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# Foreword

> "I actually enjoyed the graphic-novel format, ...before I would always think 'Pffft! I don't need graphic novels! They're for dumb people who are too lazy to read and just want to look at pictures!' Boy, was I wrong! I really did like it, and it was just as interesting and informational as it would be in a regular book form. Actually, probably more interesting!"
>
> **Danielle, Writing-Reading Notebook entry, 1/14**

I've been exploring the ways my students can use drawing as a thinking/writing tool for more than ten years, often working with Roger Essley in my eighth-grade classroom. My students have shown us how drawing helps them understand the writing of others, craft their own ideas into writing, and unravel complicated reading tasks. Through their pictures they think deeply and show others that thinking.

Danielle is a motivated, sophisticated, successful eighth grader, who has seen the value of using drawing as a reading and writing tool, yet when I introduced her class to graphic novels, she raised the same questions that I've often struggled with as a teacher. Why do many of us in education dismiss drawing as an unsophisticated tool better left behind at third grade? Why have we *taught* our students that understanding comes only from, and with, words? Of course we want our students to read and write for meaning, but why do we limit the ways they get there?

With this book Roger offers convincing evidence that we must address—and foster—our learners' natural visual learning skills. We hear from scientists, physicists, mathematicians, sociologists, historians, authors, and from our own literacy research, how drawing has always been an essential thinking tool that helps learners simplify and understand complicated issues. Examples of students' and teachers' visual work at all grade levels offers exciting and inspiring evidence that echoes what my students show me: we can encourage diversity by teaching kids that drawing is a sophisticated tool for understanding and representing our thinking, a natural and needed companion with words.

In the closing pages of this book a girl confesses hiding her drawings in school because "I worried I needed them because I lacked the intellectual heft to figure things out based on the text alone." That top student, now using drawing to unravel complicated cases with a federal judge, reminded me of Danielle. I am struck by the clear and prolific evidence presented for integrating visual tools in our curriculum, to help all our students grow their intellectual heft. And Danielle reminds me of how critical connecting words and pictures is for learners in our increasingly visual culture.

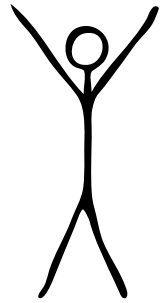
Danielle was intellectually stimulated by the complexity of the graphic novel format and, as another excerpt from her journal entry reveals, she discovered it was actually "enjoyable to read because . . . important facts were punctuated with a drawing. . . . If you missed something you could get that information from the picture. And it was just so relaxing, to turn a page and not be bombarded with six inches of very small print."

I hope you will see, through all the evidence presented in this book, how critical visual tools are to the growth and enjoyment of all of our students.

**Linda Rief,** Oyster River Middle School
Author of *Inside the Writer's-Reader's Notebook, 100 Quickwrites, Vision and Voice,* and *Seeking Diversity*

# Introduction

# An Essential Overview of Visual Tools



Late one night I turned on the TV to catch the end of an interview with the well- known historian David McCullough. He's been called our "national history teacher," having written engaging books and narrating history series on TV, but here McCullough was sharing his experience teaching. McCullough the scholar was passionate about teachers fostering engaged reading and writing, and making time for hands-on research that makes history and scholarship real. As the interview came to a close the interviewer asked, "If you could give teachers one piece of advice about teaching history, what would it be?"

McCullough thought for a moment and said simply, "Use pictures."

This concise answer was not what I was expecting, and the story McCullough told to explain his focused response got my attention. He said that he was once asked to teach a history seminar at a well-known university, and accordingly, he prepared for an intimate seminar class. When he arrived, however, he found himself at the podium facing a hundred-plus students. McCullough knew that each student was going to need to find a research topic for the course, something he or she could grab onto in a personal way, but there was simply no way he could meet and discuss possible topics with more than a hundred students.

Later, as he thought about what to do, he began reflecting on what it was that had initially engaged him about history. He remembered his first book was originally inspired by pictures, old photos left out on a library table, devastating images of the Johnstown flood. He'd been amazed by those photographs. The drama and the concrete detail in those pictures grabbed him, and soon he found himself working on his first book.

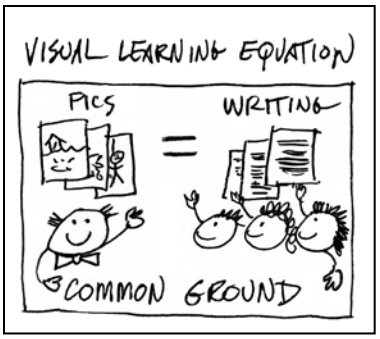
McCullough gathered a huge stack of historical photos: the last portrait of the Russian Czar, a photo taken of the Japanese surrender on the deck of the Missouri, a picture of crowd of bystanders at a lynching.

At the start of the next class, he gave each student a photo selected at random. McCullough expected that many of the students wouldn't like their photo, so he said folks could trade their pictures but that by the next class each student had to find an image he or she could use as a starting point for an in-depth research paper.

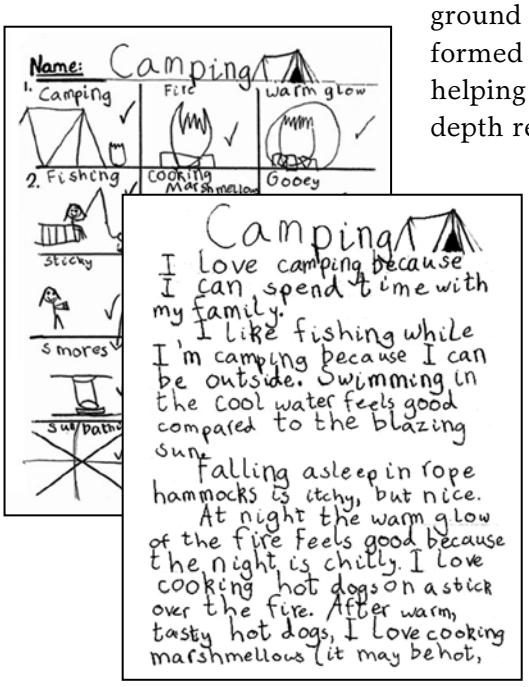
At the following class McCullough was amazed to find that only a couple of students had traded pictures. He said it was striking the way students were engaged by *their* images; he said they climbed into those pictures, and set to work. He found that the pictures grabbed students in a personal way that brought more depth to their research and their writing.

## Getting Visual *With* Our Learners

This experiment using pictures to jump-start students' research led McCullough to a larger discovery—namely, that pictures can do far more for learners than simply illustrate or supplement text. They can stimulate, focus, and deepen our work as we study and write about a topic, whether we are novices or experts like McCullough.



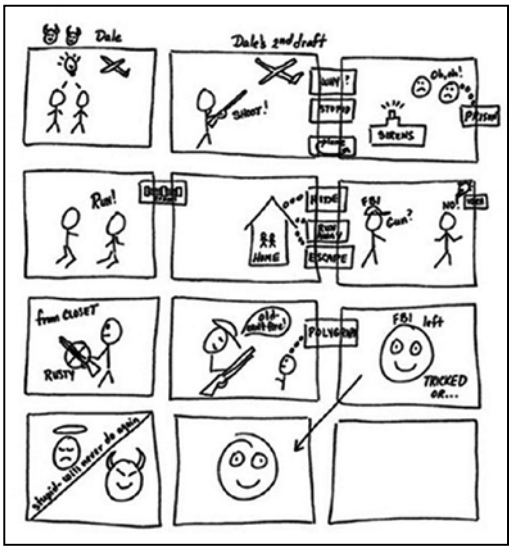

McCullough's discovery that pictures are a powerful writing tool is newsworthy, especially in a higher education context, where practice is famously text-focused: "Read chapters of content and show what you know in written essays." McCullough's advice to "use pictures" with writers hardly reflects our conventional practice in college, or even in grade school, beyond first or second grade. But McCullough the teacher was amazed to find such fertile common ground with his learners. He could see that pictures engaged and informed his students in the same ways they engaged him—the images helping to make ideas real and compelling in a way that spurred in-depth research and passionate writing.




McCullough's experience with college students impressed me because it echoed what teachers at many grade levels see when their writers use pictures as a path to writing. For more than ten years I've been collaborating with teachers, exploring the unique way visual tools engage learners. In my book *Visual Tools for Differentiating Reading & Writing Instruction* (Essley, Rief, & Rocci, 2008) teachers of different grades shared the often dramatic results they (and I) see when reluctant writers engage and when struggling readers' comprehension and participation in the literacy circle skyrocket.

In my earlier book on visual tools, we highlighted work from Amy Rocci's third grade and Linda Rief's eighth grade, showing, for example how students across grade levels embraced a visual-verbal writing process using storyboards, sequencing simple pictures and key words. Notice, for

example, how the third grader in the example on page 6 uses a storyboard to help add "significant detail" to her writing. The storyboard works first for visual brainstorming, and then as a sequencing tool as students are drafting and revising. This visual map of ideas allows students to SEE, and then organize what they want to say before they commit to writing exacting text.




Storyboard drawings can appear deceptively simple, but that is their strength: in the example to the right, an eighth grader's first-draft storyboard gives a clear overview of his ideas as the visuals make conferencing and revision easier. The student has shared a true story from his father's childhood, telling his audience the events square by square. In squares 1 and 2 he introduces two clueless kids who get the nutty idea to shoot their rifles at airplanes in the sky. Between squares 2 and 3 are three small boxes. These were added after the writer shared his work with readers, and they show a record of the audience's questions. The first box asks, "Why?" The student may add new squares to his storyboard, revising because the audience wants to know more about these two fools.

McCullough's discovery that students' research and writing deepened when they began with pictures highlights the visual learning potential that teachers like Rocci and Rief have explored with their students, pioneering practical visual strategies for reading, writing, note-taking, and more. In the pages ahead we'll hear from many more teachers who use visual tools across content areas and whose students reap the benefits. Students' work will show us how a pictures-first approach works for learners and how linking pictures to discussion, reading, or writing make abstract content more concrete and ideas more accessible.

## Visual Tools For Math, Science, and More

While McCullough's advocacy of pictures as a writing tool for history makes intuitive sense, it was another teacher's visual experiment in math that offered unexpected and provocative results. His students showed him that if you want to elicit better math problem solving from your learners, start with pictures.

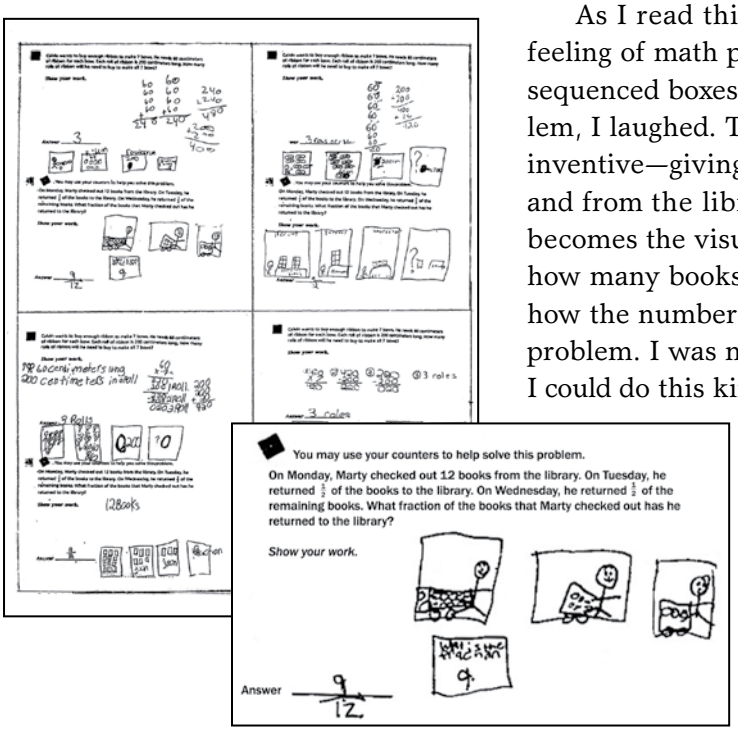
I was doing a writing residency with third graders at a school in upstate New York when during an after-school presentation to the entire faculty, I mentioned in passing that storyboards would make a great math tool. I'm not sure why I said it; my work to that point had focused on reading and writing tools. I was text-slow in school and seriously math challenged as well. Despite endless drilling, and hours of summer school, math failure still comes easy to me as an adult. Still, students had shown me again and again that our adult view of learning was often way too narrow. I had a feeling kids could show us how drawing worked with math if we gave them a chance.

Throughout this book, you'll notice that I don't just write "test"; I write "TEST" when referring to standardized state and national tests. If you teach, you'll no doubt know just what I mean by writing it this way. These tests loom large and take on an all-too-significant presence in the psyches of teachers and students alike.

Two days later I gulped when Jim Adamo, a fourth-grade teacher, introduced himself by saying "Math is my thing." He said he'd recently given his kids a sample state math TEST and found the majority of his kids had struggled with the story problems. He'd decided to try a little visual math experiment. He told his kids they were going to try some TEST problems again, but first he showed them how to storyboard using simple stick pictures ("stick-pics") and key words in sequenced boxes. Then he gave them several problems he knew the majority of kids had failed. "I didn't review any of the math concepts," he told me, "I simply told them to try using this drawing tool to solve the problems."

He showed me his students' work. The highlighted question read as follows:

> On Monday, Marty checked out 12 books from the library. On Tuesday, he returned ½ the books to the library. On Wednesday, he returned ½ of the remaining books. What fraction of the books that Marty checked out has he returned to the library?



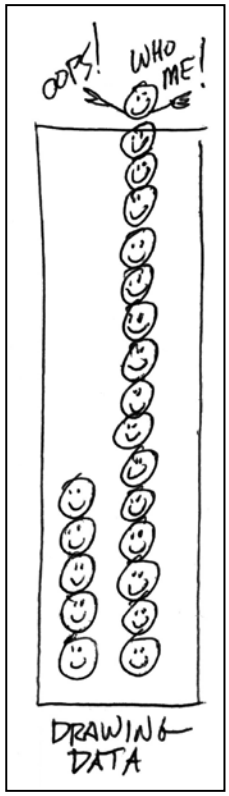

As I read this story problem I got that old familiar feeling of math panic. But looking at the student's simple sequenced boxes, mapping out the parts of the math problem, I laughed. The student's drawing was both funny and inventive—giving Marty a shopping cart to get his books to and from the library is helpful on lots of levels. That cart becomes the visual container for problem solving; we can see how many books Marty has from the start, and we can see how the numbers change at each step described in the story problem. I was not joking about feeling math-impaired, but even I could do this kind of math.

It was clear Adamo's students easily embraced pictures as a math tool, and their test results were equally exciting; on a question that only five kids had gotten right the first time, now 16 were able to answer correctly when using storyboards to create visual thinking notes for their problem solving. That dramatic pattern of success was repeated on other questions.

## Bottom-Up Data: A Tool That Works for All Learners

We hear a lot these days about data-driven learning. Experts at universities are hard at work collecting "learning data" that is turned into packaged programs of "research-proven" strategies. Yet too often teachers tell me that these strategies—dictated by a university study or handed down from the district office—and the packaged strategies that often accompany them, miss the practical needs of students and their teachers.

Adamo's "bottom-up" research was essentially different. He was working as a real teacher does, with learners he knew well, gleaning teaching insights from the students themselves. Their sudden success was so dramatic, it was dislocating to him: *All* his kids got the idea of using drawing as a math thinking tool; in fact, they got it so easily that they were immediately able to turn around and apply this new tool to advance their shaky math skills.




Students' dramatic jump in math performance raised big questions. And no wonder! Try to imagine another new tool a teacher might introduce that could produce such solid results in just a few minutes. Adamo wanted to know: *How* did drawing work so powerfully for all of his learners? And equally important: Why hadn't he heard more about drawing as a thinking tool, either in his training or in the frequent reading he'd done on learning research?

Adamo's questions go to the heart of this book. His students have already given us a compelling introduction to the way hands-on drawing supports and informs learners, in this case making math ideas concrete in much the same way manipulatives do. But Adamo's students' sudden success on the sample TEST was also a revealing introduction to issues that go well beyond the math classroom. Adamo focused his visual math experiment on story problems because that was where his students had the most trouble. If we recognize that all story problems are really reading problems first, that the so-called story poses text challenges before kids can even get to the math content, then we can see another role that drawing played in Adamo's students' math success.

As we go forward, we'll see how the drawing visualization skills used by mathematicians and engineers can help students at any grade level. And we will revisit students' struggles on standardized math TESTS. Many teachers tell me, "My kids know the math, but on the state TEST something happens." We'll look at that potent "something" and explore in detail what happens when the TEST's text and math content collide, disabling many competent math learners. We'll also see how drawing helps, including looking at compelling research evidence that a coherent use of drawing in a math curriculum can raise all students' scores on standardized TESTS.

## COLLABORATING WITH LEARNERS

But first I want to give a brief overview of where Adamo's first visual experiment took him with his learners. After our conversation that morning he sent me copies of his students' math drawings with their test results. His experiment with drawing might have ended there, with a new, narrowly focused math strategy. But when I contacted him several years later, curious to know if he was still using storyboards with his students, he told me he'd been doing a whole series of bottom-up experiments, collaborating with his students to build visual tools that worked for them across the curriculum.

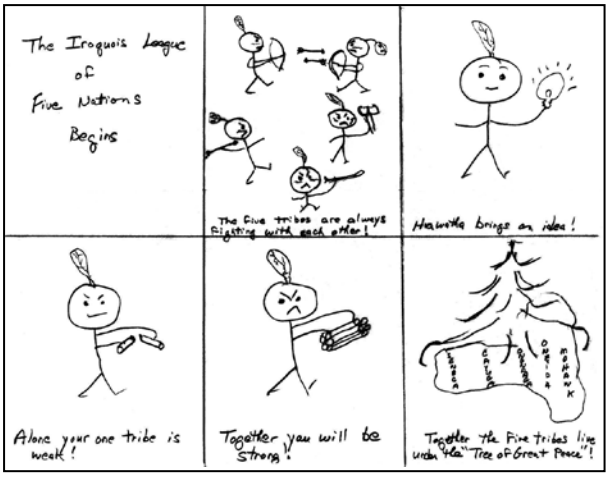
Below is Jim's e-mailed summary of the way storyboard applications grew in his classroom after his initial math TEST experiments:

Things we worked on:

- Solving math word problems (using pictures to make the problem concrete confirmed the idea that the math is secondary to the reading skills involved in understanding and solving a complex word problem!)
- Worked on students creating their own word problems using storyboards.
- Vocabulary acquisition (pictures anchored and amplified definitions).
- Social Studies—we storyboarded: the American Revolution, the story of the European explorers, Iroquois history, New York State history, etc. (Storyboarding enhanced the story of history and made it memorable! I loved using it in this curricular area!!!)
- Preparing for the New York State 4th grade math test.
- Preparing for the New York State English language arts test.

It's not surprising that storyboards became a standard math tool in Adamo's classroom (his kids' TEST performance reflected the solid learning leaps he saw that first day.) But recognizing the way drawing supported his students' math comprehension led to visual strategies in reading, writing, vocabulary, and more, including preparing his students for the math and the language arts TESTS.

Below is one of Adamo's students' social studies storyboards, built to illuminate Iroquois history. Just a quick look conveys how storyboards connect to reading and writing. This storyboard is a form of visual notes, a flexible tool that could easily be used as a first draft of an essay on the Iroquois nations, with each square expanded to build an in-depth look at early diplomacy and cooperation among nations.

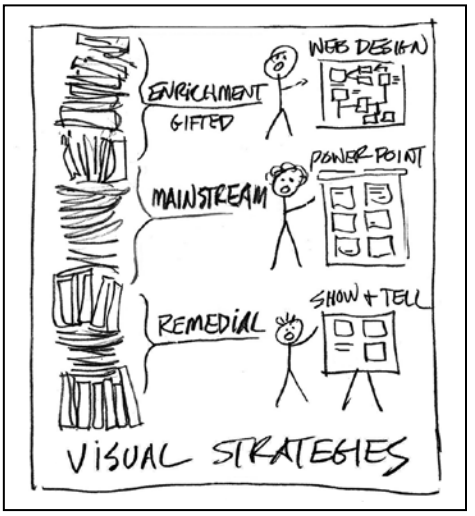



This book will build on the practical reading and writing strategies shared in my earlier book. You will see that these tools don't take any special equipment or force you to follow some cookbook curriculum. Indeed, in the pages ahead you'll see how easily these tools can be adapted to many curriculum goals. And you'll see what is possible when students and teachers grow their visual skills together, building and refining tools that meet their needs.

## Why Visual Tools Work

In recent years it seems visual tools have been appearing everywhere. Experts have produced an array of visual tools targeted for many mainstream tasks, along with mounds of graphic organizers, thinking maps, webs, and so forth. If we add to this array all the visual tools used by special educators, reading specialists, and speech folks—visuals used as remedial strategies in the resource room and recommended as "accommodations" to support struggling learners in mainstream classes—and then

include visual tools used by "enrichment" teachers—tools touted as building "higher-order thinking skills" with advanced learners—we see visuals recommended to support learners at all levels.



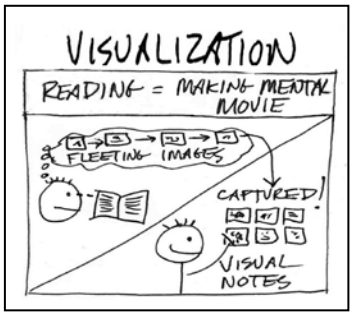

Unfortunately this proliferation of targeted visual tools and specialized strategies often produces a narrow and scattershot view of visual learning support. A format provided for one task or grade level replaces another format with a different look and logic, and the result is confusion. But if we can step back and examine this seeming diversity, we'll find effective visual tools are built on some solid time-tested ideas we know work for all learners.

For example, if we recognize how the concrete format of show and tell supports the sharing of ideas among young learners, we can see how PowerPoint's show and tell, with its sequenced boxes, supports older learners' digital communication skills, and, in precisely the same way, how Web and digital programming tools adapt this same boxed structure to help gifted students master twenty-first-century skills. At their core, all these tools, digital and not, use the same sequenced visual display as the concrete focus for sharing ideas—that is, visual display that's closely linked to talk and text.

Note: I know there's plenty of bad PowerPoint out there, but students will show how using low-tech storyboard tools and logic builds digital presentations that engage as they communicate content (see Chapter 7).

## Literacy = Visual Thinking Skills

From McCullough's college students who planned and built their history essays with primary-source photographs to third graders who use sequenced stick-pics to solve math problems, visual tools provide a critical scaffold for tackling activities we often frame and model as text-focused skills.



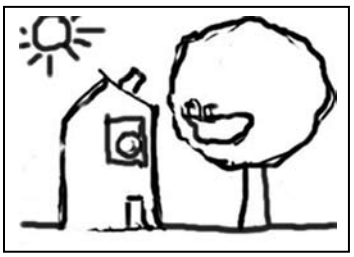

We can begin finding common ground with our learners by connecting two bodies of research that show how visual learning is intimately linked to literacy skills, linked in ways our practice hardly acknowledges: The first is the broad consensus in reading research that shows reading itself is a "use pictures" process. We know that reading, beyond decoding, is at heart a visualization skill—the ability to capture meaning from text in mental images. That idea is popularly summarized by saying "effective readers are making a mental movie" of the story or content.

Adamo's students gave him a dramatic demonstration of the way comprehension skyrockets when learners have a hands-on way of turning their fleeting mental images into concrete picture notes. (In Chapter 6 we'll explore the developmental roots of the math-drawing visualization skills his students instantaneously accessed, looking at the way all young students use drawing as a tool

to help them grasp and build math concepts.) Thus we find that drawing plays a key role in learning across the content areas, well beyond the building of literacy skills.

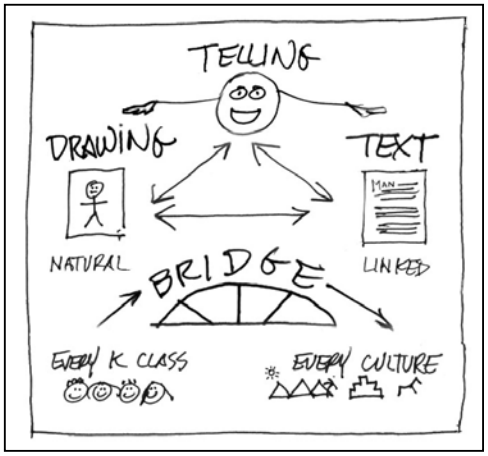
While often missed in our practice, the key role drawing plays in young learners' thinking and writing is well established. Writing teacher and researcher Donald Graves studied the early drawing-writing connection, noting that students show us in kindergarten how drawing and writing are linked. "For most children, drawing first precedes writing since the child needs to see and hear meaning through drawing" (pp. 99–100). Graves's discoveries came while observing young students during "writing time." He was surprised to find that they didn't start writing with text but instead with pictures. They drew, and as they built the parts of their picture, they narrated aloud the content they were adding piece by piece.

Graves studied kids' picture-talk process and recognized drawing and telling were logical steps to writing: students were making picture notes, then reading their notes aloud to "rehearse" and refine the words in their story. They drew, then told some, then drew more, growing the telling, all before "actual" writing. In essence they were creating a succession of visual-verbal drafts of their idea, finding their words in pictures before moving to text. It's crucial to note that Graves found that students chose to use drawing and telling as their writing tools, despite consistent modeling by teachers of our conventional text-focused writing process.



"This is my house. My window is high up. I see two baby birds in the nest."

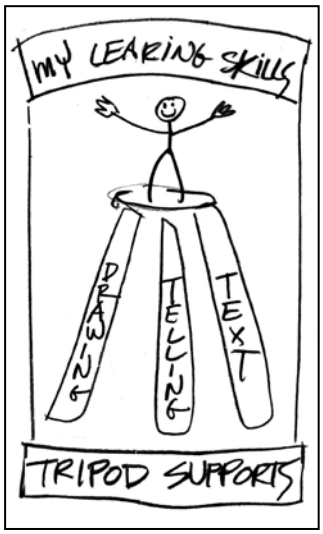
What Graves discovered is that children were using drawing and telling as a *bridge to text*. Graves wondered why students aiming for text didn't just start with words, and eventually he concluded that kids needed to draw first. He saw young learners eager to communicate on paper, but finding text too difficult they intuitively turned to drawing. He explains, "Long before they write words on paper, young children are able to show events through their drawings" (1981, p. 23). And he further finds, "They control their writing through drawing and speaking as they write and in discussing the writing . . . " (1989, p.14).



## The Learning Tripod: Natural Links

Graves found that students start writing with pictures because casual drawing is uniquely suited to this writing task—an intuitive, easy way to get ideas on paper, and to develop and expand them. His findings amplify what developmental researchers like Jean Piaget and Lev Vygotsky long ago made clear: young learners use drawing to build meaning and to communicate ideas. In Chapter 2 we'll look further at early literacy skills and see the unique way drawing naturally supports and informs young learners. We'll also explore research that underscores the import of Graves's theory that young learners need a bridge to text. This research warns that text itself is a difficult tool that can stall many competent learners.

But first, in Chapter 1 we'll visit two classrooms and see how introducing visual tools into the curriculum transforms students' learning experience. Before we look at students' work and hear teachers describe learning breakthroughs that are common when we integrate visuals with familiar text and talk tools, I want to suggest a framework for understanding the dramatic impact of these simple tools. Visual experiments, conducted at many grade levels and with diverse learners, show that young learners' intuitive bridge-to-text process offers us a working model of naturally linked learning supports. I've called this linkage the *Learning Tripod*—an integration of three mutually supporting skills: drawing (visual), telling (verbal), and text (reading and writing).

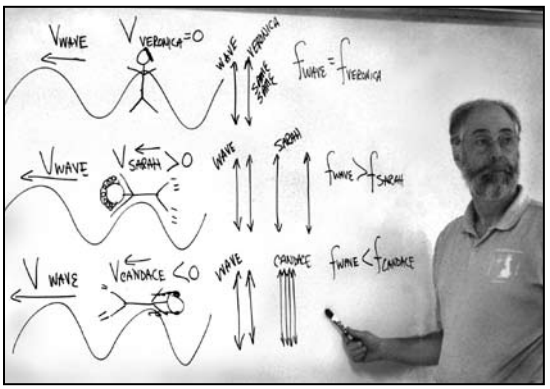



It's crucial to recognize that by introducing students to the hands-on drawing and sequenced images that characterize storyboards, we are inviting them to rediscover their natural drawing-thinking skills. Watching first graders and tenth graders use and spontaneously adapt Tripod tools to meet their individual needs reveals a remarkably versatile learning support system. When we look at diverse students' work we can see the practical mechanics of the Learning Tripod, because although each leg has inherent strengths and weaknesses for learners, when used together they allow students to tap all their learning skills, finding their path to the goal. Along the way we'll see plenty of learning diversity, and students will show us how consistently and logically linking visual-verbal tools with text dissolves common learning blocks, building bridges for all learners.

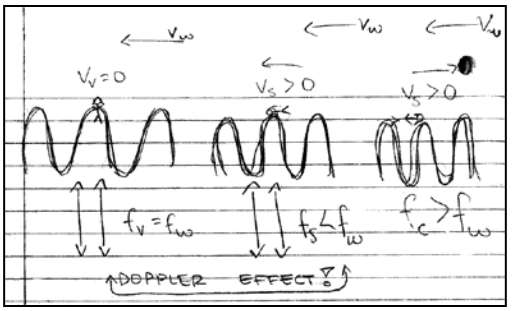
### The Tripod in Real-World "STEM" Learning

To begin looking at the reach of the Tripod, I'd like to expand on what Adamo's students showed us when they connected reading comprehension with math visualization skills.

Several years ago, I got a call from a middle school teacher. She'd seen one of my presentations at a national language arts conference, but this teacher started by



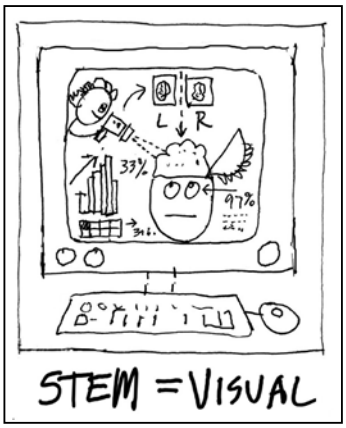

**Engineer/teacher Jon Moss shows the logic of the Doppler effect in sequenced visuals linked to equations. Below, a student takes visual notes.**




asking, "Wouldn't these same tools work for math and science as well?" She was helping to put together a regional "STEM" conference, addressing the integration of Science, Technology, Engineering, and Math—especially timely, given the urgent STEM push (now in the headlines with warnings about losing our competitive edge). One thing led to another and the next thing I knew, I was a nervous keynote speaker before an audience of middle and high school math and science teachers.

I began with an overview of learners' breakthroughs using visual tools for reading and writing, and then I showed Adamo's students' math drawings. I feared they'd dismiss these stick-pics as baby stuff, irrelevant to their work with older learners. But the teachers leaned forward to study the fourth graders' work, and when I introduced another example that showed a ninth-grader's work storyboarding the dynamics of kinetic theory, folks began asking questions that told me they already knew the power of drawing.

In follow-up workshops, teachers collaborated to see how they might adapt the logic of Adamo's students' drawings to algebra, physics, and other subject areas. Fortunately, several enthusiastic contributors showed us all how their older students used drawing to visualize abstract concepts. What struck me was that the majority of these contributors were high school teachers who also said they were trained as engineers, where drawing was used as an everyday thinking tool. One said, "You don't show up at a meeting without drawings to support your ideas." And a number remarked that bringing that real-world experience into the classroom, and drawing with their students, made them better teachers.



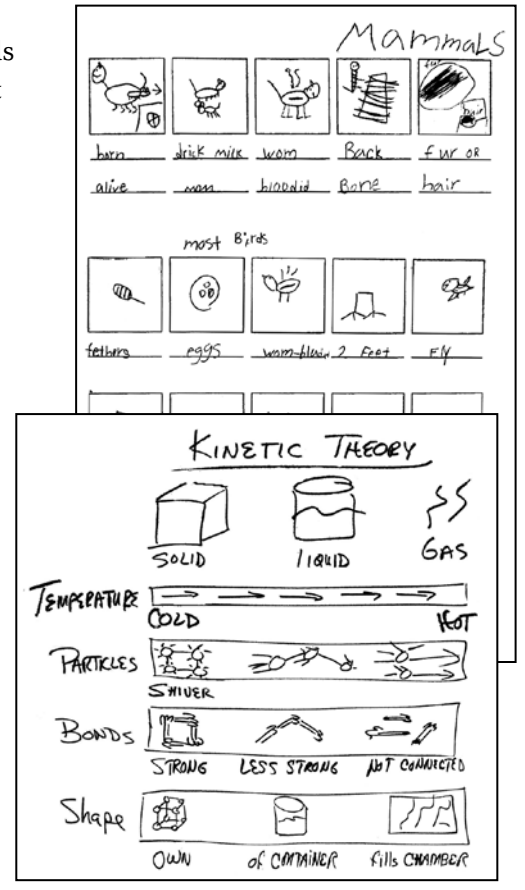

Yet these teachers also said, betraying real frustration, that their drawing was often considered strange by colleagues—and worse, when they encouraged students to draw, or gave full credit on TESTS for drawings, they were accused of "dumbing down" the serious curriculum.

Many teachers echoed their concerns, acknowledging that hands-on drawing was not a common tool in high schools (except for a few targeted tasks like graphing or CAD design) and they pointed out how counterproductive this bias against drawing was—especially in light of the recent push to engage more students with real-world STEM disciplines in order to meet the needs of the coming digital-visual revolution.

A number of teachers also talked about the inclusive quality of drawing for their learners. They emphasized the fact that concrete pictures make abstract concepts easier to grasp, opening doors for learners who struggle, including students with learning disabilities and even those with serious labels like "autistic." Many teachers said drawing was the tool they always turned to when kids were not grasping an idea. And a number went even further, reflecting on how they personally used simple drawings to help them build and focus their own lessons; the act of making diagrams or pictures helped them to organize and then present their ideas more effectively.

In considering these STEM advocates who've shown how a pictures-first approach advances learners, we've come full circle. McCullough found common visual ground with history students, and engineers bring drawing to their classrooms because they recognize how these tools work for them. Yet for any teachers who may be thinking, "But I can't draw!" let me say this: Teachers who try using visual tools with their learners will tell you students are more than ready to help you. If you collaborate with students using visual tools, they will teach you how we can all develop ideas and communicate more effectively. This is not meant to be an inspirational metaphor; students can actually take us to the next level if we look carefully at what they show us.

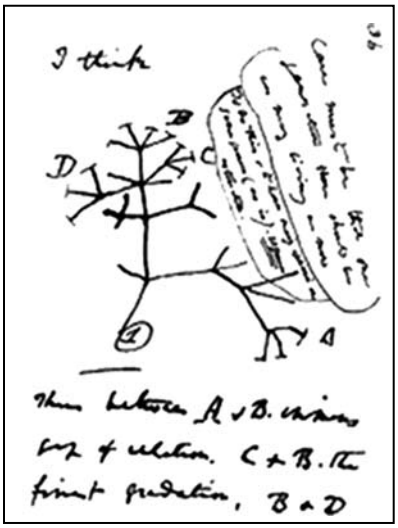
But the sad truth is most students get little chance to show teachers what they can do with hands-on drawing or visual tools integrated in the curriculum, beyond first or second grade. That is why it is so exciting when teachers collaborate with learners to tap *all* their learning skills. One of the most exciting parts of finding common visual-learning ground with our so-called "different learners" is that we can partner with them in building better learning tools. Indeed I hope the learning data presented here will show you that your "different learners" may be more like you than you imagined.




The goal of this book is to take what we know works for learners and show how a coherent set of visual tools, intimately linked to reading and writing skills, can be used to build and share ideas in any content area. Equally important, we'll see how teachers can adapt this set of visual formats to fit their curriculum and their learners' needs. We'll show, for example, how the same sequenced box tools that help second graders build a logical display that makes animal classification concrete and easier to grasp also helps older students build a series of boxes that diagram and explain the inner workings of kinetics.

As we look at the way visual tools work for learners in the classroom, it's helpful to remember that these tools are not new—storyboards and drawing have long been used by

engineers, filmmakers, scientists, inventors, writers, and many others. While we often think of text as the central tool of thinkers, we'll explore the unique role visual tools and hands-on drawing play in making ideas easier to grasp, share, and develop, in science discovery, in math visualization, in language building, and in the connecting of cultures.




I hope readers will explore the chapters related to their specific content areas, but one of the overarching themes of this book is that visual tools naturally build bridges between disciplines, and those bridges create essential links that integrate content and meaning, moving all learners forward. Charles Darwin wrote in his journal: "I think . . ." and then he showed how he thought, in his now-famous first drawing of evolution as a treelike branching process. Darwin's journals are hardly an isolated example of drawing moving big ideas forward.

In fact, Darwin's tree was not his isolated visual invention, but a variation of "tree schematics," long used by scientists and mathematicians to diagram ideas, and now used in everything from psychology to digital programming. In the pages ahead we'll see many more examples of the pivotal role hands-on drawing has played in the evolution of math, science, and social studies, often underpinning and spurring discoveries and inventions that transcend our narrow learning ideas and the narrow curriculum silos we build that limit learners.

Throughout this book we'll explore a wide range of practical strategies in all content areas, to show how the Tripod works for learners, and to suggest how flexibly Tripod tools can be used. I hope you'll see many templates for bottom-up experiments you can conduct in your own classroom, and in classrooms down the hall as well. Our students can help us see how visual-verbal and text tools can be effectively integrated to support all learners. And armed with lots of practical bottom-up, student-generated data we can build a working blueprint of practice that challenges lock-step text curriculums. We can use our students' success to show how simple tools can be easily integrated in our practice, to make any curriculum more inclusive and effective; supporting students in the college history seminar, on the state TEST, or in their larger digital-visual future.

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