

# Standard 1—Analysis, Inquiry, and Design

Elementary

## Mathematical Analysis

**1. Abstraction and symbolic representation are used to communicate mathematically.**

**Students:**

- use special mathematical notation and symbolism to communicate in mathematics and to compare and describe quantities, express relationships, and relate mathematics to their immediate environments.

*This is evident, for example, when students:*

- ▲ describe their ages as an inequality such as  $7 < \square < 10$ .

**2. Deductive and inductive reasoning are used to reach mathematical conclusions.**

**Students:**

- use simple logical reasoning to develop conclusions, recognizing that patterns and relationships present in the environment assist them in reaching these conclusions.

**3. Critical thinking skills are used in the solution of mathematical problems.**

**Students:**

- explore and solve problems generated from school, home, and community situations, using concrete objects or manipulative materials when possible.

## Scientific Inquiry

**1. The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing, creative process.**

**Students:**

- ask “why” questions in attempts to seek greater understanding concerning objects and events they have observed and heard about.
- question the explanations they hear from others and read about, seeking clarification and comparing them with their own observations and understandings.
- develop relationships among observations to construct descriptions of objects and events and to form their own tentative explanations of what they have observed.

*This is evident, for example, when students:*

- ▲ observe a variety of objects that either sink or float when placed in a container of water.\* Working in groups, they propose an explanation of why objects sink or float. After sharing and discussing their proposed explanation, they refine it and submit it for assessment. The explanation is rated on clarity and plausibility.

**2. Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity.**

**Students:**

- develop written plans for exploring phenomena or for evaluating explanations guided by questions or proposed explanations they have helped formulate.
- share their research plans with others and revise them based on their suggestions.
- carry out their plans for exploring phenomena through direct observation and through the use of simple instruments that permit measurements of quantities (e.g., length, mass, volume, temperature, and time).

*This is evident, for example, when students:*

- ▲ are asked to develop a way of testing their explanation of why objects sink or float when placed in a container of water.\* They tell what procedures and materials they will use and indicate what results will support their explanation. Their plan is critiqued by others, they revise it, and submit it for assessment. The plan is rated on clarity, soundness in addressing the issue, and feasibility. After the teacher suggests modifications, the plan is carried out.

Key ideas are identified by numbers (1).  
Performance indicators are identified by bullets (•).  
Sample tasks are identified by triangles (▲).

**Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.**

## Engineering Design

**3. The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into phenomena.**

**Students:**

- **organize observations and measurements of objects and events through classification and the preparation of simple charts and tables.**
- **interpret organized observations and measurements, recognizing simple patterns, sequences, and relationships.**
- **share their findings with others and actively seek their interpretations and ideas.**
- **adjust their explanations and understandings of objects and events based on their findings and new ideas.**

*This is evident, for example, when students:*

- ▲ **prepare tables or other representations of their observations and look for evidence which supports or refutes their explanation of *why objects sink or float when placed in a container of water.***\* After sharing and discussing their results with other groups, they prepare a brief research report that includes methods, findings, and conclusions. The report is rated on its clarity, care in carrying out the plan, and presentation of evidence supporting the conclusions.

**1. Engineering design is an iterative process involving modeling and optimization finding the best solution within given constraints which is used to develop technological solutions to problems within given constraints.**

**Students engage in the following steps in a design process:**

- **describe objects, imaginary or real, that might be modeled or made differently and suggest ways in which the objects can be changed, fixed, or improved.**
- **investigate prior solutions and ideas from books, magazines, family, friends, neighbors, and community members.**
- **generate ideas for possible solutions, individually and through group activity; apply age-appropriate mathematics and science skills; evaluate the ideas and determine the best solution; and explain reasons for the choices.**
- **plan and build, under supervision, a model of the solution using familiar materials, processes, and hand tools.**
- **discuss how best to test the solution; perform the test under teacher supervision; record and portray results through numerical and graphic means; discuss orally why things worked or didn't work; and summarize results in writing, suggesting ways to make the solution better.**

*This is evident, for example, when students:*

- ▲ **read a story called *Humpty's Big Day* wherein the readers visit the place where Humpty Dumpty had his accident, and are asked to design and model a way to get to the top of the wall and down again safely.**
- ▲ **generate, draw, and model ideas for a space station that includes a pleasant living and working environment.**
- ▲ **design and model footwear that they could use to walk on a cold, sandy surface.**

\* A variety of content-specific items can be substituted for the italicized text