Factors That Influence Your Science Teaching Philosophy

Focus Questions

- Why teach science to young students?
- Who are you, and how do you feel about science?
- What are your views of science and scientists?
- Who are your students?
- How can you help your students succeed in science?
The increasing number of students from diverse cultures entering U.S. schools, combined with the national goal of scientific literacy for all students, creates a major dilemma for teachers who belong to cultures that are very different from the immigrant cultures. Current research literature suggests that students from different cultures bring alternative ways of knowing, communicating, and experiencing the world, which may be incompatible with the way science is traditionally defined, taught in our schools, and addressed in the state and national standards. This book begins by examining equity and access issues that have a major impact on science teaching and learning. During this in-depth investigation and reflection, you examine the following questions:

- Why teach science to young students?
- Who are you, and how do you feel about science teaching?
- Who are your students?
- What are their lives like?
- How can you help your students succeed in science?

Concurrent with this process of discovery about yourself and your often subconscious expectations for all students, you also engage in an in-depth examination and reflection on your students and their lived experiences. The final self-reflection leads you to examine the question:

- How does knowing who you are and who your students are make you a better teacher?

Once you come to a better understanding about who you are and what culturally embedded issues your students bring to the classroom, you can move on to dealing with your scientific self and examining your views of science and scientists.

Throughout this book, you will find many reflective activities and be guided to collect many resources. Keep your reflections or entries in this book or in a journal and file any research that you do online in a folder that you can use for reference in your curriculum planning and development.
Why Teach Science to Young Students?

Teacher Activity: Initial Reflection

List three reasons why you should teach science to students in grades 3 through 5.

1. ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________

2. ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________

3. ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________

As we enter the era of global warming, decreased food supplies, and increased cost of energy, we become more aware of the importance of science and technology and the need to have our population capable of making decisions informed by scientific knowledge. At the same time, there is compelling evidence that only a small percentage of the students who pass through the school system develop any useful scientific literacy. We continue to produce graduates who lack even a basic understanding of science and technology, who have a negative attitude toward science, and who have not fully developed critical thinking skills capability. This paucity in science knowledge has increasingly unfortunate personal, social, and economic consequences, including the inability to take pleasure from the natural world, to make decisions that contribute to the sustainability of our environment, and to use science to inform decision-making processes. The increasing technological sophistication
of the work place will require, at least, a basic knowledge and skill in science, mathematics, and technology.

Personal and civic decisions are often better made if guided by scientific knowledge. For example:

- When states propose shipping their garbage to other states or to remote areas in the state, can residents offer a better alternative?
- As new diet fads wax and wane, how do people sort out the competing claims and choose a safe method of losing weight?
- As the cost of gasoline rises each day and energy consumption becomes more and more of an economic issue, how do people respond? What knowledge do they use to guide their decisions?

Scientific understanding alone may not suffice to guide such decisions, but its absence will likely lead to poor solutions.

In the past, it was believed that only a handful of top students had the capacity to learn science while the remaining students—those who are average and especially those who are poor, female, or in a minority group—are widely assumed to be incapable of learning the math required in science, too concrete of mind to grasp scientific abstractions, or unwilling to endure the rigors of science education.

There is ample evidence, however, that the problem is not the child, but instead that science is not being taught or is often taught in a way that progressively diminishes students’ interest in the subject and their confidence in their capacity to learn it. For many years, most elementary schools have taught only two subjects seriously—reading and mathematics—on the flawed assumption that this allows them to “leave no child behind.”

Even where students are also taught science, the nature of the content and the way it is presented often fail to engage students’ minds. Some elementary students are taught science as a series of fun experiments; others are offered “textbook” science, where they are taught facts and concepts but not given enough time and experience to connect those facts with the realities of the natural world or to grasp the underlying principles that make sense of it all. Thus, they quickly become bored by the seemingly pointless memorization of facts and terms. Not surprisingly, many students from all social classes and ethnic backgrounds decide that science is too boring and difficult. All children are capable of learning science and should have the opportunity to do so. Science provides them with a foundation for life as critical thinking adults who can contribute to the well-being of themselves and society.
When we consider the question “Why teach science?” it seems easy to answer in terms of the importance of science in society. We can immediately see the multitude of benefits from scientists’ research and technologists’ application in medicine, industry, transportation, agriculture, electronics, and technology. Think about what your day would be like if all of the scientific advances and applications that have been made in your lifetime alone were suddenly erased. How very different life would be without television, cell phones, or computers! You need to prepare your young students for a life full of technology, a type of life which has not yet been envisioned. You need to provide them with the skills to exist in that new world—a world in which critical thinkers and problem solvers will be the ones who survive and live successful lives.

The development of critical thinking skills has been emphasized as being of major importance if we want to produce rational thinkers and decision makers who can contribute to society. Great scientists are critical thinkers. The skills practiced by scientists help students become critical thinkers. Critical thinkers

- continually seek to know and to understand
- question all things
- interpret all available data
- base judgment on evidence
- respect logic
- consider consequences of their actions
- demonstrate intellectual independence

These critical life skills should be taught as part of science. For young students, their entire world is their laboratory; they continually seek to know, understand, and question all things. Though their efforts are often fumbling, students readily search for data and want verification. But what happens to their spirit of inquiry as they progress up the educational ladder? Why does the number of questions decrease? Perhaps part of the reason is a lack of opportunity to use scientific skills or thinking processes, so decline in curiosity sets in.

There is no better way to help students satisfy their wanting to know, their questioning and searching, than to allow them to interact with objects and events of the natural world. This is what is involved in their doing science, why it is so important to them, and why you should make it important in your teaching. As a teacher of young students, your major role is to foster and encourage this questioning, this unending curiosity.
Now that you have reflected on why you should teach science, let us turn to figuring out who you are and why you teach as you do.

**Teacher Activity: Reasons for Teaching Science**

Now that you have read and reflected on the above, give five reasons why you think you should teach science to young students

1. 

2. 

3. 

4. 

5. 

Now that you have reflected on why you should teach science, let us turn to figuring out who you are and why you teach as you do.

**Your Personal Context**

**Who Are You, and How Do You Feel about Science?**

In a recent survey conducted as part of their classroom observation, some of my graduate students examined the status of elementary science teaching in the schools in which they were currently student teaching. Their results lend support to the belief that they do not need to teach science when they have their own elementary classroom. Their results showed that 40 percent of classes observed had a cluster teacher who was responsible for teaching one to two science sessions per week, 25 percent of classes had teachers who did one to three science sessions per week, and 35 percent of classrooms had no science instruction. These kinds of results indicate that many teachers may be struggling with understanding that the classroom teacher must teach science as an essential
part of a well-rounded education that prepares students to be critical thinkers, problem solvers, and informed decision makers. These results mirror what is currently happening in elementary schools as teachers have mainly focused on mathematics and reading, the subjects that were being tested. However, with the recent introduction of science testing, there is more attempt to teach science in the classroom. To begin your journey of effective science teaching, you need to start with a clear idea as to where you position yourself in science teaching.

- What is the status of your current science teaching?
- Are you the classroom teacher who teaches science as part of your daily curriculum?
- Do you work closely with a cluster teacher, integrating what you do in other subjects with what is being covered in science?
- Do you leave all the science teaching up to the cluster teacher?

The answers to these questions will determine how much preparation you need to do to plan for teaching your budding scientist.

**Teacher Activity: Initial Self-Reflection**

Reflecting on the following questions will help you begin to focus on your science teaching. Be honest with your responses. No one will see your answers.

1. Can you recall what made you decide to teach young children?

2. What did you think of science then? Did you think it would be a difficult subject to teach?

3. How often are you teaching science now?

4. How are you teaching it? What strategies and resources do you use?
Based on your self-reflection, you might find that you fall into one of these categories:
- did not like science and do not teach it
- loved science and love teaching it
- teaching science because you enjoy teaching young students
- teaching science because you have to

Whatever category you fall into, the exercises in this book will help you develop into an effective teacher of young students. It is important that, as we begin to prepare for teaching science, you come to terms with your science teaching philosophy.

**What Is Your Teaching and Learning Style?**

Here are some questions you may ask and respond to in order to construct a useful picture of yourself as a teacher.

**Teacher Activity: What's Your Teaching and Learning Style?**

1. Do I plan for what might happen in my class ahead of time, or would I rather cope with problems as they arise?

2. Am I able to empower my students to do science even though I sometimes feel powerless myself?

3. Am I a visual, auditory, naturalistic, or kinesthetic learner/teacher?
Howard Gardner, in his Theory of Multiple Intelligences, identified eight different types of intelligence: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal, naturalistic, and intrapersonal. The following is a brief description of each intelligence.

Gardner points out that, in this nation, education usually focuses primarily on linguistic and logical-mathematical intelligence. Intelligence is a mixture of several abilities that are all of great value in life. But nobody’s good at them all. In life, we need people who collectively are good at different things.

For further study, it is recommended that you read Gardner’s books referenced at the end of this book. You could also visit Gardner’s Website (http://www.usd.edu/trio/tut/ts/stylest.html) and take a quick test to determine your learning style.
<table>
<thead>
<tr>
<th>Intelligence</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Bodily-kinesthetic</td>
<td>People are generally adept at physical activities (movement and doing) such as sports and often prefer activities that utilize movement.</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>This area has to do with interactions with others. People in this category are usually extroverts and are characterized by their sensitivity to others' moods, feelings, temperaments, and motivations and their ability to cooperate in order to work as part of a group.</td>
</tr>
<tr>
<td>Linguistic</td>
<td>People with verbal-linguistic intelligence display a facility with words and languages.</td>
</tr>
<tr>
<td>Logical–mathematical</td>
<td>These individuals excel at reasoning capabilities, abstract pattern recognition, scientific thinking and investigation, and the ability to perform complex calculations.</td>
</tr>
<tr>
<td>Intrapersonal</td>
<td>Those who are strongest in this intelligence are typically introverts, self-reflective, and prefer to work alone. They are usually highly self-aware and capable of understanding their own emotions, goals, and motivations.</td>
</tr>
<tr>
<td>Spatial</td>
<td>People with strong visual-spatial intelligence are typically very good at visualizing and mentally manipulating objects. They have a strong visual memory and are often artistically inclined.</td>
</tr>
<tr>
<td>Musical</td>
<td>Those who have a high level of musical-rhythmic intelligence display greater sensitivity to sounds, rhythms, tones, and music. They normally have good pitch, and may even have absolute pitch, and are able to sing, play musical instruments, and compose music.</td>
</tr>
<tr>
<td>Naturalistic</td>
<td>This intelligence involves the ability to understand and work effectively in the natural world. This is exemplified by biologists and zoologists.</td>
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Teacher Activity: Reflection

This reflection provides you with some understanding of your teaching and learning style. It helps you to understand your mindset as you prepare for science teaching and interact with your students. You need to understand yourself and your teaching style before you can begin to develop plans for teaching your students.

1. Where do you see yourself represented in Gardner’s Learning Style Inventory?

2. How does knowledge of Gardner’s multiple intelligence help you in teaching science?

3. What are the implications for how you teach science?

4. How does it affect how your students learn science?

5. How will it affect your teaching strategies and lesson planning?
What Are Your Views on Science and Scientists?

**Teacher Activity: How Do You Define Science?**

1. Science is . . .

2. Do you see science as a body of knowledge that has to be memorized? Why? Is this how you were exposed to science?

**Teacher Activity: Draw a Scientist**

Once you have come up with your own definition for science, draw what you think a scientist looks like:
Now consider these questions:

1. What are your thoughts on what scientists look like?
2. What does your drawing reflect?
3. Why do you think that this is your image of a scientist?
4. How many scientists do you know?
5. Do you have friends who are scientists?
6. Have you always avoided having scientists as friends?

During a recent professional development program, I asked teachers to submit anonymous drawings of scientists. Here are some randomly selected drawings:

These drawings are rarely representative of scientists, although they do tend to perceive the world slightly differently from nonscientists. Scientists tend to try to find responses to the types of questions that young students are always asking. Scientists are observant, curious, analytical, critical, and objective in their conclusions. In their work, they do not jump to conclusions without first verifying their facts. They constantly use the science process skills.

**Figure 1.1** Teacher Drawings of Scientists
They are patient, knowing, that often it takes a long time to find answers. These drawings represent a naïve view of a scientist; not all scientists work in laboratories or wear lab coats.

**What Were Your Early Experiences with Science?**

**Teacher Activity: Early Experiences with Scientists**

As you rekindle some of your earlier childhood curiosity, try to recall some of your earlier experiences with science.

1. As a student, what were your experiences with science?

2. What was your experience with the natural world?

**Teacher Activity: Write Your Science Autobiography**

Think back as far as you can. Use these questions to write your science autobiography.

1. What do you recall about your first exposure to science?

2. Can you recall events from your elementary classrooms?

3. What are your earliest memories of science and your involvement in science?

4. Are they good memories?
As you share your science autobiographies with other teachers, you will see that we have all had varying experiences with science. We have learned from these experiences and want to create opportunities for memorable experiences with science for our budding scientists. What do these activities tell you about your views of science and scientists? Janice Koch (2005) aptly coined the expression “we teach who we are” in discussing science autobiographies. If we have negative stereotypes and perceptions of science and scientists, then that is what we will teach our students. It is extremely important for you to closely examine your view toward science, scientists, and teaching science, because your perceptions and viewpoint will influence how you engage your students in science. Your feelings also impact your expectations and perceptions of students’ ability and capacity to do science and become scientists. It is helpful to consider the following points in your approach to teaching science:

- Will your teaching reflect science as a static body of knowledge consisting of one right answer that has to be memorized, or as a constantly expanding dynamic search for answers to questions that arise from our interaction with the natural world and our quest to better understand the world in which we live?
- Will you provide the kinds of experiences that will enable the scientist in each child to emerge?
- Will you enable your students to develop the dispositions that will allow them to continue on their journey to becoming scientifically literate?

**Teacher Activity: Write Your Science Story**

Think about your experience with science as a young child and write your personal "science story," using these questions:

1. What did you like?

2. What did you hate?

3. How much of it can you remember?
You want your students to have good memories of their science class. You want them to be able to recall some of the questions they had and the process they used for finding answers to those questions.

Science Education Then and Now

Science education has changed dramatically since the launching of Sputnik by the Soviet Union in 1957. This is the situation today, as we teach science to young students:

- Student questions guide science activities.
- Students experience examples of concepts before their names are presented.
- Life, physical, and earth sciences are treated in a more balanced way.
- Reading, doing, and thinking about science are combined.
- Mathematics, social studies, and language arts are incorporated into science in a more comprehensive, multidisciplinary way.
- The process skills of science are used to design more meaningful conditions for learning.
- Science learning is recognized as an internalized long-term change in behavior.

To some of us, this is a completely new way of looking at science. It is not the way we were taught, so we need to undergo a paradigm shift in the way we view science teaching and learning.

Many of us find science a difficult subject because we fear the unknown. This hesitancy might also stem from a resistance to change in general. The more uncomfortable you are about doing something, the easier it is to procrastinate or avoid the task entirely. In addition, there may be personal phobias or biases to overcome, including fear of the vast amount of scientific knowledge that is now available. There is no denying that we are living in the midst of an explosion of knowledge that no other generation has ever experienced. We are now surrounded by nanotechnology, plastics, synthetics, numerous electronics devices, computers, video games, lasers, and audio devices. It should come as no surprise that this explosion of knowledge, with its effects on technology, elicits fear in some and insecurity in others—and not just elementary teachers. But if you are willing, you can replace your feelings of fear and insecurity with new skills and knowledge. Additionally, teaching hands-on inquiry science requires far more preparation of physical materials than teaching other subjects. However, the time spent in the preparation is well worth the interest and achievement that you can foster in your students.
Before you can be an effective teacher, you must know who you are.