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Title

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Permalink

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Journal

Science Education, 104(2)

ISSN

0036-8326

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Publication Date



2020-03-01

DOI

10.1002/sce.21560

Peer reviewed

Preservice secondary science teachers' understanding of academic language: Moving beyond "just the vocabulary"

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Funding information

National Science Foundation,
Grant/Award Number: DUE-1439923

Abstract

To prepare preservice secondary science teachers to teach English learners (ELs), teacher education programs must provide sustained coursework and experiences in principles and strategies found effective in supporting ELs' learning of science. In the context of a teacher education program recognized for its attention to ELs, we investigated seven preservice secondary science teachers' understanding of academic language and of how to support EL students' use of academic language. More specifically, over the course of their 13-month program, we examined changes in (a) preservice teachers' understanding of the three levels of academic language (i.e., lexical, or vocabulary; syntactic, or sentence; and discursive, or message) and (b) the types of instructional support they reported using at each level (e.g., peer collaboration at the discursive level). We also compared their understanding of academic language and instructional support both to their experienced cooperating teachers' understanding and to their actual classroom practice. From qualitative analysis of data collected, we found that preservice teachers understood academic language as more than just vocabulary—as spanning lexical,



syntactic, and discursive levels—although they reported implementing more types of supports at the lexical and discursive levels than at the syntactic level. We also found that preservice teacher participants' understanding of academic language and instructional support resonated with that of their cooperating teachers and with their own classroom practice. We close with discussion of ways teacher education programs can deepen and broaden preservice secondary science teachers' understanding of the role of academic language in ELs' science learning

KEYWORDS

academic language, English learners, preservice secondary science teachers, science teacher education

1 | INTRODUCTION

Students designated as English learners (ELs)¹ are the fastest growing group of students in K-12 public schools across the United States (National Clearinghouse for English Language Acquisition, 2011). They currently account for more than nine percent of students enrolled in U.S. classrooms (National Center for Education Statistics, 2016). EL students include both those who have recently immigrated to the U.S. and those born in the U.S. who speak a home language other than English (National Academies of Sciences, Engineering, & Medicine, 2017). They are a heterogenous student group, varying in terms of their language and literacy backgrounds, including home language and number of and proficiency in languages spoken; country of origin, ethnicity, and culture; levels and quality of their prior schooling; personal history; gender identity and sexual orientation; and socioeconomic status. Traditionally, they have not been well served in science classrooms (National Academies of Sciences, Engineering, & Medicine, 2017).

ELs' increasing classroom presence has prompted teacher education programs to focus more intently on preparing their preservice secondary science teachers to effectively integrate science content and practices with English language and literacy development—to move beyond using a list of general supports to implementing coordinated, disciplinary-specific principles and strategies (Heineke, Smetana, & Sanei, 2019; Johnson, Bolshakova, & Waldron, 2016; Lyon, Tolbert, Stoddart, Solis, & Bunch, 2016). By the time preservice teachers complete their credential requirements, to be adequately prepared to teach all students, they must be able to elicit, value, and use the diverse languages, cultures, and experiences of ELs as resources for the teaching and learning of their science discipline (National Academies of Sciences, Engineering, & Medicine, 2018). More specifically, as part of their preparation, preservice teachers must learn to recognize and use both their students' own languages and the *academic language of science*² to facilitate their development and communication of scientific understandings.

In this study, we define academic language as comprising the *functions* (i.e., the purposes for using language, such as constructing explanations or arguing from evidence) and *forms* (i.e., the linguistic structures used to realize those functions) used in scientific reasoning and sense-making (Dutro & Moran, 2003). We also understand language forms to comprise three interrelated levels: the *lexical*, or vocabulary, level; the *syntactic*, or sentence, level; and the *discursive*, or message, level (Schleppegrell, 2004). Further, we emphasize that even in a science classroom, academic language is not homogenous but involves multiple *registers*. A register is a variety of language distinguished by lexical, syntactic, and discursive features that are characteristic of a particular communicative context; important contextual dimensions such as the topic, audience, and mode of communication (i.e., oral, written, or multimodal) shape the language forms students draw on to complete a particular task



(Schleppegrell, 2018). Thus, for example, the language students use to collaboratively conduct a small group investigation and the language they use to individually write a formal laboratory report are considered two distinctive registers of the academic language of science. Although these registers differ in form, in both contexts, students are using academic language to carry out valued disciplinary activity. In sum, then, we understand the academic language of science to comprise the functions and forms (at the lexical, syntactic, and discursive levels) of multiple, related registers.

Despite the central place of academic language in the recent *Next Generation Science Standards* (NGSS, NGSS Lead States, 2013) and broad scholarly agreement that content area teachers must attend to the language demands of their courses (Bunch, 2013; Lee, Quinn, & Valdés, 2013; Lee, Llosa, Grapin, Haas, & Goggins, 2019; Lyon et al., 2016; Schleppegrell, 2004, 2018), few studies have documented how preservice secondary science teachers understand academic language or scaffolding academic language demands. In response to this gap in the literature, we investigated seven preservice secondary science teachers' understanding of academic language, the types of instructional support they implemented to scaffold ELs' academic language use, and the successes and challenges they experienced in teaching academic language to ELs in their secondary science classrooms. Preservice teacher participants were enrolled in a small, 13-month, postbaccalaureate teacher education program that intentionally integrated instruction about ELs across courses. As recipients of a Noyce scholarship, they had committed to teaching in a high-needs school upon graduation. The following two sets of questions guided our research: (a) How did preservice secondary science teacher participants conceptualize academic language, in general, and academic language as spanning the lexical, syntactic, and discursive levels of language (i.e., the levels of vocabulary, sentence, and message; Zwiers, O'Hara, & Pritchard, 2014), in particular? How did their understanding of academic language change over the course of their teacher education program? How did their understanding compare to that of the cooperating teachers who supervised their student teaching experiences? (b) How did preservice teacher participants understand different types of instructional support to scaffold EL students' academic language? How did their understanding of supports change over time? How did their understanding as articulated in interviews compare to their enactment in lessons?

2 | CONCEPTUAL FRAMEWORK

Our conceptual framework is composed of two parts: conceptions of academic language, including types of support to help address academic language demands, and guiding principles for effective instruction of ELs in science. At the framework's base is a situated theory of teacher learning. A situated theory considers all learning to occur in a context and for that context, associated activity, and tools to contribute to what is learned (Brown, Collins, & Duguid, 1989; Greeno, 2006; Putnam & Borko, 2000). It also understands learning to be immersed in and developed through social interactions: Learning is conceptualized as increased participation in a community's practices as well as an individual's development and use of knowledge as a result of participating in that community (Borko, 2004; Lave & Wenger, 1991; Putnam & Borko, 2000; Sawyer, 2006).

2.1 | Academic language in science classrooms

We begin our discussion of academic language by recognizing that all students' languages and all language registers can be productive for scientific reasoning and sense-making. We recognize that attention to discourse as a critical component of the social practice of science classrooms is not new (Kelly, 2007; Lemke, 1990). However, we have chosen to focus on academic language because of the challenges encountered both by students who are learning to interpret and produce academic language and by preservice secondary science teachers who are learning how to identify and support academic language demands in their lessons. To ignore the distinctive and often unfamiliar

functions and forms of academic language is to downplay the challenges such language poses for all students, but especially for students who are still in the process of acquiring proficiency in English.

2.1.1 | Definition of academic language

As introduced above, we understand the academic language of science to comprise the functions and forms of multiple, related registers used to engage in scientific sense-making and reasoning. Each of these registers will vary according to the purpose of communication, the topic, the relationship between speakers/writers and their audience, and the mode of communication (i.e., oral, written, or multimodal; Schleppegrell, 2002, 2004). Gibbons (2003) provided a clear illustration of how students draw on three different registers as they move across communicative contexts in a lesson cycle. First, when students share a common experience and physical environment, as in a collaborative investigation, the language they use does not need to be explicit to be effective: Students can rely on paralinguistic cues (e.g., gestures and body language) as well as deictic expressions (e.g., this, that, here, there, or now) to communicate efficiently. At the same time, because language during an investigation is contingent on unfolding activity, it is spontaneous rather than planned. Second, when communication is not grounded in an immediate shared experience, as when small groups report out to peers who conducted different experiments, language itself needs to carry more meaning. Consequently, although students can continue to use paralinguistic cues and adjust their message as they gauge their audience's understanding, they need to use language that is more explicit and intentionally structured. Third, when communicating in writing for an audience who is not immediately present, as when students write a lab report, language must be maximally explicit and purposefully structured. Across these contexts, the language students use also becomes more detached, as students move from an involved, personal style expected in face-to-face interaction to the more impersonal style characteristic of academic writing. In short, these three registers described above span a continuum from the informal and conversational to the formal and literate, but we consider them all to be examples of academic language, as students are using language to engage in scientific sense-making and reasoning.

Across different registers, academic language is used to accomplish a range of functions, or purposes for using language. In a science classroom, core disciplinary practices—such as developing and revising models, analyzing and interpreting data, arguing from evidence, and constructing explanations—constitute the overarching analytic tasks that drive language use. These broad language functions, in turn, entail a range of more specific language functions, such as defining, classifying, quantifying, comparing and contrasting, making a claim, evaluating, and justifying. Moreover, when students are engaged in collaborative sense-making and reasoning, they will use language functions such as asking questions, making requests, issuing directives, and expressing agreement and disagreement.

In addition to language functions, academic language registers can be described in terms of distinctive language forms. In this paper, we have organized academic language forms in relation to three interconnected levels of language: lexical, syntactic, and discursive (Zwiers et al., 2014). At all three levels, language forms vary across registers, and so we have highlighted relevant language forms typical of both more formal written registers and less formal spoken registers. These descriptions are not meant to be comprehensive, but to indicate the range of language demands that may prove challenging to students. At the lexical level, academic language includes discipline-specific terminology; words that have both commonplace and specialized, technical meanings; words that occur with relatively low frequency outside of academic contexts but that are common across multiple content areas; and common, everyday words (Fang, 2005, 2006; Snow, 2010). Specialized terms represent critical disciplinary concepts linked by various semantic relationships (e.g., taxonomic or logical; Lemke, 1990) into conceptual networks and are an important resource for communicating precise disciplinary meanings in formal oral and written registers. At the syntactic level, formal written registers are typically dense and abstract, as writers frequently use nominalizations (i.e., nouns created from adjectives or verbs) and embedded clauses to condense a great deal of information into long, complex noun phrases that can be difficult to parse (Fang, 2005). While informal



spoken registers may not necessitate such complex grammatical forms, they do require that speakers know how to ask questions or make suggestions to participate effectively in interactions (Schleppegrell, 2018). Further, syntax level demands also include creating and deciphering figures, graphs, tables, diagrams, and other scientific inscriptions (Quinn, Lee, & Valdés, 2012). At the discursive level, formal scientific writing is typically tightly structured so that arguments or explanations can build cumulatively. Consequently, writers use a variety of linguistic forms to signal logical relationships and create textual cohesion (Schleppegrell, 2002). They also typically create an objective, authoritative relationship between themselves, their subject matter, and their audience (Schleppegrell, 2004). In contrast, in oral interactions, structure is emergent, and speakers must know how to build on one another's contributions to collaboratively construct new understandings. Because language forms at all three levels are important for doing and communicating science, we sought evidence that our participants understood academic language to include lexical, syntactic, and discursive features.

2.1.2 | Types of academic language instructional support

In considering how preservice science teachers should scaffold academic language demands, we drew from both research and practitioner-oriented literature on effective practices for supporting disciplinary language use. As such, we identified five categories of instructional support: (a) providing context for language, (b) attending to language comprehension, (c) attending to language production, (d) incorporating students' existing language and linguistic practices, and (e) general strategies that are effective with but not specific to ELs.

To elaborate, one category of academic language support involves creating meaningful contexts for using the disciplinary language of science. This category includes such supports as providing contextualizing phenomena in written formative assessment tasks (Kang, Thompson, & Windschitl, 2014) and grounding lessons in hands-on investigations that contextualize key vocabulary and academic language functions (Lee & Buxton, 2013). Research makes clear that preservice teachers need additional support in learning to provide appropriate and relevant context to frame their units and lessons (Tolbert, Knox, & Salinas, 2019).

A second category of support ensures spoken and written texts are comprehensible to EL students. In modifying input, teachers must make certain that adjustments neither undermine the cognitive demand of the content examined nor the authenticity of the disciplinary language used. For these reasons, teachers are advised to plan for message abundancy (Gibbons, 2015): to provide students numerous ways to access the same content by communicating information through multiple channels (e.g., speech, gestures, visuals, and demonstrations), speaking slowly and clearly, and augmenting rather than simplifying texts. Use of word learning strategies is also encouraged, including supplying definitions, decomposing terms into constituent roots and affixes, and identifying cognates (Nutta, Strebel, Mokhtari, Mihai, & Crevecoeur-Bryant, 2015); care must be taken to incorporate such strategies after students have had the opportunity to develop conceptual understandings using more familiar, everyday registers (Brown, Donovan, & Wild, 2019).

A third category of language support is directed at helping students produce spoken and written discourse. Such output-focused supports include providing explicit modeling and examples of the target language (Walqui, 2006), including teacher-led deconstruction, reconstruction, and metalinguistic discussion of salient syntactic- and discursive-level structures (Gibbons, 2015; Zwiers et al., 2014); thoughtfully implementing peer collaboration, such as think-pair-share and small groupwork (Windschitl, Thompson, & Braaten, 2018); using sentence frames or starters, which can help to structure oral and written output, again at both the syntactic (Dutro & Moran, 2003) and discursive levels (Zwiers et al., 2014); clarifying task expectations using examples of student work (Walqui, 2006); and providing students with rubrics and checklists (Kang et al., 2014).

Further, as teachers strategically integrate different types of support to help students interpret and produce academic language, it is crucial that they do so in ways that also recognize, validate, and leverage students' existing languages and linguistic practices. Although the formal language of science appears quite distinct from everyday

language, science and everyday discourse are interrelated, and synergistic, speaking to a crucial coherence that employs different methods for depicting reality (Bunch, 2006; Halliday & Matthiessen, 2004). Consequently, the teaching of formal scientific registers is not meant to replace everyday language but rather to provide students with an expanded array of tools for different communicative purposes (Lee, Quinn, & Valdés, 2013). For Lemke (1990), the greatest challenge science teachers experience is how to bolster students' ability to build associations across differentiated types of discourse, from everyday language to formal disciplinary discourse. For example, teachers can begin an instructional unit using everyday language and help students gradually transition to more formal scientific registers (Brown & Ryoo, 2008). Similarly, teachers can encourage students to draw on their home languages when sharing their ideas both orally and in writing (Hudicourt-Barnes, 2003; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). We add that this fourth category of language support intersects with our second category of support presented above as well as our EL principle of recognizing and building from students' funds of knowledge discussed below.

Finally, our fifth category includes strategies that are effective with but not necessarily specific to EL students. As one example, teachers are encouraged to differentiate their instruction so as to increase the quality and quantity of opportunities for students to describe their reasoning and engage in sense-making (Zwiers et al., 2017). As a second example, teachers can organize information into more manageable chunks to help students better understand and make progress on their readings, tasks, and/or assignments (Echevarría, Vogt, & Short, 2013).

2.2 | Guiding principles for English learner instruction in science

The second part of our conceptual framework includes four guiding principles integral to the effective instruction of ELs in science: (a) identifying academic language demands and supports for ELs, (b) providing students opportunities for rich language and literacy exposure and practice, (c) building on and using students' funds of knowledge and resources, and (d) providing students with cognitively demanding work (2017, 2019). In delineating this set of four principles, we recognize that ELs are diverse in terms of home language, biliteracy, language proficiency, ethnicity, culture, and prior experience (see again Section 1) and that other conceptual frameworks resonate with what we propose here (see Section 3). We view these principles as providing secondary science teacher educators and their preservice teachers with a comprehensive and coordinated approach to teaching diverse ELs science. We also understand these principles to intersect with and support one another; although presented as a list, they are better visualized as a Venn diagram.

2.2.1 | Identifying academic language demands and supports

This first principle most clearly resonates with and builds from our discussion of academic language presented above. It requires teachers to identify those aspects of language that might prove challenging to ELs and to provide adequate scaffolding for students to interpret and produce language (O'Hara et al., 2017; Rosebery & Warren, 2008). Teachers must begin by recognizing that academic language does not mean a list of vocabulary words with precise meanings, but rather the communicative competence necessary and sufficient for full participation in science discourse (Bunch, 2013; Moschkovich, 2012). They must attend to the academic language demands present in tasks across the three language levels (Zwiers et al., 2014) and the four communicative skills of reading, listening, speaking, and writing. They must also provide appropriate types of instructional support for ELs to engage with scientific sense-making and language use (Tolbert et al., 2019)—from reading disciplinary texts, to sharing their ideas and reasoning in whole class and small group discussions, to writing about their science explanations and arguments. Indeed, attention to this principle is argued to distinguish “just good teaching” from effective instruction for ELs (Cohen & Lotan, 2014).

2.2.2 | Providing students opportunities for rich language and literacy exposure and practice

This second principle attends to the importance of offering ELs multiple opportunities to understand, engage with, and produce academic language (Bleicher, Tobin, & McRobbie, 2003; Lee et al., 2013). Teachers should create opportunities for students both to receive comprehensible input and to produce comprehensible output so that they can participate in negotiations of meaning needed to advance both their English language acquisition and their science learning. Given the first principle, teachers must include adequate scaffolds for students to take up these opportunities.

2.2.3 | Building on and using students' funds of knowledge and resources

This third principle emphasizes the identification, celebration, and use of the knowledge and skills students, their families, and their communities bring to the science classroom (Moll, Amanti, Neff, & Gonzalez, 1992). Examples of relevant practices include soliciting ELs' prior knowledge and experiences; recognizing and utilizing ELs' home languages as resources for learning; encouraging ELs to speak in multiple languages, use different dialects, and/or work across varying levels of literacies in their production and display of ideas; and incorporating cultural and community resources into instruction to make content relevant and meaningful.

2.2.4 | Providing students with cognitively demanding work

This final principle asks teachers to provide opportunities for ELs to engage in the same kinds of activities and assignments they often reserve only for non-EL students (Lee et al., 2019; Understanding Language, 2013). Cognitively demanding tasks require students to move beyond "detailed facts or loosely defined inquiry" (Lee et al., 2013, p. 223) to focus on the science and engineering practices, crosscutting concepts, and core ideas identified in the NGSS (NGSS Lead States, 2013). Such tasks are expected to prompt student reasoning and sense-making about natural phenomena, local contexts, and/or socioscientific issues (Windschitl et al., 2018).

3 | SITUATING OUR STUDY IN THE LITERATURE

As stated in Section 1, there are few existing studies that investigate preservice secondary science teachers' understanding of academic language demands and supports in teaching ELs (e.g., Lyon et al., 2018; Roberts, Bianchini, Lee, Hough, & Carpenter, 2017). Our study responds to recent calls for teachers to organize their science content and language instruction around a comprehensive EL framework rather than to simply implement a list of disconnected instructional supports (Heineke et al., 2019; Johnson et al., 2016; Lyon et al., 2016, 2018; MacDonald, Miller, & Lord, 2017; Understanding Language, 2013). Lyon et al. (2016, 2018), for example, constructed the SSTEM framework to support their preservice secondary science teachers' learning about effective EL instruction. The SSTEM framework was informed by the intersection of the NGSS (NGSS Lead States, 2013) and *Common Core State Standards in English Language Arts* (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) and was organized around four coordinated practices: Preservice teachers were expected to use contextualized learning activities as a gateway to instruction, facilitate students' scientific sense-making, engage students in scientific discourse, and promote students' English language and literacy development.

Our study also builds on previous research investigating science teachers' understanding and implementation of academic language across the learning-to-teach continuum and grades preK-12 levels. A number of these studies

highlight the importance of moving beyond the teaching of vocabulary (i.e., the lexical level) to attend to the syntactic and discursive levels of language as well (Dong, 2002; Heineke et al., 2019; Mangiante, 2018; O'Hara et al., 2017; Richardson Bruna, Vann, & Escudero, 2007). Richardson Bruna et al. (2007), for example, investigated a high school teacher teaching an English Learner Science course primarily to Latinx students. Researchers found that Ms. Crabtree equated instruction in academic language with the teaching of vocabulary, failing to attend both to the important semantic relationships among the phenomena she asked her students to examine and to the linguistic resources they needed to express those relationships. As such, she tightly constrained classroom discourse, preventing ELs not only from talking like scientists but from thinking like scientists as well. In contrast, O'Hara et al. (2017) provided professional development opportunities focused on academic language and literacy development in STEM to teams of practicing middle school teachers. Professional developers emphasized three aspects of complex academic language use: interacting with complex texts, fostering academic interactions, and fortifying academic output. Their findings suggest that the program helped to strengthen teachers' knowledge of and practices in supporting students' use of complex academic language as well as their understanding of STEM concepts.

Several other studies that investigate science teachers' understanding and implementation of academic language across the learning-to-teach continuum and grades pre-K-12 levels underscore the challenges teachers encounter in their efforts to effectively scaffold ELs' science content and language learning (Buck, Mast, Ehlers, & Franklin, 2005; Cho & McDonnough, 2009; Roberts et al., 2017; Swanson, Bianchini, & Lee, 2014). As one example, the 33 practicing secondary science teachers surveyed by Cho and McDonnough (2009) had limited knowledge of the range of instructional supports effective in scaffolding academic language: They did not know how to scaffold their EL students beyond giving them extra time to complete tasks. As a second example, the beginning middle school science teacher investigated by Buck et al. (2005) grew to see the importance of implementing different types of supports to engage her ELs in cognitively demanding content over time. However, she found meeting the needs of ELs a more challenging and complex endeavor than she had originally envisioned: Types of instructional support learned in teacher education needed to be substantially modified or abandoned in light of actual classroom constraints. As a final example, Swanson et al. (2014) found that a practicing high school science teacher, Ms. H, regularly attempted to engage her ELs in disciplinary talk and practices, in particular, generating and evaluating arguments from evidence, sharing ideas and understandings with others in public forums, and using precise language. To do so, she implemented a number of different types of supports, including home language, groupwork, revoicing of student ideas, templates, and graphic organizers. Still, researchers found that Ms. H's EL students did not participate as often as their English-speaking peers in whole class discussions and struggled to inscribe their oral small group interactions into their written posters.

Our study attempts to understand the successes and struggles of preservice teachers in teaching ELs rigorous, reform-based science at the secondary level so as to inform both science teacher education for beginning teachers of ELs and science instruction for ELs themselves. More specifically, our study contributes to the existing literature on the teaching of academic language to secondary students, who possess more sophisticated linguistic and cognitive strengths and are asked to negotiate more complex concepts and texts than younger students (Harper & de Jong, 2004). It attempts to provide new insights into preservice secondary science teachers' understanding of academic language by focusing in on (a) language form as represented by lexical, syntactic, and discursive levels, a central aspect of the construct of academic language and registers; and (b) types of instructional support, a central aspect of our first principle for effective EL instruction (i.e., academic language demands and supports). In other words, this study interrogates participants' understanding of the teaching of academic language as the intentional integration of instructional supports with language levels rather than the mere teaching of vocabulary. Further, this study teases apart the successes and challenges in preservice secondary science teachers' efforts to understand and support academic language across multiple dimensions: by investigating their understanding across time in a teacher education program, in relation to their more experienced cooperating teachers, and as compared to their actual classroom practice.



4 | METHOD

4.1 | Teacher education context

As introduced above, our seven preservice secondary science teacher participants were enrolled in a small, 13-month, postbaccalaureate teacher education program located at a research university in California. Participants moved through the program as a cohort, participating in secondary science classrooms during the day and taking courses at the university in the evenings. They completed three sets of courses and experiences designed to support their learning about ELs and effective ways to teach them.

As one set of experiences, preservice teacher participants completed three student teaching placements in grades 7–12 science classrooms. Across these three science placements, they moved from conducting observations at the beginning of the school year, to periodically teaching a lesson or lesson series, to serving as the primary instructor of one course for the entire second semester; this last placement was called their second semester takeover. During each placement, they also observed and participated in a second class—a literacy placement—where students benefited from additional instructional support in literacy. Such classes typically had substantial numbers of ELs and/or special education students in them and were focused on English, mathematics, or science. Further, preservice teachers were supervised by experienced cooperating teachers, a school site supervisor, and a university supervisor. Finally, they were enrolled in a year-long professional issues in science teaching course, where they discussed connections between theory and practice and reflected on their student teaching placement experiences with a science teacher educator (i.e., the university supervisor).

A second set of courses related to language and literacy: Preservice teachers completed one course on academic language, a second on academic language instructional support, and a third on reading and writing in content areas. Collectively, these courses explored the diversity of ELs, provided foundational information about academic language, and identified best practices for supporting ELs in their understanding of language development and disciplinary content. The courses defined academic language as more than discipline-specific vocabulary (Bunch, 2013; Moschkovich, 2012); rather, academic language was presented as an essential mediator of the teaching and learning process that helps students access and communicate their understanding of core ideas (Dutro & Moran, 2003; Lee et al., 2013) using functions across the lexical, syntactic, and discursive levels of language (Zwiers et al., 2014).

Finally, preservice teacher participants enrolled in three methods courses. In the first two of these courses, they examined the recently adopted *NGSS*, theories of student learning, and examples of reform-based science curriculum, instruction, and assessment. Preservice teachers were given two options for their third methods course: Five enrolled in an integrated science and mathematics methods course focused on teaching these disciplines to ELs and two, in a bilingual methods course. For additional information about this third methods course, see Roberts and Bianchini, 2019.

4.2 | Preservice teacher participants

For this study, we focused on seven of the 12 preservice secondary science teachers enrolled in the teacher education program described above during the 2015–2016 academic year. These seven were awarded a Noyce scholarship and, as such, were committed to teaching in a high-needs school upon graduation (the other five were not Noyce awardees). Five completed their second semester takeover in a class with one or more ELs; the other two taught in classes that included at least three students who were reclassified as English proficient. ELs spoke a variety of home languages, including Spanish, Mandarin, and Bulgarian, and ranged in English proficiency from emerging, to expanding, to bridging. Table 1 provides demographic information about our participants and their second semester takeover.

TABLE 1 Preservice teacher participants' demographic and classroom placement information

Name	Race/Ethnicity	Gender	Previous K-12 teaching experience	Teaching credential(s)	Takeover placement school	Takeover placement course	# of EL students	# of reclassified EL students
Adam	European American	M	Substitute Teacher	Biology	Foothill High	Biology	1	0
Caitlyn	European American	F	-	Physics and ITE	Foothill High	Physics	0	4
David	Vietnamese American	M	Outdoor Science Instructor	Biology	Seaside Jr. High	Life Science	6	0
Haylee	European American	F	Outdoor Science Instructor	Physics and ITE	Foothill High	Physics	0	3
Kari	European American	F	Teacher of English Abroad	Biology	Seaside Jr. High	Life Science	1	13
Molly	European American	F	Outdoor Science Instructor	Biology	Summit Jr. High	Life Science	7	10
Sasha	European American	F	Classroom Aid	Biology	Mission High	Biology	8	0

Note: Race/ethnicity was self-reported. All preservice teachers reported speaking English as their primary home language. The ITE credential, or Industrial and Technology Education Credential, allows physics teachers to teach engineering courses as well. Physics courses were taught in an engineering academy.
Abbreviation: EL, English learner.

Scores from the edTPA, a teacher performance assessment required by California and a number of other states for credentialing purposes, suggest that the participants in our study were *well-started beginners* (Hollon, Roth, & Anderson, 1991). The edTPA consists of three sections: planning, instruction, and assessment. It requires preservice teachers to teach a series of lessons and to submit written reflections, instructional materials, video clips of instruction, and analysis of student work related to those lessons. It also specifically assesses preservice teachers' ability to identify and support the language demands of their lesson series (defined as language functions, vocabulary, syntax, and discourse) and to analyze their students' language use and learning. In California, at the time of this study, the minimum total score needed to pass the edTPA was 42 out of a possible 75. In 2015, the average total score of a national sample of preservice teachers pursuing a secondary science credential ($n = 1,248$) was 45.2 ($SD = 7.6$; Pecheone, Whittaker, & Klesch, 2016). Five of our seven participants scored at least a full standard deviation above this national average (i.e., from 53 to 59); one, over a half standard deviation above (i.e., 51); and one, at the national average. We continue with our discussion of the edTPA under Section 4.3 below.

4.3 | Data collection

The full data set includes individual interviews with preservice teacher participants and their cooperating teachers; focus group interviews with four sets of teacher education instructors and administrators; preservice teachers' edTPA performance assessment portfolios, including two video clips from lessons (totaling 11–17 min in length); and video records from three additional classroom observations of each preservice teacher (one in the first semester and two in the second). The results presented in this paper are based on the individual interviews and edTPA data.

Individual preservice teacher interviews were conducted five times over the course of the program: (a) at the program's beginning in July, (b) at the conclusion of summer courses but before the K-12 academic year began in August, (c) midway through the program in December, (d) midway through their student teaching takeover semester in April, and (e) near the program's completion in June. Interviews lasted between 30 min and 1 hr and were audio recorded. Each interview focused on eliciting preservice teachers' understanding of academic language; the four principles of effective EL instruction (see again Section 2), including their perceptions of academic language demands and supports in science; who ELs are and how to help them learn science; and how their teacher education program supported and constrained their understanding of teaching science to ELs. In addition, interviews 3 and 4 included questions about the class session or sessions researchers were scheduled to observe; interviews 3 and 5, a science task where preservice teachers were asked to evaluate and provide suggested changes to a sample science activity; and interview 5, questions about what preservice teachers learned from completing their edTPA (see Appendix for the Interview 4 protocol).

Individual interviews with cooperating teachers, those who were supervising preservice teachers' second semester takeover, were conducted once in the spring, after preservice teachers were video recorded teaching a series of two lessons. We conducted a total of seven such interviews with six different cooperating teachers; we note that one cooperating teacher, Kate, supervised two preservice teachers, Caitlyn and Haylee. Interviews asked about definitions of academic language, the four principles of effective EL instruction, who ELs are and how to help them learn science, and their own professional training. In particular, cooperating teachers were asked a series of seven questions about the two lessons researchers observed preservice teacher participants teach; these seven questions were the same as those posed to the preservice teachers about these lessons as well. Each interview lasted between 15 and 40 min and was audio recorded.

Preservice teachers' edTPA portfolios were also collected. As explained above, this portfolio assessment includes instructional materials and reflections related to a 3-to-4-day lesson series. For this study, we focused on preservice teachers' lesson plans. Lesson plans ranged in length from four to eight single-spaced, typed pages. We used preservice teachers' edTPA video clips, instructional commentaries (i.e., their description and analysis of how

they engaged and extended student learning in the lessons they video recorded and submitted as part of their edTPA), and copies of their classroom handouts to inform our examination of these plans.

4.4 | Data analysis

Our qualitative analysis of data proceeded in two phases. During our first phase, we began by having the interviews of preservice and cooperating teachers transcribed professionally and checked by research team members for accuracy. We then coded interview transcripts and edTPA lesson plans across two cycles of analysis. Rather than coding predetermined linguistic units (e.g., clauses), we focused on *natural meaning units* (Brinkmann & Kvale, 2015, p. 235), which we defined as the collection of statements related to the same central meaning. In the first cycle, or tier 1 coding, we used four a priori codes constructed from the principles on effective teaching of ELs (i.e., *academic language demands and supports*, *language opportunities*, *funds of knowledge*, and *cognitively demanding work*) and several additional emergent codes (e.g., *ELs as diverse*, *preservice teachers as reflective practitioners*) that became relevant during the process of data analysis (Strauss & Corbin, 1994). During the second, or tier 2, cycle, we narrowed our focus to all meaning units coded during the first round as *academic language demands and supports*. We categorized these units along two dimensions: level of academic language (i.e., *lexical*, *syntactic*, and *discursive*) and type of instructional support (e.g., *word walls*, *sentence frames*, and *peer collaboration*). Table 2 provides a complete list of our tier 2 academic language support codes. For each coding cycle, after collectively defining each code, the same four researchers coded pieces of data individually, met together to discuss codes assigned, and resolved all disagreements through discussion. The final coding reflected group consensus.

During our second phase of analysis, once our tier 1 and 2 coding cycles were completed, the same four researchers conducted specific analyses tailored to each subquestion of the two sets of research questions posed. To answer our first set of questions on preservice teacher participants' understanding of academic language, we focused on the natural meaning units coded as *academic language demands and supports* at each of the *lexical*, *syntactic*, and *discursive* levels. (a) We analyzed how preservice teachers defined academic language across these three levels. (b) We also examined how their understanding of academic language as multileveled changed across their five interviews. We used the intersection of *academic language* and *teacher as reflective practitioner* codes to determine if preservice teachers themselves identified changes in their understanding of academic language over time. (c) Further, we compared preservice teachers' understanding of academic language at the lexical, syntactic, and discursive levels to that of their cooperating teachers. We examined the two groups' responses to the same series of seven questions posed about the lessons we observed during preservice teachers' second semester takeover (i.e., in preservice teachers' Interview 4 and cooperating teachers' single interview) to determine if either or both preservice and cooperating teachers defined academic language as more than just vocabulary.

To answer our second set of research questions related to preservice teachers' understanding and enactment of types of instructional support for ELs, (a) we first examined the range of supports preservice teacher participants described using at each of the three language levels. We identified which types of supports were commonly discussed for each of the three levels; to be considered common, a type of support had to be discussed by a majority of preservice teacher participants (i.e., four or more) in aggregate across the five interviews. (b) To determine whether the types of support participants reported using changed over time, we determined during which interview and at what level each type of support deemed common was introduced by preservice teachers as well as which supports at what level were discussed by a majority in a given interview. (c) Finally, to determine if preservice teachers' reports of instructional supports were enacted in practice, we compared preservice teachers' interviews to their edTPA lesson plans. More specifically, we compared the most common types of support preservice teacher participants reported using in their interviews to scaffold academic language demands at the lexical, syntactic, and discursive levels to the most common types of support they included in their edTPA lesson plans. Parallel to the interview criteria, to be considered common in their edTPA lesson plans, a type of support had to be implemented by a majority of preservice teacher participants.

TABLE 2 Tier 2 codes: Categories, types, and definitions of academic language supports

Category of support	Type of support	Definition
Providing context for language	Hands-on activity	Teacher contextualizes content and language learning by engaging students in a hands-on activity.
	Socioscientific issue	Teacher contextualizes content and language learning using a socioscientific issue (e.g., climate change or genetic engineering).
	Starting with a phenomenon	Teacher contextualizes content and language learning by starting with a complex or puzzling phenomenon—a concrete event or process—rather than an abstract idea (e.g., students watch a video of a parachute opening or a demonstration of a can imploding).
Attending to language comprehension	Guided notes	Teacher provides students with a structured format for recording new vocabulary, taking notes, etc.
	Providing clear directions/ speaking clearly	Teacher makes speech more comprehensible by speaking more slowly, clearly, and/or concisely; attending to clarity of written directions; and/or providing directions in multiple modalities (e.g., spoken and written).
	Structured reading	Teacher uses a strategy such as popcorn reading, reading guides, highlighting and annotating, or Collaborative Strategic Reading.
	Visuals and realia	Teacher uses illustrations, drawings, videos, physical objects/realia, manipulatives, or demonstrations to develop and reinforce meaning.
	Word learning strategies	Teacher clarifies the meaning of new terms by supplying definitions and/or teaching word learning strategies (e.g., decomposing terms into constituent roots and affixes, identifying cognates, or using context clues).
Attending to language production	Facilitating discussions	Teacher deliberately uses questions, wait time, and other discourse moves during whole class or small group discussions.
	Modeling	Teacher models academic language for students (e.g., deliberately incorporating disciplinary terms into their talk, using think-alouds to model the reading or writing process, or providing exemplars or discussing samples of student work).
	Peer collaboration	Teacher intentionally organizes students to work in pairs or small groups.
	Sentence frames	Teacher provides students with sentence frames or sentence starters.
	Word walls	Teacher displays word walls in the classroom or provides students with word banks on assignments.
Incorporating students' existing language and linguistic practices	Home language	Teacher includes students' home languages in instruction (e.g., providing translations, grouping

(Continues)

TABLE 2 (Continued)

Category of support	Type of support	Definition
		students with the same home language, or encouraging translanguaging).
General strategies	Chunking the task	Teacher breaks down the activity or assignment into smaller, more manageable parts.
	Differentiation	Teacher provides different tasks or different options within a given task for students with different needs.
	Individual instruction	Teacher provides an individual student with targeted instruction not provided to the entire class (e.g., pulling a student aside to clarify content, or asking a student to come before or after class to get help on a task).

Lastly, we ensured the trustworthiness (Brenner, 2006) of our analysis in three ways. One, as stated above, we conducted all coding as a collective. Four researchers coded each piece of data individually and then met together to discuss codes assigned; all disagreements were resolved through discussion. Two, once all coding was completed for a given cycle, we recoded a subset of our data: (a) At the end of our tier 1 coding, we checked all excerpts coded as *language opportunities* for additional examples of *academic language demands and supports*; and (b) at the end of our tier 2 coding, we checked all excerpts coded for a type of support at a language level to ensure both support and level were accurate. Three, we reviewed the transcripts of the focus group interviews with teacher education administrators and instructors to confirm that academic language was indeed taught across multiple courses, that there was a consistent emphasis on the discursive level of academic language, and that multiple strategies for scaffolding academic language were discussed and implemented. We examined three such focus group interviews: one with teacher education administrators, one with science education faculty, and one with language and literacy faculty. Each of these interviews lasted approximately 1 hr and included questions focused on conceptions of academic language, the teaching of academic language in teacher education courses, and perceptions of preservice teachers' developing understanding of academic language demands and supports in science.

5 | FINDINGS

Our results on preservice secondary science teacher participants' understanding of academic language and instructional support are organized into two sections. Each section addresses one set of research questions posed in Section 1 above. The first focuses on preservice teacher participants' understanding of academic language at the three language levels of vocabulary, syntax, and discourse; the second, of supports to scaffold ELs' use of academic language, again at each of the three levels of language.

5.1 | Finding Set 1: Preservice teacher participants' understanding of academic language

To answer our first set of research questions, we investigated how preservice teacher participants (a) conceptualized academic language, (b) how their understanding of academic language changed over the course of their teacher education program, and (c) how it compared to their cooperating teachers' understanding of academic language. We defined a complex understanding of academic language as attention to a broad range of

linguistic functions and to linguistic forms, particularly at the syntactic and discursive levels in addition to those at the lexical level. We included as evidence of such growth preservice teachers' own reflections on how their understanding of academic language evolved over time.

5.1.1 | Understanding of academic language

We found that all seven of our preservice teacher participants came to understand academic language in sophisticated ways. More specifically, by the end of their teacher education program, they had learned to conceptualize academic language as including all three levels of language. They had also learned to view academic language as an integral part of science itself—to understand that the teaching of disciplinary language cannot and should not be separated from the teaching of science content.

In his final interview in June, for example, David discussed each of the three levels of language when sharing how he would craft writing prompts for an investigation on the amount of carbon dioxide produced by yeast. He explained that he would intentionally include questions in the lab report to elicit student responses at the lexical, syntactic, and discursive levels while planning and carrying out their investigation.

I just have to be very careful about what I want [students' responses] to be.... So if it's something like, "What are the things [variable] you were changing [in this investigation]?", I would probably phrase the saying like, "What in this experiment are you changing?" And I might just put variable in parentheses next to that. That would be like a fill-in-the-blank kind of thing. Then, "What is going to stay the same?" If I wanted that to be a sentence, I'd be like, "The constants in this experiment are?" It's not giving them the definition of constant over and over again, but it's exposing them to that word in part of their sentence itself. And when they write it down themselves, maybe it helps; maybe it's helpful. Then I would also add an explanation of why. "Why are you changing this one thing? Why are you keeping these the same?" (Interview 5).

At several points in this same interview, David also explained why he placed such an emphasis on the teaching of academic language, particularly for his EL students.

I think, especially with biology,... you take this huge amount of new information, and then you also need to put [it in] the context of using it in discourse, and then thinking logically to apply it to an actual, hard, critical-thinking problem. There's so much involved in that, that there's no way that you can't make that [academic language] a major part of designing a lesson (Interview 5).

Academic language, David reiterated, is "a huge access point for students to understand any of what's going on" in a science classroom (Interview 5).

5.1.2 | Changes in understanding of academic language over time

In addition, we found that all seven preservice teacher participants showed growth in their understanding of academic language over time. As explained in our Section 4, we identified growth in two ways. One way we determined growth was by examining changes in preservice teachers' definition of academic language across their five interviews. We found that preservice teacher participants' discussions of academic language shifted over the course of the year from an initial focus on vocabulary with no mention of syntax and some references to discourse, to a multileveled definition that included attention to all three language levels (see again David's responses in his Interview 5 above). This growth was most evident in comparing preservice teacher participants' first interview to their second and third interviews.

As one example, in her initial interview in July, Sasha mentioned only vocabulary when discussing how she would attend to the needs of ELs in teaching science:

Making sure you're defining everything [for ELs during instruction]. Whenever you introduce a new term, mak [ing] sure that you define it in words that they're comfortable using, so you can build their vocabulary based on what they already know. So just being mindful of that (Interview 1).

However, in her third interview conducted in December, Sasha identified all three levels in her definition of academic language, "I think it's the way of speaking or writing that's used by anyone who's working in that field. So like vocabulary, and sentence structure, and style and organization of ideas. Yeah, kind of all of it" (Interview 3).

As a second example, in her initial July interview, Molly attended to the lexical level of language and implied facilitating discourse in her description of effective science teaching:

It's also really important that students aren't overwhelmed when they hear all these crazy scientific words just being spewed at them. But maybe that they can relate it with some sort of either hands-on experience they've had or personal experience in the past... [Helping them] make more of a picture or story out of whatever they're learning versus straight memorization (Interview 1).

In comparison, after completing the foundations of academic language course in the summer, Molly included explicit discussion of all three language levels in her description of academic language during her second interview in August:

I mean what comes to mind first is big scary words that you wouldn't know if you weren't studying that area of science or whatever your academic area is. But I think it also includes... the type of language they use. Like what type of sentence structure would you use [and] the formality of your language... (Interview 2).

"I think there are two different ways you can look at it [the academic language of science at the discursive level]," Molly continued, explicitly recognizing the existence of different registers. "You can look at it as if you were writing to another scientist or you can look at it as if you were writing about science to a more general public that might not have a science background." Molly ended by noting that audience influences what counts as appropriate language in presenting arguments and explanations in science, that "it is important to know your audience to determine which type of academic language you're going to use" (Interview 2).

A second way we determined growth in preservice teachers' understanding of academic language over time was to examine their own reflections on what they had learned. We found that all seven of our participants were themselves aware of changes in their understanding of academic language. Five noted they entered the teacher education program with a vague understanding of academic language, irrespective of levels, and described learning to see this construct as a critical component of science teaching and learning over time. For example, Adam explained that he began the teacher education program without "really know[ing] what it [academic language] meant" (Interview 3). In a later interview, he added that he had initially been highly skeptical of the required foundations of academic language course taught in August, "During the summer, I was in class like, 'Why are we in a language class? This is ridiculous.'" He then described how, through coursework and conversations with teacher education faculty, he experienced "a pretty sudden change": He came to see that "academic language is truly intertwined with teaching and learning content, and it should be supported at all times" (Interview 4).

The other two of our seven preservice teacher participants discussed initially equating academic language with vocabulary but then moving toward a broader understanding of academic language over time. For example, toward the end of the teacher education program, Kari reflected on how she had shifted from a focus on vocabulary to an awareness of the importance of the syntactic and discursive levels of academic language as well—of the need to help students effectively communicate science to a particular audience.

[I]nitially I thought that it [academic language] was just the vocabulary. And we've learned that it goes beyond that. That it's the syntax. [And] it's the structure of writing and oral speaking. It's not just bullet-pointed terms. It's how do you use those in the correct context and write it or speak it in a way that people can comprehend. (Interview 4).

5.1.3 | Comparison between preservice teachers' and cooperating teachers' understanding of academic language

As did our seven preservice teacher participants, the six cooperating teachers in our study understood academic language to span the three language levels of vocabulary, syntax, and discourse. In describing the lessons researchers observed in spring, the focus of our comparison between the two groups here, we found that both preservice and cooperating teachers centered their discussions of academic language at the lexical and discursive levels. Although discussion of syntax was included, both groups paid less attention to this level than the other two. This difference in the attention paid to the syntactic language level in the context of instruction is explored further in our discussion of academic language supports below.

For example, researchers observed Adam teach two lessons he had designed for his high school biology students about human anatomy: Working in groups, students used cardboard, string, and tape to construct a prosthetic arm that could perform a variety of biomechanical functions (e.g., rotating, grasping) as a model of interactions among the muscular, skeletal, and nervous systems (see NGSS Performance Expectation HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms). When asked to explain how these lessons provided opportunities for students to learn the academic language of science, Adam emphasized student engagement in argumentation during groupwork.

Well, they're going to be working in groups. So they're going to be talking and conversing about it and collaborating [on the design and building of their prosthetic arm].... There's going to be a lot of describing, and arguing, and justifying arguments (Interview 4).

Adam added that he planned to focus on relevant "vocabulary terms" after the completion of this activity, "when we come in and talk about how the muscle actually moves" (Interview 4).

Similarly, Carl, Adam's cooperating teacher, focused his description of the academic language students used in constructing their prosthetic arm at the discursive level, highlighting student engagement in reasoning during groupwork and analysis of the model-building process in their writing.

For speaking and reasoning, I watched that happen as they were trying to explain to each other what they should do next and why [in their small groups]. And so that was probably the most fun part about it was watching them try to figure all this stuff out and what sorts of changes they should make [to their arm]. So the verbal part of it was the during [small group work]. And then there's the pre- and the post-written work where they're trying to analyze what they're doing.

Carl noted that Adam provided a word wall with relevant vocabulary terms and included these terms in his introduction to the task, but that the activity itself did not foreground vocabulary. He clarified that they were "trying to get them [students] to think about how the mechanics of their system—their muscles and their tendons and their bones—and how they work together.... It wasn't really necessary to have vocab."

In summary, over time, we found that all seven of our preservice teacher participants were able to provide a multileveled description of academic language. In the next section, we present the ways these preservice teachers translated their understanding of academic language into their teaching practice. We discuss the types of instructional support they reported using to scaffold their EL students' negotiation of academic language demands at the lexical, syntactic, and discursive levels and the ways the types of support implemented shifted over time.

5.2 | Finding Set 2: Preservice teachers' use of academic language supports

To answer our second set of research questions, we examined the types of support preservice teacher participants reported using to help their students meet academic language demands. In particular, we investigated (a) the types of support they most commonly reported using at the lexical, syntactic, and discursive levels; (b) how their reports of these instructional supports changed over time; and (c) how the common types of support they discussed in their interviews

compared with those they implemented in their edTPA lesson plans. We close this finding set by examining the kinds of limitations preservice teachers themselves identified with the types of support they implemented.

5.2.1 | Most common types of instructional support reported

We found that preservice teacher participants reported using a range of instructional supports to scaffold students' academic language use. However, the number of common types of support they discussed varied notably by language level, from seven for the lexical level, to three for the syntactic level, to 12 for the discursive level. We remind readers that we defined an instructional support as common for a particular language level if at least four different preservice teachers discussed the support in one or more of their interviews.

As introduced above, a majority of preservice teacher participants discussed using seven types of instructional support to help EL students learn and use academic language at the lexical level. Supports for vocabulary development were clustered into three of the five categories discussed in Section 2 above: providing a meaningful context for language use, ensuring comprehensible input, and facilitating language production. In the category of providing a meaningful context for language use, six preservice teacher participants described the importance of engaging students in a *hands-on activity* before introducing formal scientific terms. When the new terms were then presented, students could draw on their concrete experiences and conceptual understanding to understand and properly use them. For example, as part of an engineering project to design and build a hanging mobile, Haylee discussed engaging her physics students in an initial investigation of rotational equilibrium and torque before introducing the term *fulcrum*:

We did a lab with balance and with different masses and learned what a fulcrum was from actually physically seeing it there. Where they said, "Oh, the center thing." And then once we did the notes, they're like, "Oh, that was like the balance part that we, that was in the middle. That was fulcrum." (Interview 4).

Also at the lexical level, preservice teacher participants described using instructional supports, such as *word learning strategies*, *facilitating discussions*, and *visuals and realia*, to ensure comprehensible input. All seven reported using *word learning strategies*. For example, Adam discussed the importance of teaching students to decipher the meaning of new words using their knowledge of root words and home language cognates (Interview 2), while Molly, Sasha, and Kari all reported explicitly defining new vocabulary (Interview 4). Four participants described *facilitating discussions* to clarify the meaning of unfamiliar words. In addition, four noted they used *visuals and realia* in one of two ways: providing pictures or physical objects to illustrate the meaning of unfamiliar words and/or asking students to create drawings to reinforce their understanding of newly introduced vocabulary.

Further, preservice teacher participants reported using three types of instructional support at the lexical level that fell into the third category of facilitating language production: *peer collaboration*, *modeling*, and *word walls*. Five participants shared that they used *peer collaboration* to give students multiple opportunities to use new vocabulary in context. For example, David reported routinely providing students low-stakes opportunities to practice new language.

It's like pair sharing or doing warm-ups where you provide the language for them and say, "Hey, in your warm-up, can you describe what we learned yesterday? Here are some words that you should include." So it's there for them to access and to use, but if they do it wrong or they forget what it is, [they can] just go back and look it up. It's low-risk. It's not a big deal. So it gives them a chance to practice without further nervousness. (Interview 4).

Four preservice teacher participants discussed *modeling* the use of academic vocabulary by deliberately incorporating academic terms in their own speech and four, displaying *word walls* so that students could refer to key terminology as they talked or wrote during the unit.

In contrast, at the syntactic level, a majority of preservice teacher participants discussed three types of instructional support that fell into two categories: ensuring comprehensible input and/or facilitating language production. Five preservice teachers reported using *visuals and realia* to support both language comprehension and production. In terms of comprehensible input, they described using drawings or illustrations to help students unpack the meaning of complex sentences. In terms of output, they indicated they gave students opportunities to

initiate or augment sentences with drawings. For example, Kari explained that students could include both a picture and words to state their hypothesis before beginning an investigation.

Instead of having them just only write out the[ir] hypotheses, they could also draw a picture to describe where the forces are coming from. Because maybe a few might have a better idea or sense of it, but not be able to explain it well in words. So starting with an image first. (Interview 3).

Preservice teacher participants identified two additional ways they facilitated students' production at the syntactic level. All seven preservice teachers discussed using *sentence frames* to help students formulate oral or written responses. For example, like Kari above, Adam explained how he would support students in writing a hypothesis; however, while Kari stated she would use visuals, Adam noted he would use differentiated sentence frames.

I would give them a sentence frame. And a sentence frame can be modified to differentiate for the spectrum of English language learners and from English language learners to native speakers. And you can give them a variety of sentence frames to help them write a hypothesis, kind of looking like, "Given X evidence, this is the behavior. This is what we think is happening with these rocks." (Interview 3).

Six of the seven preservice teachers indicated that they also used *modeling* to help students produce specialized scientific and mathematical representations, such as graphs, tables, and equations.³ For example, Haylee described modeling how to set up and solve an equation (Interviews 3 and 4) and Sasha reported demonstrating how to graph results (Interview 4).

The number of common types of support used to scaffold oral and written discourse was much higher than that at either the lexical or syntactic levels. These 12 common types of support at the discursive level spanned all five of our categories: providing meaningful context, ensuring comprehensible input, facilitating students' production of spoken and written discourse, using students' home languages and linguistic practices, and general strategies.

Four preservice teacher participants described *implementing a hands-on activity* to provide meaningful context for language use at the discursive level. As one example, Caitlyn reported preparing her students to debate whether color exists independently of human perception by having them listen to an excerpt from a podcast episode on color and by examining a series of optical illusions that demonstrated the instability of perception. As a second example, Kari described engaging her students in a physical simulation so they could experience how changing food availability due to weather conditions interacted with beak size to affect bird populations (Interview 4).

All seven preservice teacher participants discussed using at least one type of support that would help ensure comprehensible input at the discursive level. All seven indicated that they used some type of *structured reading*, such as collaborative strategic reading, jigsaw reading groups, or a process for systematically annotating texts. All seven also indicated that they used *visuals and realia* to clarify written or oral discourse. For example, Haylee discussed how she would augment verbal explanations with visual references, "Not just saying it or pointing to something, but showing them physically what something means, or through demonstrations" (Interview 3). Relatedly, six preservice teacher participants discussed the importance of *providing clear directions* by making sure the language they used was clear and concise.

All preservice teacher participants also reported using multiple types of support to help students produce oral or written discourse. All seven discussed *facilitating discussions*; regularly incorporating some form of *peer collaboration*, including think-pair-share and small group investigations and/or presentations; and using *sentence frames* as a way to scaffold students' contributions in class discussions, oral presentations, and written responses. In addition, six preservice teachers described *modeling* discourse for their students, particularly for larger, more formal assignments. For example, Kari explained how she and her cooperating teacher helped their life science students produce their first extensive piece of scientific writing—an argument on the causes of mass extinction events—using a combination of *chunking*, *sentence frames*, and *modeling*.

So we had pretty structured sentence frames for them. And it was kind of broken down into each paragraph, this is where the introductory paragraph or sentence goes, and [we] showed some examples, and then had them write their own. And then also showed them how to do correct citations, showed examples, [and] had them write their own. So a lot of show and now have them do. (Interview 3).

Further, five of our preservice teacher participants reported supporting discourse by drawing on students' *home languages* and validating their linguistic resources. Those participants with newcomer students noted they provided learning materials in their home language (Sasha, Interview 3) or encouraged students to use iPads so that they could translate documents themselves (Adam, Interview 3). Others described strategically grouping students who were in the earlier stages of learning English with more proficient English speakers or bilingual peers. For example, Molly reported how she reconfigured small groups so that her three beginning ELs would be able to both confer with each other in Spanish and interact with more fluent English speakers.

[I] spread out the three ELs to different table groups. While they were still next to each other so they could still look over their shoulders and ask questions and such, they were with students who speak other languages in their [small groups]—ELs as well as a couple native English speakers. (Interview 4).

Finally, a majority of the preservice teacher participants discussed using three general strategies to support EL learning at the discursive level. Six discussed *differentiation*; four, *individual instruction*; and four, *chunking* a task into more manageable stages.

5.2.2 | Changes in common instructional supports reported over time

We also examined changes in preservice teachers' understanding of common instructional supports over time. We did so in two ways. First, we determined in which interview each common support strategy was introduced (see Table 3). For the most part, we found that common types of academic language support were introduced during one of the first three interviews, during the first half of participants' teacher education program. More

TABLE 3 Preservice teachers' initial references to common support strategies by interview

	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5
Lexical level					
Facilitating discussions			○		
Hands-on activity	○				
Modeling		○			
Peer collaboration	○				
Visuals and realia	○				
Word learning strategies	○				
Word walls		○			
Syntactic level					
Modeling			○		
Sentence frames		○			
Visuals and realia			○		
Discursive level					
Chunking				○	
Differentiation			○		
Facilitating discussions		○			
Hands-on activity	○				
Home language		○			
Individual instruction		○			
Modeling		○			
Peer collaboration	○				
Providing clear directions	○				
Sentence frames			○		
Structured reading		○			
Visuals and realia	○				

Note: A ○ indicates the first time a type of support was discussed by one or more preservice teacher participant.

specifically, in their initial interviews, preservice teachers referred to seven distinct types of support: three at the lexical level, zero at the syntactic level, and four at the discursive level. In Interview 2, preservice teachers introduced eight new types of support: two at the lexical level, one at the syntactic level, and five at the discursive level. In Interview 3, five additional types of support were discussed: one at the lexical level, and two at each of the syntactic and discursive levels. Interview 4 yielded only one new support (at the discursive level) and Interview 5, no new supports.

Second, we examined changes in the number of participants who discussed a given common support strategy across interviews. To do so, we identified the subset of supports discussed by a majority of participants in a given interview (see Table 4). We clarify that because we labeled an instructional support as common if discussed by a majority of participants *across* the five interviews, not necessarily in *one* interview, only a subset of supports listed in Table 4 were ever discussed by four or more participants in a single interview. For the most part, we found that the number of common support strategies discussed by a majority of participants in a single interview increased over time. Interview 2 was the first time a majority of participants discussed a given type of support at a particular level: one support at the lexical level and two supports at the discursive level. In Interview 3, seven supports—two at the lexical level and five at the discursive level—were discussed by the majority. In Interview 4, there were 12 such supports: two at the lexical level, two at the syntactic level, and eight at the discursive level. And in Interview 5, as with Interview 3, seven supports were discussed by the majority of participants. We add that, as with when initially introduced, supports at the syntactic level again lagged behind. In Interview 2, while a majority of participants discussed supports at the lexical and discursive levels, they did not do so at the syntactic level. Indeed, a majority of participants did not discuss the same syntactic support strategy until Interview 4.

TABLE 4 Preservice teachers' collective references to common support strategies by interview

	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5
Lexical Level					
Facilitating discussions					
Hands-on activity			●	●	●
Modeling					
Peer collaboration					
Visuals and realia					
Word learning strategies		●	●	●	●
Word walls					
Syntactic level					
Modeling				●	●
Sentence frames				●	
Visuals and realia					
Discursive level					
Chunking					
Differentiation			●	●	
Facilitating discussions				●	●
Hands-on activity				●	●
Home language					
Individual instruction			●		
Modeling				●	
Peer collaboration		●	●	●	●
Providing clear directions					
Sentence frames				●	
Structured reading		●	●	●	
Visuals and realia			●	●	●

Note: A ● indicates a majority of preservice teacher participants discussed this type of support in a given interview.

5.2.3 | Comparison between interviews and edTPA lesson plans

Further, we compared the common types of instructional support participants discussed using in their interviews to those they included in their edTPA lesson plans (see Table 5). Overall, we found substantial agreement between supports discussed in interviews and used in edTPA lessons across the three levels—both in terms of overall number and types. In terms of number, as in their interviews, the highest number of common support strategies included in participants' edTPA lessons was at the discursive level, followed by the lexical level, and then, the syntactic level. In terms of types of support, at the lexical level, we found three differences: A majority of participants discussed *hands-on activities* and *modeling* in their interviews but did not do so in their edTPA lessons; and a majority included implementing *guided notes* to support students' vocabulary development in their edTPA lesson plans, but not in their interviews. At the syntactic level, two differences were identified: *Modeling* was discussed as a common support strategy only in their interviews and *facilitating discussions*, only in their edTPA lesson plans. At the discursive level, there were more differences, in part, because there were more common types of support identified. Participants discussed seven common strategies in both their interviews and lesson plans; they discussed an additional five only in their interviews.

5.2.4 | Preservice teacher participants' perceived limitations for providing adequate support at each level

We close this second finding set by noting that some preservice teachers expressed challenges in using types of instructional support at each of the three language levels. At the lexical level, Molly and David reported limitations: Molly pointed out that breaking down new words into their component roots was not effective if students were unfamiliar with those roots (Interview 3), and David noted that although using Spanish translations were helpful for

TABLE 5 Comparison of preservice teachers' common support strategies discussed in interviews and used in edTPA lesson plans

	Lexical level		Syntactic level		Discursive level	
	Interviews	edTPA	Interviews	edTPA	Interviews	edTPA
Chunking					●	
Differentiation					●	●
Facilitating discussions	●	●		●	●	●
Guided notes		●				
Hands-on activity	●				●	●
Home language					●	
Individual instruction					●	
Modeling	●		●		●	●
Peer collaboration	●	●			●	●
Providing clear directions					●	
Sentence frames			●	●	●	●
Structured reading					●	
Visuals and realia	●	●	●	●	●	●
Word learning strategies	●	●				
Word walls	●	●				

Note: A ● indicates a type of support discussed or used by a majority of preservice teacher participants.

his native Spanish speakers, they did not support the one student in his class who spoke an Eastern European language (Interview 5). Still, none of the preservice teacher participants, including Molly and David, identified vocabulary as an area they needed to better understand to effectively teach science to their EL students.

David, Adam, and Kari each expressed concerns about their ability to support EL students at the syntactic level. David worried that by providing students with sentence frames, he might be eliminating opportunities for students to express their own ideas and reasoning, thus turning a cognitively demanding task into a mere procedural one. He elaborated, "There's constantly this fight I have [with myself] between giving students sentence frames as starters to begin talking about different things, and worrying that I'm giving them too much information" (Interview 4). Kari identified syntax as an area she would have liked additional preparation in learning to teach. She noted, "I would prefer more practice with syntax, because I feel very confident in that [my own control of grammar], but I don't really know how to teach that very well" (Interview 4).

Further, although David, Adam, Kari, Sasha, and Molly were able to draw on several types of support at the discursive level, they nevertheless described concerns about their ability to help students both use their home language to make sense of science phenomena and produce written scientific discourse. As an example of the former limitation, Sasha shared her struggles to find instructional materials written in students' home language that could deeply engage them in the reasoning and sense-making of science:

In the case of the two girls that didn't speak any English, they didn't get as many enrichment activities because we couldn't give it to them in Spanish. The only thing we could give them in Spanish was the Spanish textbook and then translate some of the worksheets to Spanish. And so it was more traditional, like, "Read the book," and then have classmates translating. (Interview 3).

As an example of the latter limitation, Adam noted that he aspired to be "more ingenious about getting my students to write science well," but discounted the highly structured approach he had seen implemented in one of his teaching placements. He contended that even with a prescribed formula, "students either don't know what counts as commentary or what counts as analysis, or they just fill in those sentences to meet the requirement." Perhaps even more important, he continued, the prescribed formulas to produce writing "haven't really done the job" of engaging students in complex thinking (Interview 5). This and other preservice teachers' comments suggest that their struggles in teaching writing stemmed largely from the difficulty of apprenticing students into discursive practices, such as constructing explanations and arguing from evidence, that reflected disciplinary norms and values.

6 | DISCUSSION

The NGSS asks teachers to engage their students in sophisticated and diverse language use to facilitate reasoning and sense-making in science and engineering (NGSS Lead States, 2013). For teachers working with ELs, teaching the content and language required to make meaning of and communicate these new standards can be a daunting task (Bunch, 2013; Capitelli, Hooper, Rankin, Austin, & Caven, 2016; Quinn et al., 2012). Studies of efforts to prepare preservice secondary science teachers to effectively teach ELs have emphasized the importance of integrating attention to disciplinary language and literacy practices into preservice coursework and experiences (Heineke et al., 2019; Lyon et al., 2016, 2018). Although the language demands of science have been thoroughly documented (Fang, 2005, 2006; Kelly, 2007; Lemke, 1990; Schleppegrell, 2004; Snow, 2010), research on preservice secondary science teachers' understanding of these demands remains scarce. The present study extends existing research by providing detailed descriptions of one cohort of preservice teachers' developing understanding of how to identify academic language demands and provide appropriate supports for ELs in science.

As explained in Section 2, to teach science as envisioned in the NGSS, teachers must conceive of academic language as more than just vocabulary. As did the practicing teachers in O'Hara et al.'s (2017) study, we found that our preservice teacher participants learned to conceive of academic language as complex language use. Their ability to define academic language as spanning all three levels of language suggests that they were neither discounting

the importance of attending to academic language in a content course nor narrowly focusing their efforts on the teaching of science vocabulary terms. In addition, changes in their understanding of academic language—as movement from a focus on vocabulary with some attention to discourse, to recognition of the importance of a definition spanning three levels—occurred primarily during the first half of their program. The pace of this change seems reasonable given that, by December (Interview 3), participants had completed two of three classroom placements, all three language and literacy courses, and two of three science methods courses.

We also found that preservice teachers' understanding of academic language as multileveled persisted throughout the rest of their program; researchers did not detect a return to narrow definitions of academic language as participants neared completion. Instead, in their last two interviews, preservice teachers themselves reflected on how and why they had come to see the importance both of attending to academic language in science instruction and of conceiving of academic language as spanning lexical, syntactic, and discursive levels. The fact that cooperating teachers' understanding of academic language was found to resonate with that of the preservice teachers they mentored helps to explain this persistence. We add that while preservice teachers' multileveled descriptions of academic language were expected, cooperating teachers' definitions were not (Lyon et al., 2018): Because we had not explicitly engaged cooperating teachers in professional development around academic language, we thought they might focus their definitions at the lexical level.

As with their definitions of academic language, we found that our preservice teacher participants were able to identify types of instructional support for ELs at all three language levels. In addition, our examination of preservice teachers' understanding of types of instructional support yielded an important insight that our investigation of their definitions of academic language did not: Preservice teachers focused their discussions of supports at the discursive level. More concretely, in terms of both the total number of supports identified across interviews and the discussion of a particular support in a given interview, participants described types of instructional support at the discursive level most often and supports at the syntactic level least often, with discussion of supports at the lexical level falling in between.

Again, as with their definitions of academic language, we also found that participants moved from initial discussions of supports at the lexical and discursive levels only, to inclusion of supports at the syntactic level as well. The related finding that participants' understanding of types of instructional support continued to grow across their entire program, rather than stop midway as did their definition, appears reasonable when contrasting the large number of supports participants could possibly implement to a single definition of academic language they could provide. Further, our examination of preservice teachers' instruction in their edTPA lesson series made clear that the number and types of supports they discussed using to scaffold ELs at each of the three language levels in their interviews resonated with what they actually enacted in their practice.

We see participants' focus on types of instructional support at the discursive level as important for two related reasons. One, supporting students' discourse aligns with the goals of conceiving of academic language as spanning three levels in the first place. As stated above, complex language use should be a priority in instruction for ELs (O'Hara et al., 2017; Zwiers et al., 2014). Two, such a focus resonates with the recommendations put forth by the NGSS (NGSS Lead States, 2013). Teachers implementing reform-based science instruction should engage all students, including ELs, in learning the language and content of science through reasoning and sense-making (Quinn et al., 2012). MacDonald et al. (2017) succinctly summarized these two reasons why a focus on supporting student discourse is desirable:

For those working from a language as action perspective... [the teaching of academic language] should not be focused on correctness, but on effectiveness; it should support students in using English to more effectively explain and argue in support of their ideas. (p. 195).

To continue with our discussion of instructional support at the discursive level, all but two of our preservice teacher participants identified limitations in the strategies they used to support science discourse and expressed a

desire to develop additional expertise, particularly in the areas of using home languages and producing written texts. One way to strengthen preservice teachers' efforts to help students both use their home language and produce written texts is to encourage them to focus more intently on integrating the four principles for effective EL instruction discussed in our Conceptual Framework above. As one example, some types of instructional scaffold that intersect with student and community funds of knowledge were not routinely employed by our preservice teacher participants. Scaffolds that preservice teachers could more regularly employ to recognize and build from students' funds of knowledge include translanguaging, encouraging students to use all of their linguistic resources to engage in content understanding (Poza, 2018), and drawing explicitly from community-based organizations and place-based resources (Chinn, 2007). As a second example, preservice teachers could more clearly conceive of academic language supports for writing as intersecting with language opportunities and cognitively demanding work, providing regular and repeated opportunities for students to present ideas individually, in small groups, and as a whole class as they develop and use models to plan and carry out investigations toward the goal of constructing explanations of everyday phenomena (Windschitl et al., 2018).

Finally, we found that while preservice teacher participants also discussed a number of instructional supports at the lexical level, they identified few supports at the syntactic level. Although we do not recommend science teachers become mired in the teaching of grammar, we argue that greater attention to supports at the sentence level is needed—that preservice teachers should be explicitly introduced to a number of other types of support at the syntactic level. After all, students cannot build discourse—they cannot construct arguments and explanations—without using sentences. In addition, while preservice teacher participants commonly and regularly employed *sentence frames*, this particular type of instructional support has its limitations. Several participants recognized that repeated, liberal use of sentence frames can confuse students or constrain students' ability to think and reason. Similarly, Zwiers et al. (2014) and Rodriguez-Mojica (2019) encouraged teachers to use sentence frames in intentional and strategic ways—to prevent overuse and resulting misunderstandings, and to promote meaningful and authentic language production opportunities. Other examples of syntactic-focused supports that could be introduced to and employed by preservice teachers are the following: stronger and clearer each time, a routine where students individually think about and write a response, use a structured pairing strategy to have multiple opportunities to refine and clarify their response through conversation with peers, and then finally revise their original written response (Zwiers et al., 2017); and sentence deconstruction, unpacking a complex sentence first to understand its meaning and then to determine the linguistic structure(s) the author used so as to enhance students' ability to write sentences on their own (California Department of Education, 2014).

Overall, our findings indicate that preservice secondary science teachers can learn to acknowledge and value their role in creating science classrooms that help all students, including ELs, to develop facility with academic language at the lexical, syntactic, and discursive levels. At the same time, our findings suggest that helping preservice teachers adequately support the learning of academic language in all of its complexity requires sustained and self-reflective effort on the part of preservice teachers and teacher education programs alike.

7 | CONCLUSION

In this study, we provided insight into an under-researched area of science teacher education: preservice secondary science teachers' understanding of academic language and of ways to support ELs in engaging in both the content and language of science. To do so, we qualitatively analyzed a series of five interviews conducted with our preservice teacher participants as well as compared their understanding both to their cooperating teachers' understanding and to their actual classroom practice. Still, we recognize that our findings—on preservice teachers' success in understanding academic language as spanning three language levels, their struggles to adequately scaffold syntax, and their concerns about the limitations of particular supports—are constrained by our small number of participants, by their enrollment in a single university's teacher education program, and by the study's duration of 1 year.

Future studies can build from our findings to continue movement toward a science teacher education that adequately prepares beginning teachers to teach academic language to EL students. As one example, studies with larger numbers of participants from several universities could tease apart how preservice secondary science teachers' understanding of academic language is related to their depth of coursework preparation in this area, their field placement experiences, and their scores on performance assessments. In particular, future research could shed light on the extent to which the understandings cooperating teachers in our study held about academic language are representative of those held by secondary science teachers throughout the US as well as how field placement experiences, more generally, influence preservice teachers' understanding of academic language. As a second example, the fact that the well-started preservice teachers we investigated reported limitations in their understanding of how to effectively support academic language for ELs suggests that developing this understanding is a complex process that extends beyond their time in teacher education. As such, additional research that follows beginning science teachers through their teacher education programs and into their first years of teaching is needed as well (see again Buck et al., 2005, for a study of a beginning teacher).

In summary, our study contributes to efforts to provide ELs greater access to reform-based science teaching and learning. Given the goals of the NGSS and the increasing number of EL students in US classrooms, teacher education programs must devote more time and attention to providing preservice science teachers with a thorough understanding of how to teach ELs—to sharing with them a principle-based, disciplinary-specific framework for reform-based instruction for ELs. Such disciplinary frameworks must place the understanding of academic language and instructional support front and center—to help preservice teachers move beyond “just good teaching” to the effective teaching of ELs (Cohen & Lotan, 2014). Such frameworks must also include a focus on all three levels of language (Zwiers et al., 2014) to help ensure that instruction in academic language goes beyond the mere reciting of vocabulary to the substantive making of meaning (Bunch, 2013; Moschkovich, 2012). We have taken one step toward providing ELs greater access to science by documenting how a select group of preservice secondary science teachers understood academic language and how they applied their understandings to the needs of ELs in science classrooms.

ACKNOWLEDGMENT

This study is supported by a grant from the National Science Foundation (DUE-1439923). However, the content is solely the responsibility of the authors and does not necessarily represent the official views of NSF.

ENDNOTE

- ¹ We note that terms such as multilingual learner and emergent bilingual are more clearly asset-based than English learner. However, in this manuscript, we decided to use the term English learner because it was employed throughout participants' coursework, field placement sites, and edTPA materials.
- ² We have chosen to use the term academic language, because it continues to have considerable currency in both practitioner-oriented literature and in consequential credentialing assessments, such as the edTPA; it is recognizable to a broad audience of science teachers, teacher educators, and researchers. However, while using this generic term, we also recognize its limitations: It has at times been used to assert a rigid dichotomy between academic and everyday ways of using language (Bunch, 2006).
- ³ As described earlier, following the structure of the edTPA, we decided to include the construction of graphs and tables as part of our definition of syntax.

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How to cite this article: Meier V, Aminger W, McLean M, et al. Preservice secondary science teachers' understanding of academic language: Moving beyond "just the vocabulary". *Science Education*. 2020;104:222–251. <https://doi.org/10.1002/sc.21560>

APPENDIX

INTERVIEW 4 PROTOCOL FOR PRESERVICE TEACHERS

Language and Literacy in Science Instruction: These beginning questions are about language and literacy in science instruction.

1. In which TEP [Teacher Education Program] classes have you learned about academic language?
2. How do you define academic language?
3. How have you taught academic language in your current placement?
4. How has your understanding of academic language changed since you began this program?

Specific Aspects of Science Instruction for ELs: This next series of questions is about science instruction specifically for ELs.

5. How do you define an EL student?
6. Are you currently working with EL students in your placement? If yes, in what classes? Before your current placement, did you work with EL students in your previous placements? If yes, in what classes?
7. What have you learned about how to teach ELs science as a result of your TEP experience? How have you acted on what you have learned?
8. What can your EL students bring as resources to increase the richness in class, such as their own interests, knowledge, language diversity, or cultural background? In what ways have you already drawn on students' funds of knowledge in your placements?
9. What kinds of cognitively demanding tasks are most effective in teaching ELs science? In what ways have you already implemented such cognitively demanding activities in your placements?
10. What kinds of language opportunities have you provided your EL science students? In what ways have you already implemented such language opportunities in your placements?
11. How do your EL students differ from one another? How do your EL students compare to those who have been reclassified fluent in English?
12. What do you think you need to learn to better help ELs in your classroom?

Lesson Observation: These final questions are related to the lessons that I will observe you teach. I have few questions that will help me understand what I am observing. Were you able to bring your lesson plans for the 2 days I will be observing?

13. Where are you currently placed? What class are you doing your takeover in?
14. Describe briefly the students in this class. How many students are in the class? Approximately how many students are ELs? Where are the proficiency levels of your EL students?
15. What science unit are you currently teaching?
16. What is the purpose of the two lessons that I will be observing?
17. Where did the ideas for these lessons come from?
18. What standards will you be covering in these two lessons?
19. Describe the ways these lessons include cognitively demanding tasks?
20. Describe the ways these lessons provide language rich opportunities for students?
21. How will these two lessons draw on the resources or funds of knowledge of your students?
22. What are the language demands of these lessons?
23. How do you plan to support the learning needs of your students during these lessons? [If preservice teacher has EL students: How do you plan to support your EL students?]

Wrap-Up

24. What questions do you have for me?