



SEED
SECONDARY EDUCATION

GEORGE MASON UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
Secondary and Elementary Education Program (SEED)

**SEED 673-001: Advanced Methods of
Teaching Science in the Secondary School**

3 credits, Spring 2023

Thompson Hall 2020, Fairfax Campus

Office: None – Go to Thompson 1800

Instructor:	Dr. Stephen Burton
Day and Time:	Tuesdays 4:30-7:20 pm
Dates:	Jan 25 – May 10
Class Location:	Thompson 2020
Office Phone:	Please email sburton7@gmu.edu

Office Hours: By appointment

Emergency Procedures: You are encouraged to sign up for emergency alerts by visiting the website <https://alert.gmu.edu>. There are emergency posters in each classroom explaining what to do in the event of crises. Further information about emergency procedures exists on <https://ready.gmu.edu/>.

Communication: Email is the best form of communication. During usual circumstances, turnaround time is 24-36 hours. You can also reach me on my cell phone at 616-502-2175. However, please text me first asking if I can receive a call at that time. If I do not respond right away, then I am unavailable. I will text back later, and we can schedule a time to talk on the phone.

Prerequisites/Corequisites: You must have taken SEED 573 prior to this course. Per state guidelines, you are required to complete 15 hours of fieldwork during this class. Please answer the survey sent out for registering for fieldwork. If you have missed this survey, go to <http://cehd.gmu.edu/endorse/ferf> to sign up for your placement.

University Catalog Course Description: Provides advanced study of teaching and curriculum development based on research and current issues. Emphasizes integrating science and technology and adapting instruction to the needs of diverse learners.

Course Overview: SEED 673 is the second course in a two-course sequence of science methods courses for students seeking a secondary school teaching license in earth science, biology, chemistry, or physics. The course builds on students' knowledge of their subject matter and from their first science methods course. The course focuses on using technology in science teaching and learning and meeting the diverse needs of learners as called for by the Standards of Learning for Virginia Public Schools and National Science Education Standards and as outlined by the National Council for Accreditation of Teacher Education (NCATE), the National Science Teachers Association (NSTA), and the Interstate New Teacher Assessment and Support Consortium (INTASC). SEED 673 introduces students to integrating technology in learning and teaching science, adapting inquiry-based lessons, assessment techniques, and the diverse needs of students.

Course Delivery Method: All SEED classes have designated delivery modes and specific modes for each class session (e.g., face-to-face, virtual synchronous, virtual asynchronous). The majority of SEED classes are held in a face-to-face mode. Students are expected to attend every class session in the mode that it is offered. This course is designated as a lecture course, however, the approach used in the class is intended to mirror best practices in the secondary classroom for developing both content knowledge and process skills.

Attendance: If you must miss a class session for illness or another valid reason, you are expected to proactively communicate (ahead of the class session) with your instructor about your expected absence.

Professional Dispositions: Students are expected to always exhibit professional behaviors and dispositions. See <https://cehd.gmu.edu/students/polices-procedures/>.

Core Values Commitment: The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: <http://cehd.gmu.edu/values/> .

GMU Policies and Resources for Students:

Policies

- Students must adhere to the guidelines of the [Mason Honor Code](#)
- Students must follow the university policy for [Responsible Use of Computing](#)
- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.
- Students with disabilities who seek accommodations in a course must be registered with [George Mason University Disability Services](#). Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor.
- Students must silence all sound emitting devices during class unless otherwise authorized by the instructor.

Campus Resources

- Support for submission of assignments to VIA should be directed to VIAhelp@gmu.edu or <https://cehd.gmu.edu/aero/VIA>. Questions or concerns regarding use of Blackboard should be directed to <http://coursesupport.gmu.edu/>.
- For information on student support resources on campus, see <https://ctfe.gmu.edu/teaching/student-support-resources-on-campus> .

Notice of mandatory reporting of sexual assault, interpersonal violence, and stalking: As a faculty member, I am designated as a “Responsible Employee,” and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason’s Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason’s confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-380-1434 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance from Mason’s Title IX Coordinator by calling 703-993-8730, or emailing titleix@gmu.edu.

For additional information on the College of Education and Human Development, please visit our website <https://cehd.gmu.edu/students/>.

Required Electronic Texts: We will be using the NSTA class bundle which provides numerous resources from the National Science Teacher Association (NSTA) library (FYI - this is our national organizing body). The purchase of these electronic materials also gives you a membership to NSTA, which opens a great deal of other resources to you. We are doing this instead of having one book for two reasons:

- NSTA is an important organization to know over the course of your career as a science teacher – they are a premiere organization in professional development- and you should get to know them and get involved as soon as possible
- NSTA peer-reviews all their work, so their professional development materials are the best available – and the biggest body of materials as well

If you took Science Methods 1 during the Fall of 2022, you should have already paid for the year-long course pack and will not need to do anything further. However, if you did not take Science Methods 1 in the Fall of 2021 OR chose not to purchase the course pack, you will need to make the purchase ([follow this link to purchase this resource](#)).

Course Materials Online: For dissemination of information, I am sharing a [Google Folder](#). You will need a Google account to access these materials. [Instructions for creating a Google Account with an existing email can be found here](#). Materials will be added throughout the semester based upon needs from the course. The Blackboard site, found at <http://mymasonportal.gmu.edu>, will only be used as a means to communicate information to you via email. Use the same login as your GMU email for the Blackboard Sites.

Course Performance Evaluation: Students are expected to submit all assignments on time in the manner outlined by the instructor..

Grade	Percentage
A	95-100%
A-	90-94%
B+	87-89%
B	83-86%
B-	80-82%
C	70-79%
F	Below 70%

Grading: High quality work and participation is expected on all assignments and in class. Attendance at all classes for the entire class is a course expectation. For each unexcused absence, the course grade will be reduced by 5% points. All assignments are graded and are due at the beginning of class on the day they are due. Late assignments will automatically receive a ten percent grade reduction (one full letter grade lower).

If circumstances warrant, a written contract (form provided by CEHD) for an incomplete must be provided to the instructor for approval prior to the course final examination date.

Requests are accepted at the instructor's discretion, provided your reasons are justified and that 80% of your work has already been completed. Your written request should be regarded as a contract between you and the instructor and must specify the date for completion of work. This date must be at least two weeks prior to the university deadline for changing incomplete to letter grades.

Student Evaluation of Teaching: The student evaluation of teaching, or SET, is an online course survey. You are strongly encouraged to complete this form for each course as this feedback helps instructors and administrators reflect on your class experiences. Towards the end of the course, you will receive email and Blackboard notifications when the evaluations open. Your anonymous and confidential feedback is only shared with instructors after final grades have been submitted. More information about the SET can be found on The Institute of Effectiveness and Planning website at <https://oiep.gmu.edu/set/>.

Big Ideas in Science Education: During this semester, we will continue focusing on helping you begin your journey to becoming a reflective practitioner of reformed science education practices. We will focus on the following big ideas as a way to frame your understanding of effective science education practices throughout both Science Methods I and Science Methods II.

- Our job is to help students figure out how to be lifelong learners
- **Have a theory of learning** – it is what should guide your instruction as you develop lessons
- Know what you want your students to be able to do and how you will assess it before you design any instruction
- Know your students – get into their heads when designing lessons
- Measure everything you do against student learning
- You don't have to reinvent the wheel, but do need to customize it based on your learning theory and unit objectives
- The more students figure out answers to tough questions on their own, the more they will trust they can learn on their own
- Science is a process that uses evidence to think critically and explain the natural world
 - The process leads to the knowledge we currently teach as facts
 - **If students don't experience and explicitly learn the process**, they won't value its ability to explain the natural world – plus they will only see science as a collection of facts

SEED 673 Learner Outcomes/Objectives: Below is a list of the major course goals along with their corresponding objectives and assessments. They are written in the same [ABCD format](#) you learned in Methods I with the **Audience**, **Behavior**, **Conditions**, and **Degree** color coded as shown. To the right is the assignment(s) that will be used to evaluate achievement of the objectives.

Goal 1: Build a learning theory for developing and implementing lessons

Objective	Assignment (linked)
Methods II students will consistently argue, using evidence, how a unit plan does or does not align with the constructivist learning theory.	Learning Theory Alignment
Methods II students will design instruction that reflects a constructivist learning theory (self-created or obtained from other sources and modified) that allow students to build the knowledge rather than being told.	Lessons in the Unit Plan Lesson Analysis Learning Theory Alignment
Methods II students will explain how the 5-E lesson design, the Learning Cycle, and a student-centered approach represent a constructivist learning theory approach.	Learning Theory Alignment

Goal 2: Do science to understand how science is done

Objective	Assignment
Methods II students will integrate authentic science and engineering practices (SEP) into their instruction that explicitly develops students' understanding of how science and engineering is undertaken.	Lessons in the Unit Plan

Goal 3: Recognize that inquiry learning using scientific practices has inherent risks that should be identified and addressed such that students learn to do science in an ethical and safe manner.

Objective	Assignment
Methods II students will design lessons that clearly indicate within the lesson any safety concerns, how to reduce them and what to do when accidents happen.	Lessons in the Unit Plan

Goal 4: Develop an understanding of how inquiry can develop both scientific thinking and content knowledge

Objective	Assignment
Methods II students will explain how using a phenomenon as the basis for instruction can drive student inquiry while developing scientific thinking and content knowledge.	Learning Theory Alignment
Methods II students will explain how Model-Based Inquiry can be used as an organizational approach and formative assessment to help students and the teacher evaluate development of scientific thinking and content knowledge.	Learning Theory Alignment
Methods II students will explain how Cognitive Apprenticeships can be applied in instruction specifically highlighting that building science and engineering practices (skills not content) require explicit instruction about processes	Learning Theory Alignment
Methods II students will develop instruction that effectively incorporates phenomenon, Model-Based Inquiry and Cognitive Apprenticeships	Lessons in the Unit Plan

Goal 5: Understand how to develop effective lessons and units with backwards design

Objective	Assignment
Methods II students will use backwards design principles to create a unit plan imbedded in a year-long course by using the CUE framework identified by the text Designing Effective Science Instruction	Unit Plan
Methods II students will create lessons for their unit plan that contain measurable objectives matched with assessments and instructional activities that will lead to student achievement of the objectives	Lessons in the Unit Plan

Goal 6: Develop skills as reflective practitioners.

Objective	Assignment
Methods II students will examine instructional activities and classroom management using their learning theory as a lens and student behavior, engagement, and learning (when possible) as the evidence	Field Experience Paper
Methods II students will evaluate efficacy of a lesson by using data from assessments aligned with the objectives.	Lesson Analysis

Assessments: Findings from science education research shows that frequent assessment of small amounts of material is most effective for learning science. Therefore, in this class formal and informal assessment will be continuously provided on assignments and class activities. Assessment is a two-way communication loop that informs both learning and teaching. Assessments for each of the objectives are identified and linked to documents describing them. [Additionally, an overview of all the assessments and the percentage they make up of your overall grade can be found here.](#) Due dates for each of the assessments can be found in the calendar below.

TENTATIVE CALENDAR		
Day	Date	Topic
Monday	Jan 23	Introduction to course Ambitious Science Teaching Anchoring Events
Thursday	Jan 25	Vision of Ambitious Science Teaching Core Practice Set - Selecting Anchoring Events and Essential Questions
Sunday	Jan 29	Making thinking visible through models - Modeling part 1
Monday	Jan 30	Discussion Modelling Anchoring Event Continued
Thursday	Feb 2	Core Practice Set - Identifying Big Ideas
Sunday	Feb 5	Assessment - Criteria for success and assessment map
Monday	Feb 6	Discussion Planning Project Unit Plan Organization - Criteria for Success & Assessment Map
Thursday	Feb 9	Core Practice Set - Sequencing Learning Activities that Build Specific Understandings
Sunday	Feb 12	Talk as a Tool for Learning - Productive Discourse, Part 1
Monday	Feb 13	Discussion Unit Plan Organization - Engaging Students & Sequence
Thursday	Feb 16	Eliciting Student Ideas - Core Practice Set Allowing students to show what they know - Modeling part 2
Sunday	Feb 19	Encouraging more students to participate in talk - Productive Discourse, Part 2
Monday	Feb 20	Discussion Planning for eliciting student ideas - 40 minute implementation
Thursday	Feb 23	Planning for eliciting student ideas - partner work
Sunday	Feb 26	Planning for eliciting student ideas- partner work
Monday	Feb 27	Discussion Implementation 1 - Eliciting Student Ideas Partner debrief
Thursday	Mar 2	Revising eliciting student ideas - partner work
Sunday	Mar 5	Revising eliciting student ideas - partner work
Monday	Mar 6	Implementation 2 - Eliciting Student Ideas Whole group debrief
Monday	Mar 13	Spring Recess
Monday	Mar 20	Detailed Lesson 1 and short lesson 2
Thursday	Mar 23	Supporting ongoing changes in thinking - Collective Thinking - Core Practice Set

TENTATIVE CALENDAR		
Day	Date	Topic
Sunday	Mar 26	Detailed Lesson 1 and short lesson 2
Monday	Mar 27	Discussion Detailed Lesson 1 and short lesson 2
Thursday	Mar 30	Supporting ongoing changes in thinking - introducing new ideas - Core Practice Set
Sunday	Apr 2	Supporting ongoing changes in thinking - activity and sensemaking -Core Practice Set
Monday	Apr 3	Discussion Planning for introducing new ideas, activity and sensemaking - 40 minute implementation
Thursday	Apr 6	Planning for introducing new ideas, activity and sensemaking
Sunday	Apr 9	Planning for introducing new ideas, activity and sensemaking
Monday	Apr 10	Implementation 3 - introducing new ideas, activity and sensemaking - 3 groups
Thursday	Apr 13	Detailed Lesson 3 and short lesson 4
Sunday	Apr 16	Detailed Lesson 3 and short lesson 4
Monday	Apr 17	Implementation 3 - introducing new ideas, activity and sensemaking - 3 groups
Thursday	Apr 20	Making and Justifying Claims in a Science Community - Scientific Argument
Sunday	Apr 16	Drawing together Evidence-Based Explanations - Core Practice Set
Monday	Apr 24	Discussion Unit Plan Organization - Sequence Remaining Lessons
Thursday	Apr 27	Unit Plan Work
Sunday	Apr 30	Formative and Summative Assessments
Monday	May 1	Discussion Unit Plan Organization - Assessment Map and Summative Blueprint
Thursday	May 4	DUE - Unit Plan Assignment - Parts A-E (Partner Work)
Sunday	May 7	DUE - Unit Plan Assignment - Part F - Lesson Analysis Due (Individual)
Monday	May 8	NO CLASS - Reading Day
Thursday	May 11	DUE - Field Experience Lesson Analysis DUE - Field Experience Reflection



The Secondary Education (SEED) Program “Seeds”

As illustrated by the model to the left, the SEED program is guided by five “Seeds” or principles that students are expected to understand and learn to apply in their teaching and professional lives: Social Justice, Inquiry and Reflection, Advocacy and Agency, Partnership and Collaboration, and Respect and Relationship. SEED students address each Seed in a developmental fashion, twice during their licensure program and once again during the master’s teacher research capstone experience:

- Each Seed is introduced and students demonstrate initial understandings and consider initial applications to teaching of the Seeds (as determined by the program and course instructor) during one of the five pre-licensure courses (Foundations, Methods I, Human Development, Methods II, Content Literacy)
 - All five Seeds are revisited and students demonstrate deeper conceptual understandings of and identify applications to their teaching of the Seeds (in a manner they determine) during internship and internship seminar
 - All five Seeds are explored more deeply, and students demonstrate mastery understandings of, applications to their teaching and teaching inquiries (via their teacher research Methodologies), and future integrations of the Seeds into their teaching and teaching inquiries (via their teacher research Discussions)

Course	Seed/Definition	Key Assignment Description
Foundations of Secondary Education	<p style="text-align: center;">Advocacy and Agency</p> <p>The SEED program educates teachers to develop a commitment to advocating for and developing agency in every young person. Teachers’ advocacy activities begin with pedagogical interactions and extend into school and community contexts. Similarly, teachers’ consideration of youths’ agency begins with enabling them to act independently and make choices in their own best interests—in the classroom and beyond.</p>	<p style="text-align: center;">Teacher Candidate Digital Portfolio</p> <p>This digital portfolio is a website the teacher candidate creates to begin assembling products and artifacts that illustrate their emerging philosophy of teaching, experiences designing instructional materials, interviews and reflections from clinical experiences, and professional documents such as resumes and work experience. Pieces that teacher candidates add to the digital portfolio demonstrate their agency as educators inside and outside of classrooms, candidates’ advocacy of critical issues relevant to secondary education, and candidates’ thinking on how educators, their learners, policy makers, and community members all have different agency in making choices related to secondary education.</p>
Methods I	<p style="text-align: center;">Social Justice</p> <p>The SEED program educates teachers to develop a commitment to social justice. Such a commitment encompasses the belief that all members of our school, university, and broader communities can contribute to disrupting inequitable interactions, practices, and structures, with a focus on enhancing each individual’s opportunity to learn and succeed. Social justice is also closely aligned with “equity,” which involves the implementation of anti-oppressive and antiracist interactions, practices, and structures that ensure that every individual has an unbiased, impartial, responsive, and appropriately-scaffolded opportunity for academic and professional success.</p>	<p style="text-align: center;">Lesson Plan</p> <p>Using a provided format, the lesson plan must include objectives, standards, instructional plans, assessments, classroom layout(s), a teacher script, and all materials that would be given to students as part of the lesson. The lesson must demonstrate the teacher candidate’s ability to integrate justice concepts/content into their instruction.</p>

Human Development and Learning	<p style="text-align: center;">Relationships with and Respect for Youth</p> <p>The SEED program educates teachers to develop relationships with and respect for youths. When a school culture promotes respect, support for students' identities, senses of belonging, and tolerance, students are able to work as active participants in the classroom and the community. Secondary teachers who create a welcoming environment in their classrooms; who strive to know and honor students' backgrounds, preferences, and perspectives; who build relationships with young people based on trust and mutual understanding; and who connect curriculum to students' cultures hold the key to effective instruction. Their instruction will contribute to developing unique individuals who will be able to connect their life experiences to learning.</p>	<p style="text-align: center;">Case Study/Student Application Project</p> <p>The case study/student application project is a summative assessment of the teacher candidate's ability to use psychological theory to analyze problems in a classroom and practice approaches a thoughtful, ethically principled teacher would use to solve problems. The case study/student applicant project must demonstrate the teacher candidate's understanding of how and why teachers can use psychological theories and principles to develop relationships with and demonstrate respect for youths, with an ultimate goal of enhancing adolescents' school and life success.</p>
Methods II	<p style="text-align: center;">Inquiry and Reflection</p> <p>The SEED program educates teachers who appreciate and know how to ask questions about their practices and who are critically reflective of their pedagogies, empowered by evidence. The ability to inquire and reflect on one's teaching practice is foundational to educators' ongoing and self-directed professional growth across their professional lifespans. Educators who can inquire into and consistently implement effective instructional practices--and who can critically reflect on and evaluate their pedagogies--will be the most responsive teachers and will best inspire students to learn.</p>	<p style="text-align: center;">Unit Plan/Lesson Implementation</p> <p>Teacher candidates will use the "backwards design" process to develop a plan for teaching a unit which actively involves students in meaningful learning; individualize learning to accommodate the strengths and needs of students; and provide authentic assessments. Unit plans will include objectives, a calendar, and an outline of each day in the unit. One lesson of the unit must be taught/co-taught in the teacher candidate's clinical experience classroom, and the unit plan and lesson implementation must demonstrate the candidate's understanding of how and why teachers use inquiry and reflection to improve their pedagogical practices and enhance student learning.</p>
Content Literacy	<p style="text-align: center;">Collaboration and Partnership</p> <p>The SEED program educates teachers who value collaborative engagement in learning and teaching and supporting collaboration through different forms of partnership. Collaboration takes on many forms, including collaboration amongst teacher candidates and their peers, course instructors and faculty advisors, mentor teachers in schools, their students and their students' families and caregivers, and amongst experts in their fields of teaching. These collaborations occur through a shared understanding of partnership. By spanning multiple boundaries, the SEED program supports partnerships with local schools and their divisions, with state and national professional associations, and with international experiences in other countries.</p>	<p style="text-align: center;">Disciplinary Literacy Inquiry Project</p> <p>Teacher candidates complete an inquiry into methods of supporting students' comprehension in their respective content areas. Using resources from class and peer-reviewed articles, candidates develop an understanding of how to guide and deepen students' comprehension, addressing questions including "Why is it important to be literate in our respective subject areas?". The inquiry project must demonstrate the candidate's understanding of how and why teachers collaborate with other education professionals, students, families and caregivers and others to support students' subject area comprehension and literacy learning.</p>
Internship and Internship Seminar	<p style="text-align: center;">All SEED Seeds: Applications to Teaching</p> <p>All five Seeds are revisited and students demonstrate deeper conceptual understandings of and identify applications to their teaching of the Seeds during internship and internship seminar.</p>	
Teacher Research (for Master's students only)	<p style="text-align: center;">All SEED Seeds: Applications to Teaching and Teaching Inquiries</p> <p>All five Seeds are explored more deeply, and students demonstrate mastery understandings of, applications to their teaching and teaching inquiries (via their teacher research Methodologies), and future integrations of the Seeds into their teaching and teaching inquiries (via their teacher research Discussions)</p>	

Professional Standards

The course focuses on the teaching of science as called for by the state and national science standards and as outlined by the National Council for Accreditation of Teacher Education (NCATE), the National Science Teachers Association (NSTA), and the Interstate New Teacher Assessment and Support Consortium (INTASC). EDCI 573 builds a repertoire of science teaching and assessment strategies to facilitate student learning.

The pre-service and provisionally licensed teacher will:

- Build a repertoire of science teaching and assessment strategies by reading, writing, observing, participating in, and reflecting on the teaching and learning of science; RESEARCH-BASED PRACTICE; SPA STANDARDS 1, 3, 5, 6, 8, 10
- Develop strategies to help students become scientifically literate, think critically and creatively, understand the nature of science, and see the importance of science as a way of knowing; ETHICAL LEADERSHIP; INNOVATION; SPA STANDARDS 2, 3, 4
- Plan standards-based (local, state, and national) units of science study including daily lesson plans for students that reflect research in effective science teaching and learning; RESEARCH-BASED PRACTICE; SPA STANDARD 5, 6, 8, 10
- Construct science lessons that include alignment of objectives, activities, and assessments that address the needs of a variety of student populations including English language learner, special needs students, and gifted and talented students; ETHICAL LEADERSHIP; SPA STANDARDS 8, 10
- Learn about science laboratory safety and plan teaching activities that highlight safety; ETHICAL LEADERSHIP; SPA STANDARD 9
- Work collaboratively with peers to teach and discuss science and science teaching. COLLABORATION; SPA STANDARD 10
- Incorporate environmental sustainability into teaching paradigms and into daily life. SOCIAL JUSTICE; SPA STANDARD 4