Summary of the Mini Materials Demo Kit lessons and the inclusion of Next Generation Science Standards (NGSS)

The framework of the NGSS is three-dimensional and includes core ideas (physical sciences, engineering technology, etc.) crosscutting concepts, and practices.

- This document breaks down each lesson of the Mini Materials Demo Kit in terms of the NGSS and provides a short description of how each applicable standard could be applied to the lesson.
- Also included is a list of crosscutting concepts and science and engineering practices. Since these are generally considered applicable for all the lessons, they are not repeated in each lesson subsection.
- The focus audience of the kit is elementary school to middle school (1^{st} through 8^{th} grade). Only standards at these grade levels, therefore, will be discussed.

Crosscutting concepts

- Patterns
- Cause and effect/mechanism and explanation
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter flows, cycles, and conservation
- Structure and function
- Stability and change

Science and Engineering Practices

- Asking questions and defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Lessons from the Mini Materials Demo Kit

Aluminum Nails

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

-The experiment instructs students to empirically collect evidence of material properties and performance. The text complements this by explaining the differences in processing. More information may be found on texts describing dislocations in crystal structures, recovery, annealing, etc.

Fiber Optics

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

-The experiment demonstrates that the cladding of the fiber internally reflects light waves as they travel through the 'cable,' only to emit the light from the end of the fiber. From a broader perspective, the lesson addresses technologies for large-scale information transfer.

Fluorescence

4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

-The experiment shows students that the provided glass objects absorb ambient light and fluoresce various colors in the dark (e.g., the electrons absorb electromagnetic waves of particular wavelengths and emit waves of different wavelengths). The lesson also addresses the technological applications of this mechanisms, such as computer monitors and medical imaging equipment.

Glass Fibers

MS-PS1-4 Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

- The experiment itself can be a model showing what happens when the structure of a material changes with varying temperatures.

Glass Fibers (continued)

- MS-PS3-4 Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
  - Discuss how the structure of candy changes to a more liquid-like state when hot (atoms are more mobile due to higher energy input) and then becomes glass-like (brittle) when cooled quickly.

Magic Color Beads and UV 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.

-Students will observe the effects of various light conditions and material treatments (e.g., application of sunscreen) on the color and brightness of the beads when observed in the dark. (The beads differ slightly in chemical composition and thus absorb and emit different wavelengths of light. For more information, see lesson on fluorescence.)

Shape Memory Alloy

1. MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures.
   - This lesson discusses the unit cell of two different phases of Nitinol which, when repeated, creates the bulk structure.
2. PS1.A Structure and Properties of Matter
   - This lesson also explains how the change in crystallographic structure causes the shape-memory properties.
3. HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
   - This lesson shows that the arrangement of atoms, which defines the phase of the material, corresponds to different material properties.

Silly Putty

PS1.A Structure and Properties of Matter

- The basic concept of this experiment is to analyze how the structure of the silly putty affects its behavior under various loading conditions.

The Ceramic and Glass Industry Foundation, building on lessons developed by Dr. Mary Reidmeyer of Missouri University of Science & Technology, is pleased to offer you the Mini Materials Demo Kit, a collection of seven easy demonstrations for use practically anywhere by parents, teachers, and students who are utilizing online and at-home teaching resources.

You may want to review our larger Materials Science Classroom Kit, which was developed for 7th-12 grades. Fun, hands-on lessons and labs introduce students to the four basic classes of materials: ceramics, composites, metals, and polymers. Also included with the kit is the widely respected book, *The Magic of Ceramics*.

The nine demonstrations and lab activities comply with Next Generation Science Standards and the kit is highly regarded as the best of its kind.

We also offer numerous resources that are free to download, including the lessons contained in the Materials Science Classroom Kit, study guides for *The Magic of Ceramics*, and informative classroom posters on different aspects of the science of ceramics.

There is a multitude of additional and interesting resources on materials science, as well as glass and ceramics science, on our Ceramics are Cool! web pages.

If you have any questions or comments, please contact us at:

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