2A

Action

Educator Preparation Committee

Proposed Adoption of Revised Science Subject Matter Requirements in Alignment with the Next Generation Science Standards

AGENDA INSERT

Executive Summary: This agenda item provides the draft revised Subject Matter Requirements (SMRs) for the CSET: Multiple Subjects, and Single Subject Science examinations in alignment with the Next Generation Science Standards (NGSS) to the Commission for potential adoption. The SMRs have undergone a content validation study since initial presentation to the Commission in February 2016.

Policy Question: Do the proposed revisions to the selected subject matter requirements adequately and appropriately align with the Next Generation Science Standards?

Recommended Action: That the Commission adopt the draft revised SMRs and the draft revised test design as presented in this agenda item.

Presenter: Mike Taylor, Consultant, Professional Services Division

Strategic Plan Goal

II. Program Quality and Accountability

a) Develop and maintain rigorous, meaningful, and relevant standards that drive program quality and effectiveness for the preparation of the education workforce and are responsive to the needs of California's diverse student population.

Proposed Adoption of Revised Science Subject Matter Requirements in Alignment with the Next Generation Science Standards (NGSS)

NGSS Science SMRs and the Multidimensionality of Candidate Knowledge, Skills, and Abilities in Science

One of the key hallmarks of the NGSS, as compared to prior Science content standards, is the intent for teachers to view and practice science within a three-dimensional approach. The three-dimensionality of NGSS science is typically expressed as the integration of Disciplinary Core Ideas (DCI), Science and Engineering Practices (SEP), and Crosscutting Concepts (CCC) within both science instruction and expectations for TK-12 student science-related assessment and achievement.

Readers looking at the Science Subject Matter Requirements (SMRs) as proposed in this agenda item may be wondering how the three-dimensionality of NGSS-based science is reflected in the SMRs as presented in Appendix C of the agenda item. This issue has recently been raised by the field, concerned that based on an initial reading of the SMRs, it is not clear how candidates will be prepared to teach NGSS science in a manner different from what science instruction has been in the past. Some stakeholders have recently expressed a concern regarding whether and how candidates taking the CSET examination, or completing a subject-matter program based on the draft SMRs, will demonstrate they are prepared to provide instruction to TK-12 students within the expected three dimensions of NGSS-based science.

Three foundational questions provide an organizer to respond to the field's concern:

- What is the purpose of the draft SMRs? Where and how do they fit within preparation to teach science?
- Do these SMRs assure that candidates have an underlying knowledge of how the three-dimensionality of science is represented in the view and practice of their respective science fields?
- Will candidates prepared through mastering these SMRS be able to provide science instruction to students that reflects in practice the three-dimensionality of NGSS-based science?

This agenda insert will discuss and address each of these concerns with respect to the draft CSET: Science SMRs and the preparation of candidates to teach NGSS-based science to TK-12 students.

What is the purpose of the draft SMRs? Where and how do they fit within preparation to teach science? Candidates for California teaching credentials must demonstrate that they meet two key requirements for licensure:

- **Content Knowledge** of the subject matter of the credential area, and
- **Pedagogical Knowledge** of how to teach the subject matter content effectively to TK-12 students.

Subject Matter Content Knowledge: In California, subject matter preparation and pedagogical preparation have historically been addressed separately: content knowledge is addressed and assessed by the CSET examination or by a subject matter preparation program, and pedagogical preparation is addressed and assessed within teacher preparation programs and by the Teaching Performance Assessment (TPA).

Within subject matter preparation, the SMRs define the range of subject matter content eligible to be assessed on the CSET examination, and they also serve as a foundational basis for developing subject matter program coursework. Each of the SMRs is related directly back to the state-adopted TK-12 student standards and/or framework in Science. The state-adopted TK-12 student standards and Science framework are reference materials for candidates studying for the CSET Science examination as well as required texts for Commission-approved Science subject matter preparation programs to assure that all candidates are knowledgeable about the content of these two documents. But because of the historical separation of subject matter preparation and teacher preparation, the SMRs do not address the pedagogy of how to teach science, or how to organize curriculum and instruction in science. These aspects of preparation to teach science are addressed within teacher preparation, as explained below, and not within subject matter preparation.

Pedagogical Knowledge: Within teacher preparation, candidates learn how to apply their subject matter knowledge to provide standards-aligned instruction to TK-12 students. The *Teaching Performance Expectations* adopted by the Commission define the expected pedagogical knowledge for each subject matter field. The revised TPE for Science proposed for adoption by the Commission during the June 2016 meeting (item 2B) is reprinted below to reassure readers that the pedagogy of teaching NGSS-based science is clearly expected and required of all Commission-approved teacher preparation programs.

Teaching Performance Expectation for Single Subject Science

Beginning Single Subject Science teachers demonstrate the ability to teach the state-adopted academic content standards for students in science and applicable English Language Development Standards. They balance the focus of instruction between disciplinary core ideas, crosscutting concepts, and scientific and engineering practices as indicated in the Next Generation Science Standards. Their explanations, demonstrations, and class activities serve to illustrate science concepts and principles, scientific investigation, and experimentation. Beginning teachers emphasize the nature of science, the integration of engineering design, and the connections between science, society, technology, and the environment. Further, beginning teachers integrate mathematical concepts and practices including the importance of accuracy, precision, and estimation of data and literacy into science pedagogy. They provide students the opportunity to use and evaluate strengths and limitations of media and technology as integral tools in the classroom. Beginning teachers encourage students to pursue science and

engineering interests, especially students from groups underrepresented in science and engineering careers. When live animals are present in the classroom, beginning teachers teach students to provide ethical care. They demonstrate sensitivity to students' cultural and ethnic backgrounds in designing science instruction. Beginning teachers also teach students to engage in disciplinary discourse practices that foster evidence-based explanations and argumentations to write opinion/persuasive and expository text in the content area. Beginning teachers teach students to independently read, comprehend, and evaluate instructional materials that include increasingly complex subject-relevant texts and graphic/media representations presented in diverse formats. Beginning teachers also teach students to write argumentative and expository text in the content area. Beginning teachers assure that students at various English proficiency levels have the academic language needed to meaningfully engage in the content. Additionally, beginning teachers guide, monitor, and encourage students during investigations and experiments. They demonstrate and encourage use of multiple ways to measure and record scientific data, including the use of mathematical symbols. Beginning teachers structure and sequence science instruction to enhance students' academic knowledge to meet or exceed the state-adopted academic content standards for students. They establish and monitor procedures for the care, safe use, and storage of equipment and materials and for the disposal of potentially hazardous materials.

As part of teacher preparation, candidates are required to demonstrate their ability to provide effective science instruction to TK-12 students through completion of both a Teaching Performance Assessment and at least 600 hours of student teaching wherein candidates for a science teaching credential practice NGSS-based instruction with students. These are the primary ways in which candidates demonstrate that they can provide science instruction that includes the three-dimensionality of science as required by the NGSS. The CSET subject matter examination, which focuses exclusively on science-related content knowledge, is not intended to assess candidates' instructional ability or classroom science teaching practices.

Some stakeholders have raised a concern about how candidates would demonstrate, prior to teacher preparation, that they understand the three-dimensionality of NGSS-based science as a content area. The following questions and answers address that concern.

Do the proposed Science SMRs assure that candidates have an underlying knowledge of how the three-dimensionality of science is represented in the view and practice of their respective science fields?

The content expert panel that worked on the development of the draft SMRs shared the goal of the field to assure that candidates for a science teaching credential have and can demonstrate an underlying knowledge of the three-dimensionality of science as outlined in the NGSS, and how the DCI, SEP, and CCC are integrated within a three-dimensional view of science teaching and learning. To that end, the CSET test design has been revised to include constructed response test items that will require candidates to demonstrate application of three-dimensional science concepts and approaches.

All candidates for a single subject Science credential must pass Subtest I, General Science. Within this subtest, the content to be assessed specifically includes Scientific Practices, Engineering Designs and Applications, and Crosscutting Concepts, and the interaction of these dimensions within NGSS-based science. The test design for Subtest I includes both multiple choice items, which focus on candidate knowledge of foundational science concepts, and four extended constructed response items, which will require candidates to demonstrate understanding of the three-dimensionality of NGSS-based science. This test design is shown on page 8 of the agenda item. In addition to Subtest I, candidates for a single subject Science credential in a concentration area such as biology, earth science, physics or chemistry will also take Subtest II in that concentration area. Subtest II will also include three extended constructed response items focused on candidate understanding and application of the three-dimensionality of NGSS-based science.

While it would be helpful to provide examples within this agenda item of constructed response items that require candidates to address the three-dimensionality of NGSS-based science, these items have not yet been developed, as the content expert panel and the contractor are waiting for the Commission to approve the draft SMRs before proceeding to develop test questions. Staff and the content expert advisory panel appreciate the continued input and feedback from the field as the test development process moves forward.

Licensure examinations need to be legally defensible, as they are used to make decisions that affect a candidate's ability to enter a profession and gain employment. It is also important to note that examinations used for licensure purposes are, by nature, significantly different from examinations used to assess TK-12 student learning within the context of classroom instruction. Licensure examinations need to be structured to provide sufficient diagnostic feedback to candidates who are not successful on the assessment that they can understand where their underlying knowledge was not sufficient and needs to be improved. This is why the updated CSET Science examination will include both multiple choice items that are focused on more discrete, fundamental concepts, and constructed response items that are focused more on the three-dimensionality of NGSS-based science. Some readers might ask if the CSET examination could instead consist entirely of constructed response items, given the nature of NGSS-based science. However, the use of multiple choice items is an effective and appropriate way within standardized large-scale testing to assess candidate knowledge of specific science concepts, and, in addition, helps to keep candidate costs for assessments as reasonable as possible, allows for focused diagnostic feedback to candidates, and allows for a reasonable turnaround time for providing results to candidates. Using only constructed response items on the CSET examination would not be a feasible approach at the current time. By using a mixture of multiple choice and constructed response questions the examination will assess basic science concepts (multiple choice questions) and the three-dimensionality of science (constructed response questions).

Will candidates prepared through mastering these SMRs be able to provide science instruction to students that reflects in practice the three-dimensionality of NGSS-based science?

It is the intention and the commitment of the Commission, the content expert advisory panel, and the contractor that candidates prepared through mastering these SMRs and completing a

teacher preparation program will be able to provide science instruction to students that reflects in practice the three-dimensionality of NGSS-based science. However, the CSET subject matter examination assesses candidates' underlying knowledge of science, and not the pedagogy of teaching science within the context of NGSS-based classroom instruction. Candidates are prepared to develop NGSS-based teaching practices primarily within teacher preparation programs. Teacher preparation programs provide candidates with extensive field experiences, clinical practice experiences, methodology coursework and fieldwork, student teaching experiences, and preparation for the Teaching Performance Assessment, wherein candidates demonstrate with actual TK-12 students that they can provide effective NGSS-based science instruction. The Teaching Performance Expectation relating to the pedagogy of teaching science was presented earlier in this agenda insert, and documents the Commission's expectation for all candidates to be able to provide NGSS-consistent instruction to TK-12 students.

The field's interest in and support for assuring that all Science teacher candidates are well-prepared to teach NGSS-based science is appreciated by the Commission, staff, the science content expert advisory panels, and the testing contractor. The Commission looks forward to continuing conversations with the field as the CSET examination development process along with the updating and implementation of parallel subject matter preparation program standards move forward.