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Teaching With Science Writing in the Humanities Classroom

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It's Not All Numbers: Science, Stories, and the Case of Academic Ecology[1]

My first draft curriculum for teaching writing to ecology undergraduates read much like a battle plan: I anticipated toiling to convince burgeoning scientists that writing was as worthy of their time as chemistry and statistics. To my (pleasant) surprise, I was proved wrong. In introductory surveys, students overwhelmingly named writing as a lynchpin of success in their degrees, careers, and lives. Yet, simultaneously, they confessed their *dread*, even *terror*, at taking a writing class. Many delayed until the last possible semester despite knowing that they needed, and wanted, to improve their writing.[2] My plan shifted from battle to treatment: Students needed a therapeutic space to reimagine their relationship with writing.

This scene was familiar. In the years that I tutored at a college writing center, humanities' students stumbled to me—the lone scientist—with a data-dense journal article clutched in their hands and desperation in their eyes. They wanted to supplement their arguments with "the science," yet it seemed locked beyond reach, the story hidden amid labyrinths of *p*-values and six-syllable jargon.

Both situations exemplify the same cycle of frustration—students reach toward knowledge from another discipline, find themselves ill equipped to comprehend (nevertheless implement) this knowledge, then receive poor grades for their struggle. This cycle embeds negative self-perceptions ("I'm a bad writer" or "I don't *get* the science") that become self-

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[1] Teaching experiences referenced throughout this essay were made possible through funds from a U.S. Agriculture and Food Research Initiative Predoctoral Fellowship (2022-67011-36460).

[2] Though I highlight my anecdotal experience, it is echoed across universities (e.g., "Better Science" 184).

fulfilling prophecies: My ecology students struggle to write the paper that my English students struggle to read.

No one panacea will break the cycle; however, a starting point is to use our classrooms as spaces to heal from the lingering myth of a science/humanities dichotomy. A step in this direction is to uncover, and celebrate, the oft-hidden synergies between literature, rhetoric, and the science writing crafted *by* experts *for* experts. I use U.S. scientific ecology as a case study to assert that *all* science writing (even a data-dense story) is inextricably entangled with humanistic theories and legacies. Working from this expanded notion of science writing, I turn to the matter of cultivating classrooms—led by scientists, humanists, or both—that facilitate students' access into the under-exploited wealth of inter-expert scientific texts and spaces.

Expanding the Notion of Science Writing

Ecology—the study of relationships between the living and nonliving—is a discipline shaped by leaders that borrow(ed) the name *writer* as easily as *scientist.* Modern U.S. environmentalism is as readily traced to Aldo Leopold's pen as any pipette; similarly, the U.S. Environmental Protection Agency has called itself the "extended shadow" of Rachel Carson's *Silent Spring* (Lewis). Contemporary leaders discussed within this collection, such as Robin Wall Kimmerer, epitomize the tradition of moving science from a private laboratory to the public library. Yet few of the >9,000 ecology students trained annually will become science popularizers (Data USA). Most science stories never escape the Ivory Tower—instead, they hang in posters pinned to universities' halls, echo in closed conference rooms, or join the ever-expanding body of disciplinary knowledge (Baron 3). This insularity, in turn, perpetuates the illusion that such inter-expert science communications are isolated from the humanistic influences self-evident in popular science writing.

Examining how we teach U.S. ecologists shatters this illusion. The humanities appear in our scientific textbooks. *The Princeton Guide to Ecology*, an authoritative textbook in the field, highlights publications by William Wordsworth and Henry David Thoreau as “Milestones in Ecology” (Morris 764–5). The humanities appear in our conferences. The 2022 Tri-Societies international conference (celebrating agronomy, crop science, and soil science) featured readings from Virgil’s *Georgics* and open-mic poetry slams. Humanists, themselves, appear in our journals with calls for “deeper integration between the two fields” (Druschke and McGreavy 51). Evidently, the humanities haunt most “scientific” spaces.

Yet merely highlighting these appearances undersells humanistic influence on ecological sciences, particularly the influence of writing. I teach from the text *Writing Science* by ecologist Joshua Schimel, which he bookends with a simple claim: “As a scientist, you are a professional writer” (3, 204). Truthfully, every step of the scientific process requires us to write, and those who write well shape scientific exploration. New scientific ideas are born in grant writing, where persuasive writers steer funding into the problems they convince us merit investigation. We write protocols to define our investigative approach, and we chart our progress in written activity reports. We write academic articles to decipher this progress, and the act of writing with coauthors distills and refines our conclusions. Our final products are stories about our data that must be good enough for others to read, share, and amplify, because we measure scientific impact not just by how many papers we publish, but by how often others cite them (e.g., the h-index). None of these written products are intended for the public. Yet they are persuasive, rhetorical acts, which support Schimel’s claim that successful ecologists are those who shift perspectives from “treating writing as something a scientist *does* […to] treating *being a writer* as something a scientist *is*” (6).

Still, my examples of inter-expert writing likely conjure the image of dry, data-dense reports far diverged from *Braiding Sweetgrass*. To continue shattering the illusion, consider one of the most competitive and prestigious grants for ecology students. The U.S. National Science Foundation's Graduate Research Fellowship Program draws >10,000 annual applicants, of which about 3 in 20 students are successful (Hu). Their success hinges on two core components: a research statement (the story of the *science*) and a personal statement (the story of the *scientist*). Personal statements are a call to "[w]eave together your personal story with your academic and career plans and past experiences […]" (NSF). Skimming hundreds of successful examples unveils classic storytelling elements (Lang). Scientists-turned-narrators shed the royal pronouns and passive voice to reclaim the personal *I*. Some write love letters—where we first bumped into science, how we fell in love, and why we've committed for the long-haul. Some write memoirs. My proposal opened with a childhood spent catching blue crabs along Assawoman Bay, where I witnessed an ecosystem's decline that drives my research today. Others write eulogies—a mourning for species we tried, and failed, to save. All borrow elements of mystery: We end on the tantalizing cliffhanger of knowledge yet to be discovered. It is fitting, then, that we call these our grant *narratives*.

Thus, scientists *are* writers, and must be trained as such; however, scientists invest most of their energy into writing not intended for a "general" public. This investment creates a vast yet relatively untapped pool of science stories; and science writing educators have an opportunity to ask, *how can we help students activate the energy trapped in inter-expert science writing?* The next section offers strategies for three approaches to answering this question: (1) teach science students to tell better stories, (2) teach humanities students to access inter-expert science writing, and (3) collocate scientists and humanists to explore existing science stories and co-create new ones.

Bringing an Expanded Notion of Science Writing into the Humanities Classroom

Teaching Science Students to Tell Better Stories (for Scientists)

Helping students access the knowledge trapped in inter-expert science writing begins with making such writing more accessible, a feat accomplished by teaching scientists to tell better stories about their data. While humanists devote ample time to teaching (and practicing) storytelling, scientists stepping into the role of writing instructor may find that their own writing training has been informal. Since many scientists are not formally trained communicators (Ritchie et al.), our writing practices may be shaped by personal anecdotes, trial-and-error, or inheritances from our mentors rather than theory-driven writing pedagogy. However, scientists can readily deploy rhetorically-informed teaching models by adopting three vetted tenets: (1) making writing a habit, (2) writing in multiple genres, and (3) reviewing frequently ("Better Science" 178–80). These methods improve STEM students' writing behaviors and confidence after just two writing workshops ("A Low-Investment" 5).

For science students to tell better stories, they must begin by telling any story—that is, writing must become a habit. Yet putting pen to paper proves challenging for many science students. One common challenge is a lack of time to write. Another challenge is an inability to reckon with the emotions that hinder writing, such as perfectionism and fear of criticism. These emotions feel taboo to acknowledge in "rational" scientific spaces. I address both challenges through frequent low stakes (e.g., short, or ungraded) reflections. I assign weekly journaling on writing successes and anxieties paired with a reading from *The Scientist's Guide to Writing* (Heard 22–9), which normalizes scientists acknowledging and reflecting upon our writing behaviors. Recurring low stakes writing lowers the activation energy needed to spur students into forming positive writing habits, and these habits render revising and refining our science stories a less burdensome task.

Once students begin to write, they must write "early and often" in multiple genres for real audiences ("Better Science" 179). Though scientists' audience is rarely a general public, neither is it uniformly academics within our niche expertise. Readers of top journals (see *Nature* or *Science*) are diverse global experts, and expertise transcends scientists: Ecologists engage local practitioners with lived expertise (foresters, Indigenous land stewards, and beyond), who scientists risk alienating if we assume that our language and values completely overlap. This assumption fails even for the seemingly homogenous audience of "scientific ecologists"—I study soil CO_2 efflux, and I never assume that my peers who study salamander movements or cacao genetics know this term, nevertheless why it matters, much more than a local farmer or a journalist reading *Nature*. As such, any benefits of perpetuating less generally accessible writing practices (under-defining jargon, burying the lede, etc.), even in "inter-expert" writing, do not outweigh the risk: that we lose our reader altogether (Schimel 149). Thus, *all* science writing encompasses genres improved by the adage of "know thy audience," a skill that STEM students themselves recognize as vital (Ritchie et al.). To hone this skill, my students trace transformations of primary scientific writing to new genres—e.g., academically rigorous journalism, such as *The Conversation*—to learn how writers recycle and repackage information for different audiences. Students then transform their own inter-expert writing through a "genre swap" project, in which they choose to write in a new genre (which has ranged from fact sheets to Twitter threads) and reflect on their rhetorical choices. These activities build critical translational writing skills (Beaufort 17–21) and increase students' motivation by giving them agency to choose genres that reflect their interests.[3]

[3] "Optimiz[ing] individual choice and autonomy" is a key strategy for recruiting students' interest under recent Universal Design for Learning Guidelines (CAST).

Students learn to fine-tune writing (of all genres) through feedback from readers with diverse experiences and interests; consequently, frequent reviews are vital in science writing classrooms. Rather than waiting to review full drafts, I incorporate reviews throughout the writing process (outlines, figures, or a single thesis statement). Early feedback reorients students before they submit assignments that miss guidelines or develop illogical arguments. While reviews can occur asynchronously, students enjoy *talking* about writing with their peers and instructor. In Fall 2022, 30% of my students' end-of-semester reviews named feedback through discussion as an aspect of the course that helped them learn. Since one-on-one instructor conferences are time consuming, I supplement with "self-reviews," in which students target and submit evidence of specific revisions (e.g., through tracked changes in Microsoft Word).[4] Overall, these experiences improve students' writing during class and prepare them to engage in formal peer review during their careers, both as reviewees writing and reviewers assessing inter-expert science writing for more accessible stories.

Teaching Humanities Students to Access Inter-Expert Science Writing (for Humanists)

Some of the best writing educators that I have had the pleasure of working alongside found working with science students an intimidating task—if instructors struggle to pronounce phytate mineralization, could they critique a paper written on it? It is unreasonable for humanists to extend themselves into niche scientific expertise; instead, those tasked with teaching writing that incorporates science can encourage students to access inter-expert science writing by finding writing worth reading, then reading like a scientist.

Students struggle to find sources from scientific journals because the quantity and specificity of articles render sifting for relevant knowledge overwhelming. To mitigate these

[4] I use Schimel's end-of-chapter exercises.

issues, I offer two suggestions. First, direct students to journals that require "Plain-Language Summaries"—a second abstract stripped of jargon to reach broader audiences. These simplified abstracts allow for rapid sorting of materials to identify papers worth reading closely. Second, direct students to syntheses on a current state of knowledge, such as literature reviews or meta-analyses, to glean trends and knowledge gaps. These genres speak holistically while maintaining the rigor of scientific peer review, which popular science books often lack.[5]

After finding writing worth reading, teach students to read science stories like a scientist. Students learn critical reading strategies in a literary context and, while activating prior knowledge generally is helpful, when students misapply that knowledge to a new disciplinary context it obstructs their learning and performance (Ambrose et al. 21). In this case, students likely learned to carefully read papers from start to finish; but few scientists read papers this way (Pain *passim*). Rather, most skip to the discussion for key takeaways (Pain *passim*). I find students stuck amid technical details of methods that scientists themselves rarely read (unless they plan to replicate an experiment). Instead, humanities students can critique science papers through credibility assessments suited for any primary literature source (the journal's legitimacy, the authors' vested interests, etc.). Moreover, students from "nonscience, nonquantitative backgrounds" will find that most flawed science falls prey to logical fallacies that are the backbone of argumentation: "the data are flawed or unrepresentative, or the conclusions and interpretation are unjustified. Students do not need […to be scientists] to spot these problems" (West and Bergstrom).[6] Without opening the "black box" performing a technical method, students can still critique the data that go into science stories and the conclusions that come out (West and Bergstrom).

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[5] Consider *The Hidden Life of Trees* by Peter Wohlleben, a book publicly popular yet so scientifically controversial that scientists started a petition "about how we represent scientific knowledge to the lay public" which garnered >4,500 signatures (Kingsland).

[6] See Bergstrom and West for free curricular resources.

Together, these strategies encourage humanities students to find, read, and critique science papers like a scientist. By engaging with inter-expert science writing, students can access cutting-edge knowledge for countless applications: to enrich literary interpretations with the biophysical context from which a piece arose; to confirm translations of species' names; to complicate representations of environmental disasters in contemporary texts; to contest "hard" science fiction; and more. Beyond their scholarship, students need these skills in their lives: Accessing primary scientific knowledge is essential for critical thinking and rational decision making in an era of mounting misinformation (West and Bergstrom).

Collocating Scientists & Humanists (for All)

The previous strategies envisage classrooms with instructors of one expertise teaching students about another. However, such disciplinary divides may not reflect humanities classrooms as increasingly transdisciplinary. One way to lean into this transdisciplinarity is to co-locate scientists and humanists—that is, to help humanities students not only access scientific texts, but the spaces where science happens. Accessing such spaces bypasses the issue of knowledge captive in inter-expert science writing by empowering students to uncover it themselves: for students to experience their own encounters with and within ecosystems, and to record their reflections alongside scientists.

Such efforts are not new. Scattered across the U.S. are ecological research programs dedicated to centuries-long, place-based observations in which scholars spanning disciplines congregate to explore their own questions and to enrich others' explorations. Perhaps the most well-known is the Long-Term Ecological Reflections Project (LTERP). LTERP has supported projects like *The Forest Log* (Brodie et al.), a 200-year writing collection that parallels science datasets at the H.J. Andrews Experimental Forest (Oregon, U.S.). These arts-humanities-science collaborations increase participants' knowledge of, attitudes towards, and motivations to learn about ecological processes, as well as increase empathetic awareness of more-than-human others (Goralnik et al. *passim*). Yet the LTERP network is only one of many such opportunities for humanities' instructors to access scientific spaces.[7] The National Ecological Observatory Network, Critical Zone Collaborative Network, and countless others represent resources for educators to visit local sites with students alongside ecologists, craft writing inspired by students' observations, and preserve this writing in long-term records.[8]

Co-locating students is mutually enriching. Humanities students learn the *why* behind their observations and how mechanistic explanations for ecological phenomena arise from these very acts of observation.[9] In essence, they learn how "science" happens and can use it to inform interpretations of others' writing and (or) to inspire their own. Simultaneously, science students learn the *how to* for new, and improved, ways to express these data and processes in their own stories.

Concluding Thoughts

Teaching ecology and English students has taught me that both share common frustrations—one wants to share their knowledge but dreads the act of writing about it; one wants to gain that knowledge but dreads wading through jargon to find it. This "fear factor" formed in students shapes their careers and lives (Baron 103–4). Science students who fear writing risk telling stories read by few or misunderstood by many, and humanities students who

[7] By *scientific spaces*, I mean physical spaces where science happens, not that such spaces "belong to" scientists. Rather, humanist collaborations may help scientists reckon with the (oft-fraught) histories of these spaces in hopes that we might decolonize and reimagine them.

[8] While I encourage using "scientific" spaces to collocate humanists' and scientists' research, students can experience rich observational encounters in any outdoor spaces (see Miller's essay in this collection).

[9] A classic example is how ecologist Robert MacArthur observed birds feeding in a forest to elucidate the ecological niche, an invaluable insight formed without the technological assistance of so much as a stopwatch (603).

fear engaging with the science risk misunderstanding it or, worse, never encountering it at all. My goal as an instructor is to move students from this place of fear to one of discovery, even joy, and the humanities classroom is an excellent vehicle. Positive, lasting encounters with science writing in the humanities classroom takes many forms. For science students, it may be when they first tell a story that makes their science matter to a new audience; for humanities students, it may when they first wield data to clinch their claim. Popular science writing facilitates these encounters, but we can complement such efforts with the communications in which scientists most invest—inter-expert science writing.

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