

TEACHING K-5

SCIENCE

Encouraging
**Exploration, Inquiry,
and Problem-Solving**

Coral Zayas

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TABLE OF CONTENTS

Introduction	1
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Part 1: Foundations for Student Success

Chapter 1: Welcome to the Wonder-Filled World of Teaching Science	7
Chapter 2: From Novice to Confident: Setting Up Your Science Classroom for Success	22
Chapter 3: All Means All: Strategies to Engage Students in Science.	45

Part 2: Exploring Science Disciplines

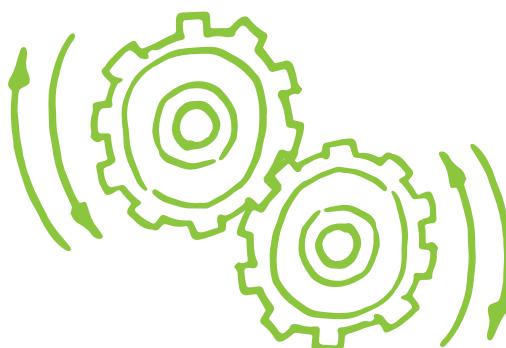
Chapter 4: Beetles, Butterflies, and Bears! Oh My! Making Life Sciences Come Alive	69
Chapter 5: From the Kitchen to the Amusement Park: Investigating Physical Sciences	86
Chapter 6: Shifting Lands and Starry Skies: Exploring Earth and Space Sciences	103

Part 3: Cross-Curricular and Real-World Connections

Chapter 7: From Science to STEAM and Beyond.	125
Chapter 8: Connecting Student Learning to Real-World Problem-Solving	149

Final Thoughts	168
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Acknowledgments	171
Resources	172
References.....	176
Index	179
Digital Resources	185
About the Author	186



INTRODUCTION

Welcome, Bienvenue, Bienvenidos! Whether you're teaching science for the first time or you're a veteran educator looking for ways to better connect science content to real-world problem-solving, this book is for you. Maybe you're an elementary teacher juggling multiple subjects, short on time for science but eager to bring the subject alive for your students. Maybe you're searching for cross-curricular connections or trying to meet the varied needs of the learners in your classroom. Wherever you're starting—and whatever your current science instruction looks like—this book offers concrete strategies to create rich learning experiences, bridge content to real-world problem-solving, and bring more of the wonder of science into your classroom.

Why This Work Matters: Opening STEM Doors in Elementary School

Expanding opportunities for all students to engage in science, technology, engineering, and math (STEM) is critical to preparing the next generation for a rapidly changing world. Careers in STEM are among the fastest growing and highest paying, offering students pathways to economic and social mobility for themselves and their families (U.S. Bureau of Labor Statistics 2025a). The opportunities are vast, but national data reveal that too many students are not reaching the levels of preparation needed to pursue these pathways with confidence.

In fact, in 2022, only 32 percent of high school graduates met the national college readiness benchmarks for science (National Science Board, National Science Foundation 2023). More recently, the 2024 National Assessment for Educational Progress (NAEP) showed that only 31 percent of eighth grade students met proficiency levels in science (U.S. Department of Education 2024).

As early as elementary school, many students begin to fall behind in math and science. By the time students reach middle school, they are often placed into different course levels, particularly in math and science, based on their class grades and state assessments. These placements can either open or close the door to advanced coursework in high school—the typical starting point for a STEM pathway. Without early preparation and encouragement, students may find it difficult to access these classes, limiting their options later on.

Confidence is another barrier. For example, a national survey of more than 17,000 girls found that while interest in STEM careers has risen, only 59 percent of respondents felt they were smart enough in math and science class to pursue their dream careers (Hinkleman 2024). That lack of self-belief is not unique to girls; many children begin to lose confidence in their abilities as the content becomes more challenging.

The path forward begins in elementary school, where educators have an opportunity to open doors for all students by helping them connect with science. We must engage, excite, and encourage students to study science and related STEM fields so they are prepared and motivated to choose STEM pathways courses in middle and high school. Encouraging greater interest in STEM fields is essential to building a more equitable and innovative future for all students.

The Teacher's Role

I believe education can offer transformational experiences for students—especially in science, where there is a unique opportunity to connect what they’re learning with the broader society and the world around them. However, our charge to develop the global citizens of tomorrow is more challenging than ever. When educators are facing so many obstacles, where do we even begin?

Well, if you’re a teacher, you can start within the four walls of your classroom—building relationships with your students, shifting your own mindset when burnout and frustration are at an all-time high, leaning on your professional and home communities, and preparing yourself for positive change.

With this book, I want to support you in that work. Let’s explore the book’s framework and see how it can help you feel more confident in your teaching, connect to fellow science educators, and guide your students to connect their learning in your classroom to what’s happening in other classrooms—and to the world around them.

Goals of Our Journey

This book focuses on a few key goals to develop your science teacher expertise:

- ▶ **Lay a foundation for success:** Study best practices for teaching elementary science—both generally and within each major science discipline.
- ▶ **Engage and support all learners:** Learn strategies to reach and support emergent bilingual students, neurodivergent learners, and students in special education.
- ▶ **Make cross-disciplinary connections:** Discover how to connect science with other core subjects—math, reading, writing, and social studies—to reinforce and deepen student learning.
- ▶ **Reflect and apply:** Grow as a science educator through reflection prompts and meaningful challenges to deepen your teaching practice.

About This Book

Let’s take a look at what’s ahead. Part 1 (chapters 1 to 3) explores best practices for science instruction. Chapter 1 introduces three-dimensional learning through core ideas, crosscutting concepts, and scientific and engineering practices. Chapter 2 highlights practical ways to set up classrooms for success using inquiry-based models such as the 5E framework, science notebooks, and hands-on exploration. Chapter 3 focuses on how to support all learners—especially emergent bilingual students and students with special needs—by using flexible strategies that make science accessible, engaging, and equitable for everyone.

Part 2 (chapters 4 to 6) dives more deeply into three science disciplines—life sciences, physical sciences, and Earth and space sciences—through hands-on activities, real-world connections, and instructional strategies tailored to different grade levels. The chapters show how to bring the 5E framework to life, build academic vocabulary, and make science relevant through community ties and cross-curricular learning. Incorporating visual routines, debates, simulations, and graphic organizers helps connect content to students’ lives and interests, making space for all learners to engage meaningfully with the world around them.

Part 3 (chapters 7 and 8) explores how science connects across disciplines to create deeper, more meaningful learning. The chapters highlight ways to integrate STEM, STEAM, and STREAM,

weaving science into reading, writing, engineering, math, and the arts. We expand our lens outward—connecting classroom learning to real-world careers, global issues, and community-based challenges. Through digital journals, engineering challenges, and inclusive technologies, students can use their knowledge to solve real problems. Project-, problem-, and place-based learning take center stage to empower students as changemakers in their communities and beyond.

As you read, you'll notice special features designed to guide, inspire, and encourage you:

- ▶ **Instructional Strategies:** These specific teaching methods or approaches can be used to engage students and support learning goals.
- ▶ **Sample Lessons:** Sample lessons or classroom examples illustrate how strategies and concepts can be applied in practice.
- ▶ **Pro Tips:** Quick, practical advice drawn from my own experience as an educator helps make your planning and implementation more effective.
- ▶ **Cross-Curricular Connections:** Discover ways to connect lessons or concepts to other subject areas, supporting integration across the curriculum.
- ▶ **Pause and Connect:** These prompts invite you to think about your own practice and encourage self-assessment and deeper understanding of the material.
- ▶ **Extend Your Learning:** These ideas and resources help you build your own knowledge and deepen your understanding of effective practices.

Whether you're brand new to teaching science or simply looking for fresh ideas, there's something here for you. Along the way, you'll find practical tools, flexible strategies, and new ways of thinking that can help you bring science to life for every student—making it more engaging, more inclusive, and more connected to the world they live in.

How to Use This Book

Although I wrote this book in a linear format, I encourage you to explore it in a way that supports your needs and teaching context. Here are ways to engage with this book.

ON YOUR OWN

You may wish to read the book from start to finish, applying what you learn in a way that aligns with your district or school's pacing calendar for science. Begin with part 1 to build a strong foundation, then chart your own path. Part 2 offers content deep dives that you can explore as you teach specific science disciplines. Part 3 focuses on interdisciplinary and real-world connections—perfect if you are looking for ways to integrate science across the curriculum.

If you're a veteran teacher but newer to science instruction, part 1 will help you establish your footing. From there, move into part 2 for content support, and jump into part 3 when you're ready

WORD CHOICE IN THIS BOOK

You may notice that I focus strongly on asset-based terms for various student populations, such as using *emergent bilingual (EB) students* rather than *ELLs* (English language learners). I also call lessons *learning experiences*, because I believe learning should be a meaningful journey that connects concepts day to day and ties directly to real-world applications, rather than being limited to a single, isolated activity. Throughout the book, a deeper explanation of these terms, uses, and classroom applications will be discussed.

to explore broader applications and connections. No matter your path, you'll find tools, strategies, and inspiration to help you bring science to life for all learners.

AS A GROUP OR PLC

Using this book as part of a professional learning community or book study—whether in your school, across your district, or through an online educator network—is a powerful way to grow together. Each part offers opportunities for discussion, strategy sharing, and collective planning. A book study guide, including all the reflection questions, can be found in the digital resources.

My Own Journey

My path in education has taken many turns—from teaching fourth through twelfth grade to working in higher ed and nonprofits—but it has always been grounded in a passion for equity and inclusion. I've long believed that education is the most powerful lever for upward mobility, especially for girls and women around the world. Since my early twenties, I've been drawn to the intersections of educational equity, policy, and economic development. Becoming a bilingual teacher gave me the opportunity to teach all content areas, but it was in STEM that I found the clearest connection between my interests and my strengths. Shifting my focus to science instruction and coaching has allowed me to champion access and opportunity where it's often least expected—helping every student, in every classroom, see themself as a scientist, problem solver, and changemaker.

Building Bridges

Why do I think our science classrooms are a bridge to real-world problem-solving? Because science is a beautiful, vastly interdisciplinary area of study. It naturally connects to other content areas, making it an ideal subject when the goal is to help students gain the knowledge and skills needed to solve real-world problems—problems that are complex and interdisciplinary by nature. In this book, I focus on highlighting those connections to support your understanding so you can, in turn, help your students make them as they learn.

You'll likely hear my teacher and coach voice throughout. I hope to empower you to feel confident in your ability to teach science to your students. Most importantly, this book is about growth. Don't be afraid to step outside your comfort zone and try something new—your students will thank you for it.



**PART
1**

Foundations for Student Success

WELCOME TO THE WONDER-FILLED WORLD OF TEACHING SCIENCE

Whether you are an elementary teacher responsible for multiple subjects or have the privilege of teaching science exclusively, science is deeply interdisciplinary—both within its own domains and across other content areas. Teaching science gives you the opportunity to deepen your students' curiosity, guide them in finding answers to their own questions, and build a strong foundation that prepares them to engage in science and STEM pathways as they move from elementary to secondary school, college, and eventually into their careers.

But to guide students effectively, we must first deepen our own understanding of the content we teach.

Here's what I will focus on in this chapter:

1. Understanding the foundational science disciplines—including the major topics and themes taught in the elementary classroom, known as core ideas
2. Exploring the scientific and engineering practices—the hands-on skills that help students understand what it means to think and work like a scientist
3. Deepening your knowledge of crosscutting concepts—the big ideas that connect the major science disciplines and link science to other academic subjects such as math and language arts

These three areas are central to effective science instruction. Let's take a closer look at how they work together.

Overview of the Three Dimensions

Throughout this book, I will be referencing *A Framework for K–12 Science Education* (National Research Council 2012). The framework explains what all students should learn in science and why it matters, and it provides the vision and research base for the Next Generation Science Standards (NGSS). The NGSS takes the ideas from the framework and translates them into specific learning standards across grade bands. The majority of states and the District of Columbia have adopted the NGSS or standards based on the framework.

Even if your state hasn't adopted standards based on the framework, it's still worth exploring. This research-based guide lays the foundation for strong instruction. Understanding this vision can help you design more meaningful learning experiences and better prepare students to think critically, solve problems, and engage with science in real-world contexts.

The framework introduces three dimensions of science learning:

1. Core ideas
2. Scientific and engineering practices
3. Crosscutting concepts

You may hear this referred to as three-dimensional (3D) learning. You'll explore this connection later in this chapter.

Core Ideas in Elementary Science

The core ideas your students will explore fall into four disciplinary areas. Science can be divided into many more major disciplines, but for our purposes as elementary science teachers, we focus on these four: physical sciences; Earth and space sciences; life sciences; and engineering, technology, and applications of science. Parts 2 and 3 explore these disciplines in more depth, but here in chapter 1, I'll lay the groundwork with a basic overview of each.

PHYSICAL SCIENCES

Physical sciences include chemistry, physics, and astronomy. At the elementary school level, we typically focus on three major topics within the physical sciences: force and motion, energy, and the properties of matter.

In the study of force and motion, students begin by exploring basic push-and-pull interactions, then progress to understanding balanced and unbalanced forces. When learning about energy, they investigate light, sound, thermal, electric, and mechanical energy. By the end of elementary school, students begin to explore how energy is transferred from one form to another. Properties of matter is the broadest area of study within elementary-level physical science. In the lower grades, students examine basic characteristics like color, texture, and flexibility. In upper elementary, they go deeper—exploring magnetism, density, solubility, and other more complex properties (National Research Council 2013).

EARTH AND SPACE SCIENCES

Earth and space sciences include disciplines such as meteorology, hydrology, geology, and oceanography. In elementary school, when we explore Earth's atmosphere through topics like weather and climate, we connect to the field of meteorology. As we study the water cycle and consider the water resources across continents—think lakes, rivers, and streams—we are engaging with the discipline of hydrology. Geology, in a broad sense, is the study of the Earth, and it is considered the most interdisciplinary of the Earth sciences, often overlapping with physical science. Oceanography, which focuses on oceans around the globe, is similarly interdisciplinary in nature. Earth and space science also involves understanding Earth's place in the universe, including the study of the solar system, gravity, patterns of the sun and moon, and phenomena such as tides, seasons, and eclipses (National Research Council 2013).

LIFE SCIENCES

Life sciences cover disciplines such as biology, botany, genetics, ecology, and many other subdisciplines. In elementary school, we explore these areas through topics such as plants, animals, and the environment. On a broader scale, we look at ecosystems and the relationships between plants and animals, considering how humans impact the environment and how all living things survive and adapt to their environments.

Students also learn about life cycles, genetic traits, and even how the Earth has changed over time by studying fossils. You'll notice patterns as topics in the life sciences overlap with concepts from Earth and space and physical sciences, reinforcing the interdisciplinary nature of science learning (National Research Council 2013).

ENGINEERING, TECHNOLOGY, AND APPLICATIONS OF SCIENCE

Engineering, technology, and applications of science is an additional core idea in elementary science. Students come to understand how science is used in real-world contexts, particularly through the engineering design process. While there is no chapter in this book dedicated solely to this core idea, it is woven throughout and expanded on in part 3. There, you'll explore the connections between science and other disciplines, bridge to STEM and STEAM integration, and focus on project-based learning.

Starting to Build the Bridge: Scientific and Engineering Practices

Let's dive into the second dimension of the framework: the scientific and engineering practices. These practices form a bridge across the science disciplines and create opportunities for interdisciplinary learning, particularly with math and literacy. They are an essential part of the NGSS standards—and for me, this is where the fun really begins. In an elementary classroom, these practices invite students to explore, question, investigate, and solve problems in hands-on, meaningful ways. This can be especially engaging for young learners, who are naturally curious and eager to make sense of the world around them. These practices not only foster meaningful connections that support learning but also highlight the importance of both content knowledge and skill development. Making connections between subjects encourages creativity, collaboration, and deeper understanding. Take a look at the table below:

Practices for K-12 Science Classrooms
1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

(National Research Council 2012)

Pause and Connect

How do these scientific and engineering practices connect to skills used in other subjects?

The first time I saw these practices, a light bulb turned on for me as a teacher. I realized that though I was teaching science, there were going to be plenty of opportunities to bring language arts, social studies, math—and even STEM by incorporating engineering—into my science instruction.

IN-DEMAND SKILLS

In 2025, LinkedIn identified top in-demand and rising skills, including hard and soft skills. As technology reshapes how we learn and work, students will need a blend of these skills.

- ◆ AI literacy
- ◆ Communication
- ◆ Adaptability
- ◆ Critical thinking
- ◆ Project management
- ◆ Data literacy
- ◆ Collaboration
- ◆ Emotional intelligence
- ◆ Problem-solving
- ◆ Digital literacy

Helping students explain their thinking, work together, and use data and evidence to support their ideas is not only essential in the classroom but will continue to be critical as they move beyond elementary school and become part of the future workforce (Dewar 2025; LinkedIn News 2025).

My hope is that when you’re planning science instruction, you begin to notice ways to design cross-curricular lessons. Whether you’re a self-contained teacher with limited time for science or a science teacher looking for ways to support your teammates by incorporating literacy into your lessons, leaning into the scientific and engineering practices makes that possible. They highlight the interdisciplinary nature of science and show both you and your students that science draws on a wide variety of skills.

CROSS-CURRICULAR CONNECTIONS

Across the United States, most K–5 classrooms are self-contained, with teachers responsible for all four core content areas. The scientific and engineering practices offer opportunities to connect these subjects. Practice 5—using mathematics and computational thinking—explicitly connects to math. For example, it aligns well with the data analysis standards in mathematics. Students can apply their mathematical thinking to better understand scientific phenomena. This practice in science not only reinforces their data analysis skills but also helps them apply their learning to real-world concepts.

Practices 6, 7, and 8 make clear connections to language arts. Though students write extensively and learn to construct arguments as part of language arts, these skills are also key components of the science standards. These practices are more than just requirements; they are essential skills for young scientists to develop as they engage with science throughout their K–12 education. The practices also help ensure that students know how to communicate what they’ve learned, not only in classrooms but also within their communities as they grow older and enter the professional world.

Science fairs are great examples of how these practices prepare students to share their learning with a real-world audience. Without strong science communicators, how would the public understand topics such as nutrition and how viruses spread through a community? You can begin building these communication skills in learners early on.