



A Closer Look at Secondary Content in the Sciences

Undergraduate Secondary Programs

KEY FINDINGS: Thirty-seven states and the District of Columbia fail to require licensing tests that ensure all secondary science teachers have adequate content knowledge. Where inadequate tests are found for general science certification, a review of program requirements finds only 64 percent of general science certification routes to require adequate coursework.

Why teacher prep programs should have strong content requirements for secondary science certifications

Teachers cannot teach what they do not know. For decades, teacher preparation and higher education reformers attempted to improve the rigor of undergraduate teacher preparation programs by promoting the requirement of academic majors for prospective secondary teachers. Research generally supported this action, as strong subject-matter expertise was found to promote better instruction, especially at the high school level, and particularly for teachers of mathematics and science. The passage of *No Child Left Behind* made content mastery paramount with the “highly qualified” designation that requires high school teachers to either have completed a major in the subject they teach or pass a rigorous test in that subject, which is this standard’s benchmark for certifications that allow instruction in a single subject. Complicating the aim of content mastery are multiple-subject certifications, which permit instruction in more than one of the high school sciences. Where such certifications are found, programs earn an A on this standard with the requirement of minors in two of the sciences or a total of 50 semester credit hours (SCH) across all of the sciences for general science certification.¹

For more information about analysis and program grades, see the *Methodology in brief* and *Understanding program grades* sections below.

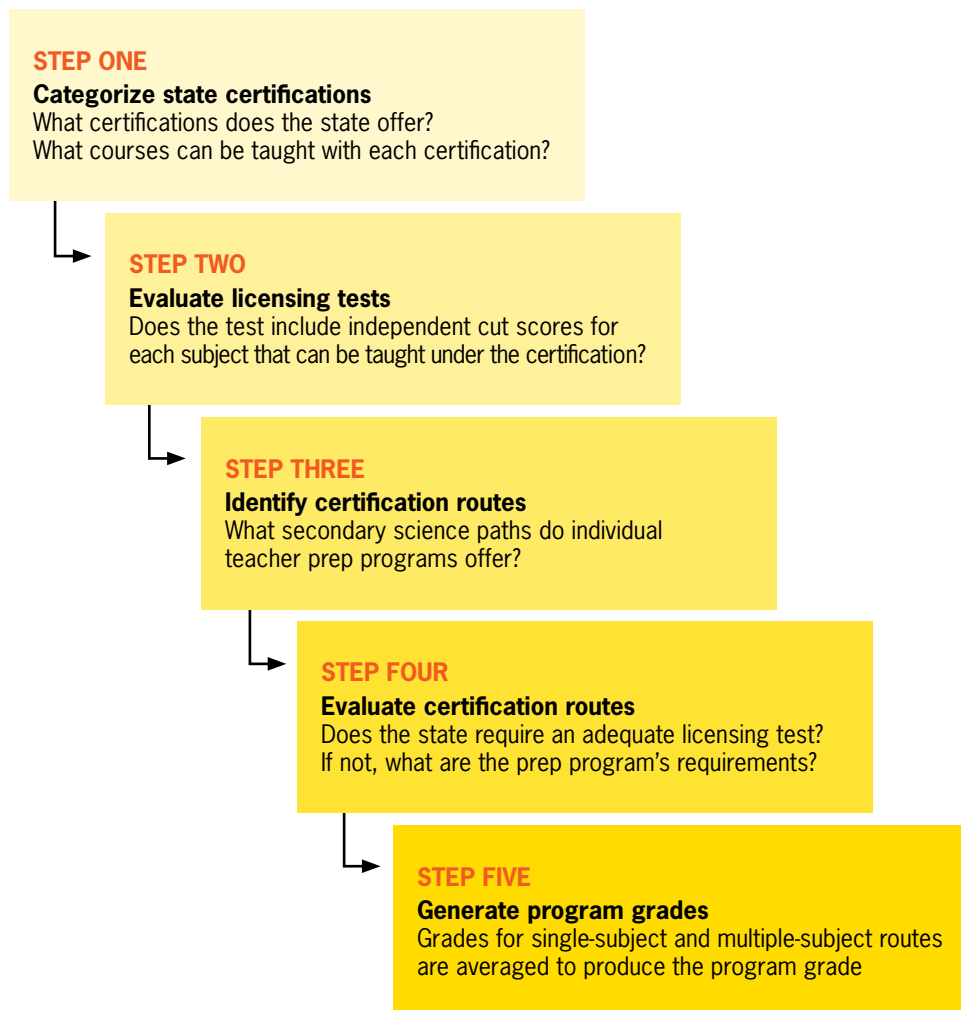
Key components of analysis

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 a general science certification allows a teacher to teach all science courses including biology, chemistry, earth science, and physics. Teacher preparation programs may offer *certification routes* — a major, minor, or other defined sequence of courses that satisfy state requirements for a specific secondary teacher certification — that lead to some or all of the teaching certifications in the state.² Prep program may differ in what coursework they require for each certification route; however, states can verify content knowledge by requiring a passing score on a licensing test as a condition of certification.

Analysis under this standard considers one or more certification routes for each program. The overall program grade for this standard is based on the analysis of the individual certification routes at each institution. Because of differences between certifications in each state, the evaluation of each certification route progresses through the following steps:

- 1 For physical science certification, which allows for instruction in chemistry and physics courses, programs can earn an A on this standard with the requirement of at least a minor in each subject.
- 2 In some cases, a program may offer multiple routes to the same certification. For example, a candidate may be able to pursue a major in chemistry, earth science, or physics to receive the same general science certification. The inverse is also found where a single major allows the teacher candidate to choose between multiple certifications.

Steps of Secondary Content in the Sciences analysis



As part of the first step in this process, every certification is categorized as either single subject or multiple subject. Single-subject certification permits instruction exclusively in the subject named in the certification. A biology certification that limits instruction to high school biology courses is an example of single-subject certification. General science certification, which allows instruction in all of the sciences, is categorized as a multiple-subject certification. Science certifications are typically designated as follows:

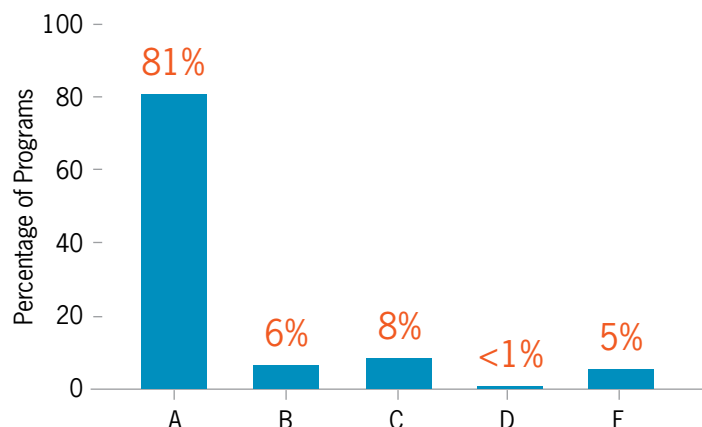
Single-Subject Certifications	Multiple-Subject Certifications
Biology Chemistry Earth Science Physics	Physical Science <i>(can teach physics and chemistry)</i> General Science <i>(can teach all of the sciences)</i>

Where states offer a general science certification, licensing tests with a single cut score are considered inadequate because it is possible for a teacher candidate to incorrectly answer most or all of the physics questions, for example, but still score well enough to pass the test and be assigned to teach physics. For general science certifications, a licensing test is adequate only if candidates are independently evaluated on their biology, chemistry, and physics content knowledge.

A full explanation of all five steps of analysis under this standard can be found in the [Standard Book](#) for Secondary Content in the Sciences.

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

(N=664 undergraduate secondary programs)



This is the first edition of the *Teacher Prep Review* to include Secondary Content in the Sciences. Previously, analysis of secondary science certification routes was completed under the High School Content standard. In the 2014 *Teacher Prep Review*, 66 percent of programs were found to earn the equivalent of an A. Since then, the criteria under which general science certification routes can satisfy the standard has been expanded to include the requirement of at least 50 SCH across the sciences. As a result, many well-rounded programs that previously fell short of the two minor threshold now earn an A.

A closer look at undergraduate science content preparation

Teacher prep programs can offer one or more certification routes for as many or as few of the available science certifications in the state. Regardless of the combination of single-subject and multiple-subject certifications offered in each state, programs are found to offer an average of three certification routes each. Analysis under this standard separately evaluates the routes leading to single-subject certification and multiple-subject certification, averaging the grades for the two types of certification to produce an overall grade for the program.

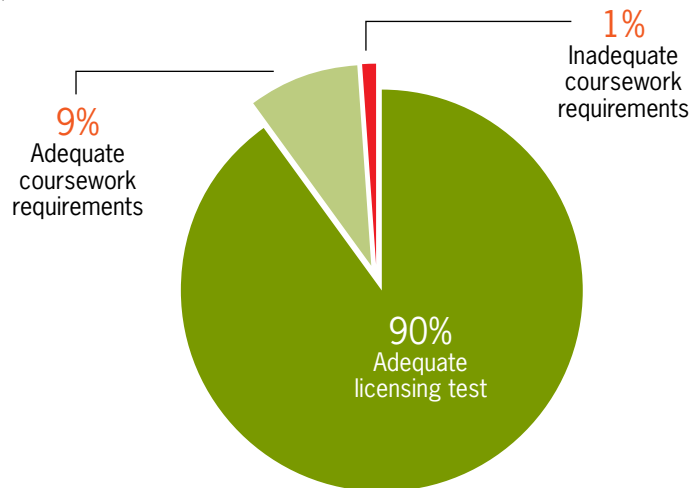
Single-subject certification routes

The vast majority of states require adequate licensing tests for single-subject certifications. Among all single-subject routes for programs in the sample, 90 percent satisfy the standard with the requirement of an adequate licensing test. Only Alaska, Montana, Nevada, North Carolina, Tennessee, Wisconsin, and Wyoming fail to require adequate tests for single-subject certifications. Where coursework is reviewed in those states, 93 percent of routes pass with the requirement of at least 30 SCH of certification-specific coursework.³ In total, only 9 out of nearly 1,300 single-subject certification routes do not satisfy the standard, and one-third of those routes are housed within a single institution.

³ Where routes fall short of the 30 SCH threshold, single-subject analysis can also be satisfied with at least 26 SCH in the subject area and at least 12 SCH of supporting coursework. Supporting coursework covers courses that benefit instruction, but fall outside of what is directly taught under a given single-subject certification. As an example, calculus courses are counted as supporting coursework for physics certification routes.

Analysis of single-subject certification routes under Secondary Content in the Sciences

(N=1,284 certification routes)



Multiple-subject certification routes

The most common multiple-subject certification is general science, which allows for instruction in all of the high school sciences.⁴ A general science licensing test must provide independent cut scores for each subject that a teacher can teach to be deemed adequate under this standard. Missouri is the only state that requires such a test. In order to teach all subjects, teacher candidates in Missouri must independently pass tests in biology, chemistry, earth science, and physics.

Because all other states which offer general science certification require inadequate licensing tests, analysts reviewed coursework for close to 400 routes in these states. To satisfy the standard, a program's general science certification route must require either two minors or at least 50 SCH across all of the sciences.⁵ Additional coursework thresholds exist for certification routes to meet at least part of the standard.

Analysis of general science certification routes under Secondary Content in the Sciences

(N=427 certification routes)⁶

Grade for route	Criteria	Percentage of routes earning each grade	
A	General science certification route requires either 15 SCH of certification-specific coursework in two subject areas or 50 SCH across all the sciences	59%	Total: 68%
	A series of adequate licensing tests is required as a condition of earning general science certification	9%	
B	General science certification route requires at least 15 SCH of certification-specific coursework in one of the sciences with at least 24 SCH of coursework in the remaining science subjects	5%	
C	General science certification route requires at least 15 SCH of certification-specific coursework in one of the sciences with at least 18 SCH of coursework in the other sciences.	8%	
D	General science certification route requires at least 12 SCH of certification-specific coursework in one of the sciences with at least 18 SCH of coursework in the other sciences.	2%	
F	General science certification route does not meet the criteria for any of the above grades	17%	

4 Seventy-eight percent of 549 multiple-subject routes reviewed under this standard were general science certification routes. Physical science certification routes accounted for 18 percent of multiple-subject certification routes, with the remaining four percent divided between unique certifications (biology and chemistry or physics and math, for example) found in Arkansas, Nevada, Ohio, and Texas.

5 To fully satisfy the standard with 50 SCH of coursework in the sciences, at least 18 SCH of science coursework must be found outside of the subject area with the greatest sum of credits.

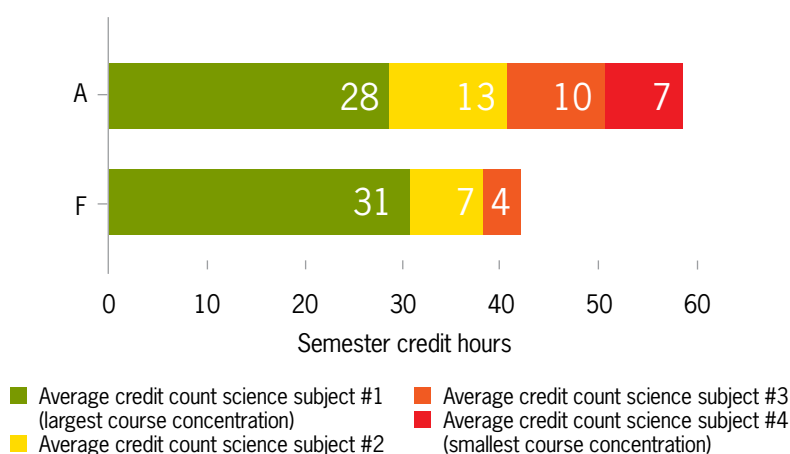
6 Includes up to three certification routes from some institutions

The structure of the 72 certification routes earning an F is notable. These routes average 42 SCH of coursework across the sciences — more than enough to provide teacher candidates with minors in two subjects — however, instead of spreading the coursework across the sciences, these routes require an average of 31 SCH in one subject, leaving only 11 SCH to spread across the other subjects, ill-preparing teacher candidates for all the subjects they will be certified to teach.

In comparison, the programs earning an A require an average of 58 SCH across the sciences that includes nearly a major and minor in two of the sciences and at least a couple courses in the two remaining sciences. As can be seen below, compared to programs earning an F, those receiving an A not only require an additional 16 SCH of science coursework, they also provide a better distribution of courses across the sciences.

Analysis of general science certification routes under Secondary Content in the Sciences

(N=250 certification routes earning A and 72 certification routes earning F)



Physical science certification, which permits teachers to teach both chemistry and physics, is the second most common multiple-subject certification. Offered in 22 states, only Ohio, New Jersey, and West Virginia require teacher candidates to independently pass licensing tests in chemistry and physics. Where coursework requirements are evaluated, the standard is satisfied with the requirement of 15 SCH in both subjects.

In the review of coursework requirements for 71 physical science certification routes offered by 64 programs, only 37 percent were found to require 15 SCH both in chemistry and in physics. Fifty-five percent of the evaluated routes required fewer than 15 SCH in one of the subjects, and alarmingly, eight percent failed to require 15 SCH in either subject.

Methodology in brief

We review the course requirements and licensure tests for potential science teachers in the context of their state's [science certification structure](#). In some states, science teachers are certified to teach only one subject (e.g., biology), while in others they may be qualified to teach multiple subjects (e.g., a general science certification that allows a teacher to teach biology, chemistry, and physics). For single-subject certifications, we look to see if aspiring teachers are required to have a major or pass a licensing test in their certification area. For multiple-subject general science certifications, we look to see if aspiring teachers are required to take a test with subject-specific scoring, complete minors in two science subjects, or complete at least 50 SCH across the sciences.

Understanding program grades for Secondary Content in the Sciences

Each program's letter grade is based on analysis of up to three single-subject and three multiple-subject certification routes. Where both single-subject and multiple-subject routes are offered, the program's grade reflects the average of those two evaluations. Below are the criteria for evaluating individual single-subject and multiple-subject general science certification routes.⁷

Grade	Single-subject finding	General science finding
A	Adequate licensing test is required - or - At least 30 SCH of certification-specific coursework is required - or - At least 26 SCH of certification-specific coursework and at least 12 SCH of supporting coursework is required	Adequate licensing test is required - or - At least 15 SCH of coursework is required in two subject areas - or - At least 50 SCH of coursework is required across the sciences with at least 18 SCH found outside the subject with the largest coursework concentration
B	<i>Individual single-subject certification routes cannot receive this grade</i>	At least 15 SCH of coursework in one of the sciences and at least 24 SCH of coursework across the other sciences
C	At least 26 SCH of certification-specific coursework and at least 8 SCH of supporting coursework is required	At least 15 SCH of certification-specific coursework in one of the sciences and at least 18 SCH of coursework across the other sciences - or - At least 50 SCH of coursework is required across the sciences with at least 15 SCH found outside the subject with the largest coursework concentration
D	<i>Individual single-subject certification routes cannot receive this grade</i>	At least 12 SCH of certification-specific coursework in one of the sciences and at least 18 SCH of coursework across the other sciences
F	Failure to satisfy any of the above criteria	Failure to satisfy any of the above criteria

⁷ Separate criteria for physical science scoring can be found under the Secondary Content in the Sciences [methodology](#).



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