Standard II
Knowledge of Science

Accomplished science teachers have comprehensive understandings of the nature of science, inquiry, and natural phenomena.

Introduction

Accomplished science teachers realize that the goal of science education is to cultivate scientifically literate adults, and they know that productive learning is structured around knowledge of the nature of science, the process of inquiry, the context of science, and science content.

The Nature of Science

Accomplished science teachers know that scientific thought is multifaceted and that science is a way of knowing about natural phenomena. Science educators have identified a core set of concepts that express the nature of science: science is reliable and yet tentative; science is based on empirical evidence; science relies on observations and inferences; science utilizes theories and laws; scientific knowledge is generated through multiple methods; science is a creative and imaginative human endeavor; and science is a human activity that takes place within a cultural, political, and economic context.

Accomplished science teachers understand science as an expression of the deep human impulse to explore and learn ever more about natural phenomena. Teachers have a thorough grasp of science as a sense-making activity, that is, an approach to building a consistent, testable set of understandings about natural phenomena. Accomplished teachers are aware of the many complex ways in which scientific knowledge is generated, such as through experiments, correlational studies, and observations; they understand that there is no simple scientific method through which all scientific understanding is achieved. Accomplished teachers know how to apply scientific understandings to engineering practices. They also know how to help their students develop an understanding of the nature of science and to use this understanding to make informed decisions in their daily life.

Accomplished science teachers realize that in order for students to understand the nature of science, students need to engage in hands-on investigations. However, teachers also know that students do not develop an understanding of the nature of science through investigations alone; they require explicit instruction. For example, through an investigation of a pendulum, an accomplished teacher might illustrate
how scientific knowledge is built on empirical evidence. The teacher would help students understand how the observations they make of a specific pendulum can be used to create a general model that can be used to predict and describe the behavior of all pendulums. The teacher could subsequently provide opportunities for students to apply their model in order to discover its strengths and its limitations. (See Standard III—Curriculum and Instruction.)

Understandings about Inquiry

Accomplished science teachers understand that inquiry is important to science classrooms for two basic reasons. Inquiry is both the process scientists use to learn about natural phenomena and a process that students can use to develop their knowledge of science content and their metacognition related to the field of science. (See Standard III—Curriculum and Instruction.)

Accomplished science teachers understand that scientists use inquiry to learn about natural phenomena. Scientific inquiry involves making observations; posing questions; examining books and other sources of information to see what is already known about a given subject; planning investigations; using tools to gather, analyze, and interpret data; proposing answers, explanations, and predictions; and communicating results. Inquiry requires the identification of assumptions, the use of critical and logical thinking, and the analysis of alternative explanations. Inquiry must be undertaken with consideration for the ethics of the scientific process.

Accomplished science teachers provide students with multiple opportunities to engage in scientific practices, including inquiry. They teach students how to develop scientific questions, design and conduct investigations, obtain and analyze meaningful data, and arrive at conclusions. (See Standard III—Curriculum and Instruction.)

Accomplished science teachers know that their students need more than the ability to conduct scientific inquiry. Students need to possess a deep understanding about the capacity of scientific inquiry to generate knowledge, solve problems, answer questions, generate new questions, and enhance collaboration. Accomplished teachers facilitate the process through which students learn to combine their ability to conduct investigations, their understandings about scientific inquiry, and their critical thinking skills to further their own scientific understandings.

Context of Science

Accomplished teachers realize that there are many different lenses through which science can be viewed, including historical, personal, sociocultural, technological, and ethical perspectives.

Accomplished science teachers make sure that students develop a rich and diverse historical perspective on science in order to understand how science developed as a discipline. Teachers provide students with evidence that scientific understandings are continually built upon prior knowledge. Historically, scientific