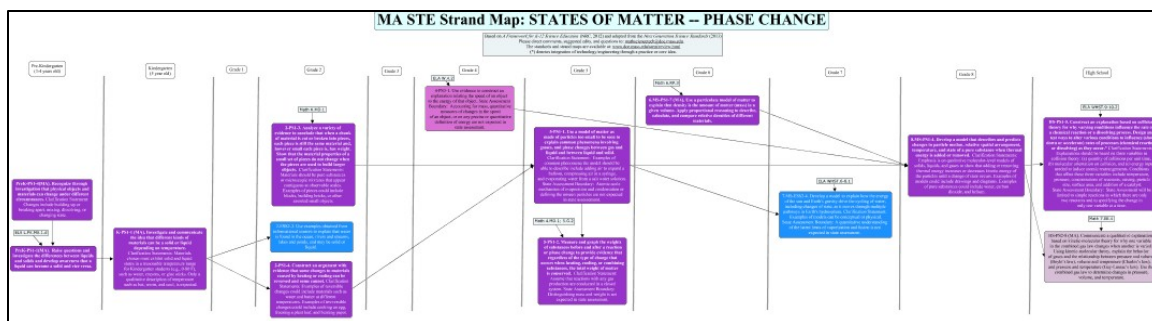

Appendix IV

Strand Maps of Science and Technology/Engineering Standards

The standards reflect coherent progressions of learning that support the development of core ideas across grades. This makes it useful to visualize how concepts progress across grade spans and are related across disciplines when planning and aligning curricula (horizontally and vertically).

Strand maps are designed for this purpose. Learning is facilitated when new and existing knowledge is structured around core ideas rather than discrete bits of information. The strand maps show the conceptual relationship between concepts in standards within and across grades.



Sample STE strand map showing linked concepts from pre-K (left) to high school (right)

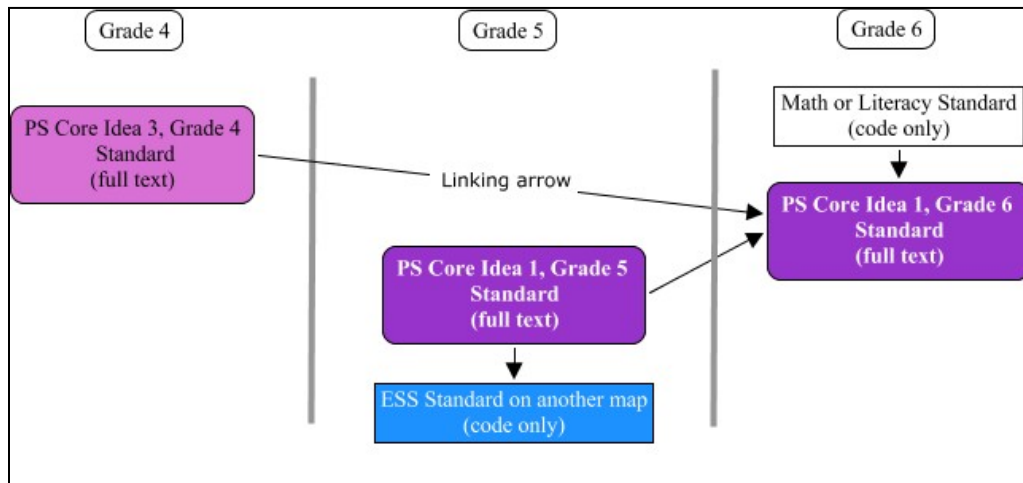
Individual teachers can use strand maps to identify concepts that should be the focus of pre-assessment, to convey to students how the standard they are learning will contribute to future learning, and to cluster standards into effective units of study. Schools and districts have found strand maps to be particularly useful in vertical team meetings, curriculum mapping workshops, and interdisciplinary meetings. Planning an STE curriculum at any grade level is most effective when it is known what students have already been taught and what they will learn in subsequent years.

Features of Strand Maps

The strand maps are presented by discipline (e.g., life science, physical science) and grade span (pre-K–5, middle and high school). Each discipline is identified by a thematic set of color-coded standards (e.g., Earth and space science is a blue scheme) and each core idea is a consistent color. Please note that pre-K–5 physical science includes technology/engineering and high school physical science includes both introductory physics and chemistry. Topical examples (e.g., weather and climate, states of matter and phase change) illustrate how concepts relevant to a particular topic relate across disciplines and progress across grades.

Each strand map includes the full standards in individual cells, organized by the grade level or course and color coded by discipline and core idea. Arrows link certain standards, highlighting how concepts within particular standards are related and progress. An arrow leaving a standard implies that the concept is fundamental to learning the concept of the next/connected standard—it would be difficult to learn the next standard without knowing the previous/connected standard(s). In addition to links among science standards, links from mathematics and English language arts standards are also included in clear cells. Again, their inclusion implies that fluency with those standards is an important contributor to learning the

linked science standards. While the full STE standard is included in each cell of the strand maps, the mathematics and literacy standards are only indicated with their codes. The key below provides an overview of the structure of the strand maps.



Key showing the basic structure and components of an STE strand map.

The linking arrows do not represent connections or progressions of practices in the standards, only concepts. Nor is there any particular research that suggests particular arrows are fixed or true; the linking arrows reflect professional judgment by informed and experienced STE educators and researchers.

The strand maps only represent *conceptual* connections and progressions across grades. For those developing curricula or asking students to develop concept maps for particular topics or core ideas, there would be many more possible connections between standards. The main idea of the strand maps is to show how ideas and understanding develop over time, to visualize what contributes to a student learning any particular standard and how that enables progressions of learning over time.

Accessing STE Strand Maps

The maps can be accessed on the Department's website in several formats:

- A one-page (PDF) document useful for viewing electronically (zoom in several hundred percent).
- A multipage (PDF) document useful for printing (cut off selected edges, then tape together).
- The original CMapTools file useful for manipulating or changing the strand maps; any map can be printed at desired scale from within the application (download free CMapTools from cmap.ihmc.us/Download).

The strand maps may be updated periodically or additional topic maps may be added. Please provide input, share maps you have created, or comment on how you have used them by emailing mathsciencetech@doe.mass.edu.