

A Closer Look at Secondary Science Content Preparation

Graduate and Alternative Route Secondary Programs

KEY FINDINGS: Only a quarter (25 percent) of graduate programs which offer a *certification route* — a path to a specific certification — that qualifies teachers to teach all science subjects have the right guardrails in place. Worse still are alternative route programs, for which only 4 percent do enough to ensure candidates seeking certification to teach all of the sciences have adequate content knowledge. This is primarily due to the inability to provide courses to remediate content gaps.

Compared to the 69 percent of undergraduate programs that manage to provide adequate preparation for general science certification, it is clear that post-baccalaureate certification routes — be they graduate or alternative route — are not doing enough to make up for candidates' potential gaps in content knowledge, a problem that is exacerbated by state licensing tests which are themselves inadequate.

Fewer issues arise when programs prepare candidates to teach a single science subject, as the vast majority of states employ adequate licensing tests for these certifications. Where such licensing tests are not required, all programs were found to require a certification-specific major.

Why teacher prep programs need strong content requirements for secondary science certifications

In the latter half of the 20th century there was considerable debate over secondary teachers' need to earn a certification area major over and above their teacher preparation coursework. That debate officially ended in 2001 when that requirement was embedded in ESEA's reauthorization. Since that time, even though ESEA no longer makes a content major a requirement, no state has backpedaled, with all essentially requiring secondary teachers to complete an academic major or at least pass a licensing test of content knowledge.¹ These tests are particularly important to graduate and alternative route programs which do not typically build in room for subject matter coursework. However, not all licensing tests can deliver. With only a few exceptions, the various tests used to assess the multiple-subject physical science and general science certifications fail to *separately* measure content knowledge in each of the subjects teachers will be certified to teach. Information about the adequacy of licensing test requirements for every state can be found [here](#).

Methodology

States offer one or more certifications in the sciences. Each certification defines what subjects a teacher can teach. For example, a certification in biology allows a teacher to teach biology courses, while general science certification allows a teacher to teach all science courses including biology, chemistry, earth science, and physics. In turn, teacher preparation programs offer certification routes that lead to some or all of the available certifications in the state.²

- 1 States set different credit threshold for academic majors. In many cases, the threshold is set below 30 semester credit hours, what institutions commonly define as the coursework required to complete a major.
- 2 In some cases, graduate programs offer a single route that allows teacher candidates to choose between two or more certifications. For example, a program may offer a “science education” route that allows candidates to choose between certifications in chemistry, physics, physical science, etc.

In the 29 states and the District of Columbia where general science certification is found, we look for one of the following requirements:³

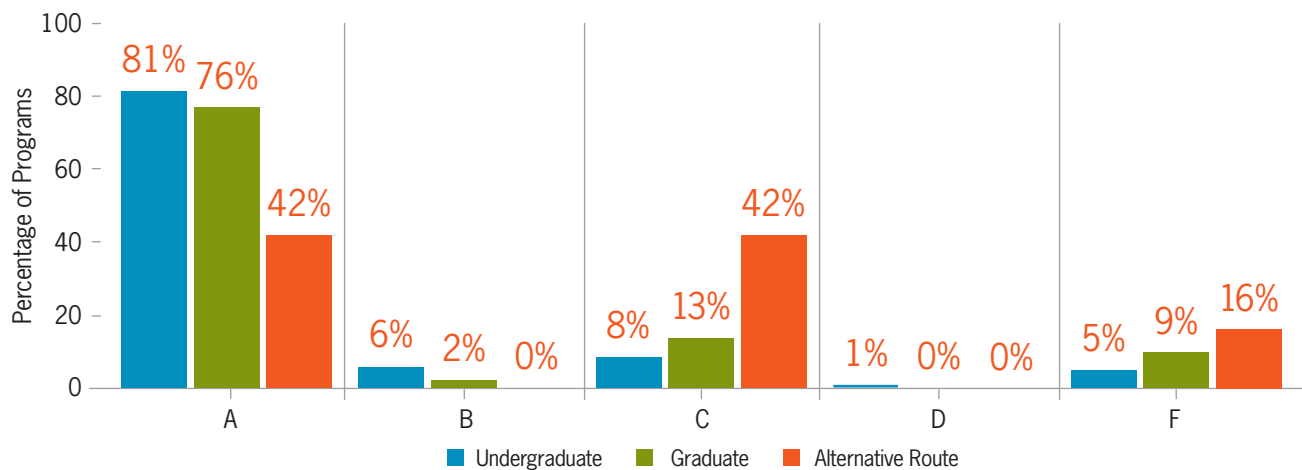
- The candidate has completed or will complete as part of the program 15 semester credit hours (SCH) of coursework in each of two subjects (biology, chemistry, earth science, or physics); or
- The candidate has completed or will complete as part of the program 50 SCH of coursework across the sciences; or
- The candidate will complete 15 SCH of graduate-level science coursework, which includes courses in at least two science subjects; or
- The program requires the candidates to pass an adequate licensing test.

Unfortunately, other than in Missouri, the licensing tests that are used to assess content knowledge for general science certification yield only a single overall score, not a score for each subject. This problem makes it possible for a teacher candidate to incorrectly answer most or all of the chemistry questions, for example, but still score well enough on questions for the other science subjects to pass the test and be assigned to teach chemistry.

This is the first edition of the *Teacher Prep Review* to break out analysis of science preparation as its own standard. Previously, analysis of secondary science certification routes was completed under the High School Content standard. We made this move to report with more detail on the complexity both programs and states face when general science certification is offered.

How many programs ensure that secondary science teacher candidates know the content they will be certified to teach?

(N=664 undergraduate; N=310 graduate; N=119 alternative route)



Program grades represent the average of the lowest scoring single-subject route and the lowest scoring multiple-subject route. If each single-subject certification route were to earn an A and the general science route received an F, the resulting program grade under this standard would be a C.

This graph shows that 76 percent of graduate programs earn an A under this standard, which falls short of the 81 percent of undergraduate programs to earn the same grade. The limited difference between the two program types is, in part, due to a greater concentration of graduate programs in states with general science certification.⁴ Still, it is not surprising that graduate programs still lag behind. Undergraduate programs, which have four years to do what graduate programs do in one or two years, typically dictate which content courses must be completed in order to be recommended for certification.

3 For physical science certification, which allows for instruction in chemistry and physics courses, programs earn an A on this standard with the requirement of at least a minor in each subject or by requiring licensing tests for which candidates must independently pass chemistry and physics sub-tests.

4 An extrapolation of the data suggests that if graduate programs offered general science certification at an equal frequency as undergraduate programs, 69 percent of graduate programs would receive an A.

Alternative route programs are subject to the many of the same constraints as graduate programs. Additionally, alternative route programs not affiliated with a higher education institution lack the ability to offer remediation where knowledge gaps exist. On a positive note, due to when alternative route candidates become the teacher of record (the teacher responsible for a classroom), programs typically require candidates to pass state licensing tests as a condition of program admission; however, this is still not a sufficient screen in states requiring inadequate licensing tests. Because so few alternative route programs offer coursework that can make up for inadequate licensing tests, only 42 percent earn an A.

A closer look at graduate science content preparation

Where teacher candidates pursue a narrow certification in a single subject such as physics, we employ a straightforward rubric. We look for the requirement of at least 30 SCH of certification-specific coursework; 15 SCH of graduate-level certification-specific coursework; or an adequate licensing test. As the vast majority of states employ adequate licensing tests for these certifications, almost all single-subject certification routes satisfy this standard under that criterion. In the few states that require either inadequate licensing tests or no tests at all, every program (14 in total) was found to require at least 30 SCH in the subject.

The rubric used to analyze general science certification routes is more involved and is summarized with program results below.

Analysis of graduate programs offering general science certification

(N=85 programs)⁵

Grade	Criteria	Programs	
A	At least 15 SCH of coursework is required in two science subjects selected from biology, chemistry, earth science, and physics - or - At least 50 SCH of coursework is required across the sciences - or - At least 15 SCH of graduate-level certification-specific coursework is required, including courses in at least two different science subjects	20%	Total: 25%
	Adequate general science licensing test is required	5%	
C	At least 42 SCH of coursework is required across the sciences - or - At least 15 SCH of graduate-level certification-specific coursework is required, without including courses in at least two different science subjects	5%	
F	Failure to satisfy any of the above criteria	71%	

The 71 percent of graduate programs earning an F clearly exceeds the 16 percent of undergraduate programs earning an F as reported by NCTQ in 2017. This is due primarily to graduate programs frequently requiring no more than a major in any one science field in pursuit of general science certification. For example, a “content area major” is a common admissions requirement for graduate programs. While such a requirement is adequate for biology, where it can be reasonably assumed a major in biology is required for admission, that same requirement falls short for general science certification, because there is no undergraduate major that covers all of the sciences.

5 Due to rounding, the reported figures add to 101 percent.

A closer look at alternative route science content preparation

While the majority of states offering single-subject certifications require adequate licensing tests, alternative route programs receive credit for that requirement only if candidates pass the tests before they become the teacher of record. Among the 103 alternative route programs offering single-subject science certifications, 97 percent satisfy the standard through the requirement of a licensing test or transcript review as a condition of program admission.

With the deficiencies of general science certification licensing tests previously noted, alternative route programs other than those in Missouri must independently require tests with separate cut scores or administer a transcript review to satisfy this standard. Programs offering general science certification are graded using the criteria detailed in the table below. As can be seen, only 4 percent of alternative route programs ensure general science candidates have adequate content knowledge.

Analysis of alternative route programs offering general science certification

(N=69 programs)

Grade	Criteria	Programs
A	At least 15 SCH of coursework is required in two science subjects selected from biology, chemistry, earth science, and physics - or - At least 50 SCH of coursework is required across the sciences - or - Adequate general science licensing test is required	4%
F	Failure to satisfy any of the above criteria	96%



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