**Appendix 1**

Code of Maryland Regulation 13A.12.02.29 (http://mdrules.elaws.us/comar/13a.12.02.29)

The following text has been taken verbatim from the Instructional Leader: STEM (Grades PreK-6) endorsement, regulation 13A.12.02.29. This is the complete text of this endorsement:

“To add an endorsement as Instructional Leader: STEM, grades PreK-6, an applicant shall:

A. Hold a valid, professional certificate with certification in early childhood education or elementary education;

B. Complete a minimum of 18 semester hours of post-baccalaureate credit or Department-approved Continuing Professional Development credits, to include the following:

(1) 12 semester hours in STEM education which integrates a balance of the following content:

(a) Authentic problem-based and project-based learning;

(b) Essential skills including questioning, spatial reasoning, communication, critical thinking, and problem solving;

(c) Engineering design process;

(d) Application of scientific practices and content;

(e) Application of mathematical practices and content;

(f) Technology literacy; and

(g) Collaborative learning.

(2) 3 semester hours or the equivalent in leadership knowledge and skills in providing professional learning in a school/district setting; and

(3) At least 3 semester hours or the equivalent in a supervised practicum or school-based internship in which the applicant works with a range of students in grades PreK6 and adult learners in a variety of professional development settings; and

C. Present verification of 27 months of satisfactory teaching experience.” (Instructional Leader: STEM (Grades PreK-6) Endorsement, 2015).

**Appendix 2**

**Affective Behavioral Checklist for SCIE 650 Engineering in iSTEM Education**

Please check the activities which YOU have independently (not as a specific assignment) engaged in the Engineering course:

\_\_\_\_\_1. Read an article in a newspaper or magazine about engineering and/or new technologies

\_\_\_\_\_2. Watched, rather than skipped over, part of a television show on how things are engineered.

\_\_\_\_\_3. Sought out classroom teaching engineering ideas that other teachers have posted on line

\_\_\_\_\_4. Checked out what your school library had on engineering/technology that students might enjoy

\_\_\_\_\_5. Talked to a fellow teacher about something you found really interesting in the class

\_\_\_\_\_6. Made an age-appropriate engineering -math link class connection or activity in a math lesson

\_\_\_\_\_7. Asked children to explain how they would “engineer” a tool for a particular purpose

\_\_\_\_\_8. Found myself more interested in and/exploring how things around me worked

\_\_\_\_\_9. Used a technology resource (short CD, game, video clip or suggested website) for my class

\_\_\_\_\_10. Created a bulletin board or independent activity linking science and engineering

\_\_\_\_\_11. Found myself checking out state Standards as I planned a new STEM classroom activity

\_\_\_\_\_12. Talked with a colleague about how helpful I found it to link a STEM lesson to state Standards

\_\_\_\_\_13. Sent home a note to families about the “exciting engineering” activities going on in class

\_\_\_\_\_14. Put a book about engineering achievements or engineers’ jobs in the class reading center

\_\_\_\_\_15. Encouraged each child to create an art, music, poetry, or dance project to about some aspect of engineering to share with the class during the unit

\_\_\_\_\_16. I do feel more confident about including engineering ideas/topics in my classroom

\_\_\_\_\_17. I do feel more confident about teaching an integrated STEM lesson in my classroom

\_\_\_\_\_18. I do feel my students enjoyed learning about engineering and “discovering” what engineers do

\_\_\_\_\_19. I do feel this graduate course has increased my repertoire of inquiry teaching skills

\_\_\_\_\_20. I do feel this graduate course has increased my interest in and/or my capabilities of assuming future leadership roles in developing STEM-related activities in my school, system, or other state venues.

**Appendix 3**

**Final Program Evaluation by Program Participants**

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**. For each of the following statements, please make three ratings:

1. How confident were you in your abilities with regard to each of the following areas before entering the program? (“Level of Confidence at Start of program” column; check one)
2. How confident are you in your abilities now since completing the program? (“Level of Confidence Now” column; check one)
3. If you are interested in doing this *and* likely to do this in your future. (“Interest” column; check if “yes”; leave blank if no.)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. Teaching the engineering design process, engineering practices, and engineering habits of mind to students. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Teaching students that technologies, broadly defined, solve and sometimes create problems. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Helping students recognize that the tools that they use (e.g., rulers, calculators) are “technologies.” | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Allowing students/teams to “fail” and then try again in the context of an engineering design challenge. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Teaching scientific content and practices to students. |  | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**, continued.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. Teaching how science is applied to “the real world” to answer questions, investigate issues, or solve problems. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Teaching students outside, where the outdoor environment is central to the lesson. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Teaching how science is applied to “the real world” to answer questions, investigate issues, or solve problems. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Teaching mathematical content and practices to students. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Teaching how mathematics is applied to the “real world” to answer questions, investigate issues, or solve problems. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Engaging students in generating, researching and refining their own questions (as emphasized in the Earth-space/physical course). | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**, continued.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. *Teaching* standards-based integrated STEM (iSTEM) lessons/units to students where engineering (E) is emphasized, and the other areas (STM) are meaningfully and purposefully addressed. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. *Designing/writing* standards-based iSTEM lessons/units for students such that: engineering (E) is emphasized, the other areas (STM) are meaningfully and purposefully addressed, and another teacher could teach the lessons/units. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. *Teaching* standards-based (iSTEM) lessons/units to students where environmental/biological science (S) is emphasized, and the other areas (TEM) are meaningfully and purposefully addressed. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. *Designing/writing* standards-based iSTEM lessons/units for students such that environmental/biological science (S) is emphasized, the other areas (TEM) are meaningfully and purposefully addressed, and another teacher could teach the lessons/units. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**, continued.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. *Teaching* standards-based iSTEM lessons/units to students where mathematics (M) is emphasized, and the other areas (STE) are meaningfully and purposefully addressed. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. *Designing/writing* standards-based iSTEM lessons/units for students such that mathematics (M) is emphasized, the other areas (STE) are meaningfully and purposefully addressed, and another teacher could teach the lessons/units. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. *Designing/writing* trans-disciplinary, project-based iSTEM lessons/units; another teacher could teach from this lesson/unit. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Engaging students in analyzing and evaluating an issue, text, or argument during STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**, continued.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. Engaging students in using evidence-based reasoning (supporting a claim with evidence in readings) during STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Considering safety in lesson planning and teaching activities with students. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Encouraging students to be creative and innovative during STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Engaging students in communicating with one another in verbal and written form precisely and accurately during STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Providing students with opportunities to engage in spatial reasoning during STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**, continued.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. Engaging students in collaborating with one another by contributing ideas, listening to each other, taking on roles, etc.) during STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Engaging students in considering ethical implications of their actions during STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Critically analyzing and evaluatingan engineering curriculum, determining the quality of the curriculum and how it could be improved. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Critically analyzing and evaluatinga science curriculum, determining the quality of the curriculum and how it could be improved. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Critically analyzing and evaluatinga mathematics curriculum, determining the quality of the curriculum and how it could be improved. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**, continued.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. Critically analyzing and evaluatingan iSTEM curriculum, determining the quality of the curriculum and how it could be improved. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Assessing student learning with regard to individual STEM subject area content and practices. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Assessing student learning with regard to engagement in iSTEM skills. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Using evidence of student learning to improve a lesson plan and/or assessment plan in STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Using evidence of student learning to improve students’ overall learning experience (e.g., via re-teaching) in STEM or iSTEM instruction. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Planning and leading iSTEM Professional Learning Experiences (PLEs) for teachers or administrators. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part I: Self-Assessment of Confidence and Interest/Likelihood of Future Action**, continued.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Level of Confidence at Start of Program | | | | | Level of Confidence Now | | | | | Interested and likely to do in future? |
| *Low* |  |  |  | *High* | *Low* |  |  |  | *High* |
| Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Not at all Confident | A Little Confident | Somewhat Confident | Confident | Very Confident | Check if “Yes” |
| 1. Presenting curriculum development or other work in iSTEM to peers, teachers, and administrators. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1. Presenting curriculum development or other work in iSTEM to parents and other members of the public. | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

**Part II: Open-ended questions.**

1. Aside from the required assignments within the program and your normal “required” teaching curriculum, have you **engaged PreK-6 students in innovative STEM or iSTEM experiences** over the last year? (Include, for example, new field trips, outdoor learnin experiences, units of study, enhancements to existing units, etc.)

☐ Yes ☐ No

If yes, please explain:

|  |
| --- |
|  |

1. Aside from the required assignments within the program, have you participated in STEM or iSTEM **curriculum revision or writing** within your school, school system or the state over the last year? (Include, for example, revising science units to better address the NGSS, writing mathematics lessons that address the College & Career Ready Standards and integrate with engineering or science, etc.)

☐ Yes ☐ No

If yes, please explain:

|  |
| --- |
|  |

1. Aside from the required assignments within the program, have you participated in **leading STEM or iSTEM professional learning experiences** (PLEs)? (Include, for example, peer coaching and mentoring, guiding pre-service teachers in your classroom in STEM/iSTEM, more traditional forms of professional development, etc. within your school, system, or the state).

☐ Yes ☐ No

If yes, please explain:

|  |
| --- |
|  |

1. Have you taken on any other **STEM or iSTEM leadership roles or opportunities** not included thus far in this open-ended part of the survey? (Include, for example, a new role as a science facilitator or school STEM leader, work with the PTA to add STEM to an activity, presenting STEM/iSTEM work at conferences, writing articles about your STEM/iSTEM work, writing grants to support STEM/iSTEM work, involvement in STEM Work Groups, etc.)

☐ Yes ☐ No

If yes, please explain:

|  |
| --- |
|  |

1. What have been the **two** **biggest benefits of this program for your future as a STEM/iSTEM teacher and leader**?

|  |
| --- |
|  |

1. What have been the **two** **biggest challenges in being in this program**?

|  |
| --- |
|  |

1. If you have any **other** comments, questions, or things you want us the Program Director and instructors to know, please include them here.

|  |
| --- |
|  |

~ Thank you for completing this survey! ~

**Appendix 4**

**Summary of Key Program Assessments for the iSTEM Program.** (Indirect measures are *italicized*. All other measures are direct.)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Assessment Title** | **Assessment Description** | **Direct or Indirect Measure** | **Outcome Measured** | **Course or Time Assessment is Implemented** |
| Collaborative Research Project Paper | This paper is part of the Collaborative Research Project. It is unique in engaging program participants in conducting collaborative research to investigate a student-selected question related to the theme of water and survival, which: inherently connects to multiple STEM subjects; is grounded in authentic, real-world context; and entails synthesis and critical analysis of STEM/iSTEM information. The paper involves students individually writing about their findings and questions that arise from their research, as well as writing about their participation in collaborative research and the collaborative presentation of results. | Direct | iSTEM Research | Course 3: Mathematics course |
| Unit Analysis and Redesign Project | This project involves program participants critically analyzing and evaluating an existing Earth-space or physical science unit (e.g., within her/his school system) with respect to STEM content, STEM integration, and STEM skills and habits of mind. Participants then revise and rewrite the unit as an integrated STEM (iSTEM) unit that better addresses STEM content, integration, skills and habits of mind. | Direct | STEM Subject Matter and iSTEM Content | Course 4: Earth-Space & Physical course |
| Lesson Plan Assignment | This assignment is part of part of the iSTEM Teaching Project. The assignment involves program participants writing an iSTEM lesson plan, including an assessment plan, which focuses on one subject (e.g., science or mathematics), but meaningfully and purposefully reaches out to other STEM areas. Participants also plan for assessment and teach the lesson. (Each participant must teach students who are within grades Pre-K to 6, and who they did not teach in another iSTEM teaching experience within the mathematics course. | Direct | Planning | Course 6: Practicum course |
| Impact on Student Learning Assignment | In this assignment, which is part of the iSTEM Teaching Project, program participants evaluate the extent to which her/his students met STEM subject matter and iSTEM skills and objectives of the lesson using evidence from assessment data. Participants use evidence to determine: appropriate next steps for instruction; how to improve the lesson; how to improve the assessment plan; and how to improve students’ engagement in iSTEM, STEM content knowledge, and iSTEM skills and habits of mind. | Direct | Impact on Student Learning | Course 6: Practicum course |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Assessment Title** | **Assessment Description** | **Direct or Indirect Measure** | **Outcome Measured** | **Course or Time Assessment is Implemented** |
| Growth & Leadership Final Project | This final project engages program participants in reflecting on their growth experiences as emerging leaders. Specifically, participants reflect on the iSTEM Teaching Project and the two professional learning experience (professional development) projects they had between the Transformational Leadership & Professional Development course and the Practicum course. This project includes a reflection paper, the creation of a video and a poster, and the delivery of a poster presentation to peers, other teachers, project instructors, and school system and other leaders. All of these elements aim to address participants’ growth as iSTEM leaders. | Direct | Leadership | Course 6: Practicum course |
| *Grades in Content Course* | *The first four courses in the program represent the program’s “content courses” in which program participants learn and apply STEM subject matter content, pedagogical content knowledge, and practices, and learn to integrate particular STEM subject areas (e.g., mathematics) with others (e.g., science, technology, and engineering). Thus, course grades for these four courses represent a good, indirect measure of program performance with regard to STEM content.* | *Indirect* | *STEM Content* | *End of the first four courses: 1 Engineering, 2 Environmental & Biological, 3 Mathematics, and 4 Earth-Space & Physical* |
| *Final Program Evaluation by Participants* | *After completing the program, participants will complete this evaluation to reflect upon their confidence – both before enrolling in the program and after recently completing the program – with regard to: STEM content and practices; iSTEM instructional approaches; iSTEM essential skills and habits of mind; critical analysis, redesign and writing of iSTEM curriculum; iSTEM teaching; and delivery of iSTEM Professional Learning Experiences. Confidence will be measured on a 5-point Likert scale. Participants’ interest and likelihood in using content, practices, approaches, etc. will be assessed in a yes/no checklist fashion. Finally, open-ended questions on the survey will examine participants’ engagement in key activities beyond the scope of the program and the teachers’ “normal” curriculum, and will seek holistic feedback on program quality.* | *Indirect* | *STEM Subject Matter, iSTEM, Leadership* | *At end of program* |