometimes also captured in notebooks.

Collaborative Groups Because students generate their understanding through processing experiences and within social settings, collaborative groups are a key instructional strategy within Phenomenal Science.

Evidence-Based Investigations / Talk / Writing All discourse, visible thinking and student writing should be based on evidence that students have generated or gathered. Written evidence should be gathered in student notebooks when informal.

Explanatory and Argumentative Speaking and Writing Both explanatory and argument speaking and writing are critical to building deep understanding of concepts. They work together but are still distinctly different. Many informal opportunities are embedded in the units such as in discourse, spoken prompts for collaborative groups, and written notebook jots. More formal examples tend to occur toward the end of instructional cycles and units. These are also key areas for integration with language arts.

Science Discourse / Talk Moves Students build science understanding of concepts through processing of hands on investigations and activities. Their first mode of processing is talk.

Concept Maps Through use of concept maps as a processing tool, students can track their thinking and revise understanding in notebooks and together in collaborative groups.