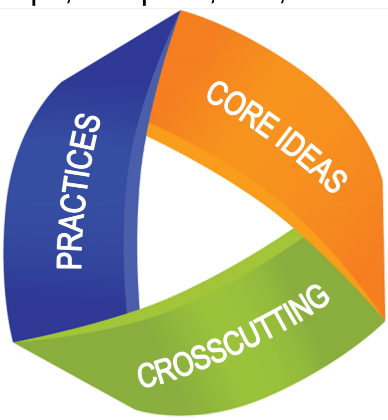
## MND + NGSS: 3D Learning through Earth Science Phenomena

MND recognizes that teaching science is about helping students make sense of the world around them, not memorizing facts and principles. MND makes teaching Earth Science easier (and more interesting) by organizing NASA data with the phenomena that they support. By providing these data, in the forms of maps, line plots, etc., students develop models to explain or predict the phenomena




using evidence.

Phenomena are the context for learning science. These are naturally occurring events that are used by teachers as opportunities to have students observe, ponder, inquire, explain, and predict using scientific evidence. For more information on the use of phenomena, see the link.

To check out the MND resources related to the 3 Dimensions of the Next Generation Science Standards, check out the following links:

## Science and Engineering Practices

**Asking Questions and Defining Problems**

- A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested.

**Developing and Using Models**

- A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations.

**Planning and Carrying Out Investigations**

- Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters.

**Analyzing and Interpreting Data**

- Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large datasets much easier, providing secondary sources for analysis.

**Using Mathematics and Computational Thinking**

- In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships.

**Constructing Explanations and Designing Solutions**

- The products of science are explanations and the products of engineering are solutions.

**Engaging in Argument from Evidence**

- Argumentation is the process by which explanations and solutions are reached.

**Obtaining, Evaluating, and Communicating Information**

- Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity.

## Crosscutting Concepts

**Patterns:**

- Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

**Cause and effect: Mechanism and explanation:**

- Events have causes, sometimes simple, sometimes multi-faceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

**Scale, proportion, and quantity:**

- In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

**Systems and system models:**

- Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

**Energy and matter:**

- *Flows, cycles, and conservation.* Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

**Structure and function:**

- The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

**Stability and change:**

- For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

## Disciplinary Core Ideas

ESS: Earth and Space Science

- **ESS1: Earth's Place in the Universe**
  - ESS1.A: The Universe and Its Stars
  - ESS1.B: Earth and the Solar System
  - ESS1.C: The History of Planet Earth
- **ESS2: Earth's Systems**
  - ESS2.A: Earth Materials and Systems
  - ESS2.B: Plate Tectonics and Large-Scale System Interactions
  - ESS2.C: The Roles of Water in Earth's Surface Processes
  - ESS2.D: Weather and Climate
  - ESS2.E: Biogeology
- **ESS3: Earth and Human Activity**
  - ESS3.A: Natural Resources
  - ESS3.B: Natural Hazards
  - ESS3.C: Human Impacts on Earth Systems
  - ESS3.D: Global Climate Change