

Science

Accomplished teachers understand that an education in the sciences helps students develop scientific habits of mind while gaining the knowledge and skills necessary to become scientifically literate. They realize that scientists and children use inquiry-based processes to discover and construct meaning. They foster the innate curiosity that children possess to help them become inventive, reflective, and skeptical thinkers, open to new ideas and willing to experiment and take risks.

Accomplished teachers know the four domains of science and introduce their students to these domains based on their curricula: earth and space science, life science, physical science, and engineering and technology. They know that a synergy exists between these domains and that engineering is the application of scientific knowledge to solve problems. When designing activities to help students understand these domains, middle childhood generalists teach concepts that appear across them—pattern, similarity and diversity; cause and effect; scale, proportion and quantity; systems and system models; energy and matter; form and function; and stability and change. Teachers integrate domains and concepts to help students develop a comprehensive understanding of science.

Knowledge of science enables accomplished teachers to encourage students to observe, generate questions, predict, explore, experiment, discuss ideas, interpret data, and draw conclusions around fundamental scientific concepts. As students design and perform experiments, they may employ problem-solving, critical thinking, and mathematical and measurement skills; they may also use computation, graphing, data collection and recording skills, tools and technology, oral speaking, writing, collaboration, and research skills. For instance, to understand the concept that air contains water molecules, students might perform an investigation to discover why the outside of a cold container shows water droplets when placed in a warmer environment. These experiences allow teachers to address misconceptions and help students better understand natural phenomena.

Accomplished teachers capitalize on students' prior knowledge as they design a rich array of open-ended experiences that integrate knowledge and practice and allow students to engage in cognitive, social, and physical practices, to formulate critical questions, and to follow their interests. For example, an accomplished teacher might guide students in designing an experiment to discover if light refracts when moving from one medium to another. Through experimentation, the teacher facilitates student understanding of refraction and how to observe and record results. The teacher purposefully plans instruction that leads students to discover unifying concepts and generate questions for further experimentation. Accomplished teachers know that “doing science” is not limited to direct experimentation but also includes sharing ideas with peers through discourse, using content-specific vocabulary, and developing representations of phenomena.

Accomplished teachers understand that science is a collaborative exchange. Throughout classroom activities, teachers model how to use scientific and mathematical language appropriately and measure students' ability to do so. They facilitate the appropriate use of scientific vocabulary in discourse and argumentation. Students collaborate as they experiment and share problem statements, observations, and conclusions. They also learn to participate in scientific discussions, to adopt a critical stance while respecting the contributions of others, and to be willing to ask questions and revise opinions.

Accomplished teachers help students use texts to become scientifically literate, to increase scientific knowledge, and to improve language art skills. Teachers assess students' learning as they listen and participate in discussions between and among groups of students. They may also evaluate students' understanding of science and engineering as they review students' work such as journal entries, lab reports, physical models, and responses to assessments. Teachers recognize that providing prompt feedback is essential to fostering and expanding students' thinking and facilitating further investigation. They are aware of students' preconceptions and misconceptions. When these arise, teachers respond in a timely manner to guide students to experiences that will help them correct their misunderstandings. Teachers help students understand that scientific thinking has changed over time and that scientific knowledge will continue to change. (See [Standard V—Instructional Decision Making](#).)

Accomplished teachers provide a balance of factual information and hands-on experiences to nurture a greater understanding of science and engineering. They teach students to use tools such as microscopes, rulers, computers, and graduated cylinders in the process of doing science. Teachers know that creating representational models such as pictures, diagrams, physical models, mathematical models, or computer simulations can help students refine their mental models and thereby internalize scientific concepts and build meaning. For example, a teacher might help students understand scale better by relating familiar objects such as marbles, pinheads, and balls to objects in the solar system. The teacher could then have students pace the relative distance of each planet to the sun. Accomplished teachers know that the use of models allows students to participate in rich discourse, refine their thinking, and solve problems.

Accomplished teachers help students connect earth, life, and physical science concepts and processes to real-life applications. They may use technology to research connections between and among disciplines, recruit speakers, plan virtual or actual field trips, enlist the support of families and community members, or provide other experiences that allow science learning to come alive for their students. They look for opportunities to expose children to career options in science as well. For example, when students are designing experiments to discover how plants grow in different light conditions, an accomplished teacher might invite family or community members to share how they use their knowledge of plants as they experiment and create hybrid varieties.

Accomplished teachers understand the similarities and differences between engineering design and scientific inquiry. They show their students that technology and engineering employ scientific principles to create products and processes that meet human and environmental needs. For example, when discussing reliance on the limited supply of fossil fuels, students may employ the design process to develop innovative ways to address the problem. Accomplished teachers are resourceful and mindful of environmental issues. They are adept at creating learning experiences that show students their dependence on, and relationship with, their communities and the natural environment. For instance, they may have students investigate changing air and water quality and create solutions to problems based on inquiry and the use of critical thinking skills. Teachers help students investigate, understand, and learn about community and environmental stewardship.

Using their knowledge of child development as well as an understanding of content in all curriculum areas, middle childhood generalists employ many strategies and techniques to facilitate scientific learning. Experiences such as these not only tap into students' natural curiosity of the world and how it works, but also help these future stewards of the natural and technological world explore, understand, and contribute meaningful ideas and advancements.