

## Educational Standards within the Nanoworld

As your students investigate the *Exploring the Nanoworld* kit, you will find that most of the materials and properties you discuss with them will have relevance to their daily lives. Use this familiarity to foster interest in further explorations. Have students take the activities, expand upon them, and question them. There is no limit to what they may find. After all this is the way new technology and understanding is typically generated. Learning science is something students do, not something that is done to them. New developments and advancements would not be possible without curiosity and perseverance.

In addition to promoting enthusiasm for science and technology, the activities in this booklet correspond to a number of the National Science Education Standards (NSES) for science teaching, assessment in science education, and science content. Some of these science standards are listed below and correlate with booklet activities. This list is neither meant to be restrictive nor exhaustive but simply to serve as a guide.

### Science Teaching Standards

Teachers of science plan an inquiry-based science program for their students.

- Teachers select materials based on science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experience of students.

**Memory Metal:** Exploring the Nanoworld, Investigations 1-5; and Experiment 1

**X-Ray Diffraction & SPM:** Investigations 1-3; and Activity 1

**LEDs:** Demonstrations 1-4; Investigations 1-2; and Experiment 1

**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1

- These materials reflect teaching and assessment strategies that support the development of student understanding and nurture a community of science learners.

**Memory Metal:** Exploring the Nanoworld, Investigations 1-5; and Experiment 1

**X-Ray Diffraction & SPM:** Investigations 1-3; Activity 1, and X-Ray Review Questions

**LEDs:** Demonstrations 1-4; Investigations 1-2; Experiment 1, and LED Review Questions

**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1

Teachers of science guide and facilitate learning.

- Activities/demonstrations focus and support inquiries while teachers interact with students.

**Memory Metals:** Investigations 1, 3-5; and Experiment 1

**X-Ray diffraction & SPM:** Investigations 1-3

**LEDs:** Demonstrations 1-4; and Experiment 1

**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1

- Teachers as well as these activities promote discourse among students about scientific ideas.

**Memory Metals:** Investigations 1-5; and Experiment 1

**X-Ray Diffraction & SPM:** Investigations 1-2; Activity 1, and X-Ray Review Questions

**LEDs:** Demonstrations 1-2, 4; Investigations 1-2; Experiment 1, and LED Review Questions

**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1

- Teachers can use these materials to challenge students to accept and share responsibility for their own learning.

**Memory Metal:** Exploring the Nanoworld, Investigations 2-3; and Experiment 1

**X-Ray Diffraction & SPM:** Investigations 1-2; Activity 1, X-Ray Review Questions, and X-Ray Diffraction & SPM Assessment

**LEDs:** Demonstrations 2-3; Investigation 1-2; Experiment 1, LED Review Questions, and LED Assessment

**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1

- Utilizing these materials, teachers can encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterizes science.

**Memory Metal:** Exploring the Nanoworld, Investigations 1, 3-4; and Experiment 1

**X-Ray Diffraction & SPM:** Investigations 1, 3

**LEDs:** Demonstrations 1-4; Investigation 1, and Experiment 1

**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1

Teachers of science engage in ongoing assessment of their teaching and of student learning.

- Teachers are to use multiple methods of gathering data, regarding student understanding and ability as they use this booklet.

**Memory Metal/X-Ray Diffraction & SPM/LEDs/Ferrofluids:**

All Activities

Teachers of science develop communities of science learners that reflect the intellectual rigor of scientific inquiry and the attitudes and social values conducive to science learning.

- Through the activities and labs, students have a significant voice in decisions about the content and context of their work and must take responsibility for the learning of all members of the classroom community.

**Memory Metal:** Investigations 1-2; and Experiment 1

**X-ray Diffraction & SPM:** Investigations 2-3; and Activity 1

**LEDs:** Demonstrations 1, 3; Investigation 2, and Experiment 1

**Ferrofluids:** Investigation 1-2, and Experiment 1

- These materials nurture collaboration among students.  
**Memory Metal:** Exploring the Nanoworld, Investigations 1-5; and Experiment 1  
**X-Ray Diffraction & SPM:** Investigations 1-2; Activity 1, and X-Ray Review Questions  
**LEDs:** Demonstration 4, Investigations 1-2; Experiment 1, and LED Review Questions  
**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1

## Assessment in Science Education

Assessments must be consistent with the decisions they are designed to inform.

- Assessments are deliberately designed and have explicit purposes.  
**Memory Metal/ X-Ray Diffraction & SPM/LEDs/Ferrofluids:**  
 All Assessments

Assessment practices must be fair.

- These assessment tasks are set in a variety of contexts, are engaging to students with different interests and experiences, and do not assume the perspective or experience of a particular gender, racial, or ethnic group.  
**Memory Metal/ X-Ray Diffraction & SPM/LEDs/Ferrofluids:**  
 All Assessments

## Science Content Standards

Science as inquiry.

- These activities/demonstrations engage students in inquiry, which helps students develop an understanding of scientific concepts, an appreciation of “how we know” what we know in science, an understanding of the nature of science, skills necessary to become independent inquirers about the natural world, and the dispositions to use the skills, abilities, and attitudes associated with science.  
**Memory Metal/ X-Ray Diffraction & SPM/LEDs/Ferrofluids:**  
 All Activities, except each assessment

Physical Science

- Materials covered throughout this booklet help students understand the structure and properties of matter, chemical reactions, motions and forces, conservation of energy, increases in disorder, and interactions between energy and matter.  
**Memory Metal/ X-Ray Diffraction & SPM/LEDs/Ferrofluids:**  
 All activities

## Science and Technology

- Most tasks establish connections between the natural and designed worlds.  
**Memory Metals:** Exploring the Nanoworld and Investigations 1-4  
**X-Ray Diffraction & SPM:** Investigations 2-3; and Activity 1  
**LEDs:** Demonstrations 1, 3-4; Investigations 1-2; and Experiment 1  
**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1
- They provide students with opportunities to develop decision-making skills.  
**Memory Metals:** Investigations 1-5; Experiment 1, and Memory Metal Assessment  
**X-Ray Diffraction & SPM:** All activities  
**LEDs:** Demonstrations 1, 3; Investigation 2, Experiment 1, LED Review Questions, and LED Assessment  
**Ferrofluids:** Investigation 1-2, and Experiment 1
- By utilizing these materials, students will develop abilities to identify and state a problem, design a solution, implement the solution, and evaluate the solution.  
**Memory Metal:** Experiment 1  
**X-ray Diffraction & SPM:** Investigation 3 and X-Ray Diffraction & SPM Assessment  
**LEDs:** Experiment 1 and LED Assessment  
**Ferrofluids:** Experiment 1 and Ferrofluid Assessment

## Science in personal and social perspectives

- By using common materials existing in students' lives, students have a chance to understand how these materials work and how they directly influence their lives through decisions made about science and technology.  
**Memory Metal:** Exploring the Nanoworld and Investigations 1, 3-5;  
**X-Ray Diffraction & SPM:** Investigation 1  
**LEDs:** Demonstrations 3-4; and Investigations 1-2  
**Ferrofluids:** Demonstration 1 and Investigation 1
- Social and personal perspectives are brought to the foreground.  
**Memory Metals:** Exploring the Nanoworld, Investigations 1, 5; and Experiment 1
- Students will develop a foundation on which to base decisions they will make as citizens.  
**Memory Metal:** Exploring the Nanoworld, Investigations 3-4; and Experiment 1  
**X-Ray Diffraction & SPM:** Investigations 1-3; and Activity 1  
**LEDs:** Demonstrations 1-4; and Investigation 2  
**Ferrofluids:** Demonstration 1, Investigation 1-2, and Experiment 1
- Science and technology in local, national, and global settings will be discussed.  
**Memory Metal:** Exploring the Nanoworld  
**X-Ray Diffraction & SPM:** Investigations 1-3; and Activity 1  
**LEDs:** Demonstration 3 and Investigation 2  
**Ferrofluids:** Demonstration 1 and Investigation 1

## History and nature of science

- Students will have the opportunity to experience science as an ongoing, changing enterprise.  
**Memory Metal:** Exploring the Nanoworld and Investigations 1, 5  
**X-Ray Diffraction & SPM:** Investigations 2-3  
**LEDs:** Demonstration 3 and Investigation 2  
**Ferrofluids:** Investigation 1 and Experiment 1
- Human aspects of science and the role that science plays in the development of various cultures will become clearer as these materials are used to learn about scientific concepts.  
**Memory Metal:** Exploring the Nanoworld and Investigations 3-4  
**X-Ray Diffraction & SPM:** Investigations 1-3  
**LEDs:** Demonstration 3  
**Ferrofluids:** Investigation 1-2, and Experiment 1

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