

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



SEED 573-001: Teaching Science in the Secondary School

3 credits, Fall 2022

Face-to-face class - Tuesdays, 4:30 – 7:10 pm

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
E-mail:	sburton7@gmu.edu
Office Hours:	By appointment

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: Per state guidelines, you are required to complete 15 hours of fieldwork during this class. Please answer the survey sent by Dr. Zenkov. If you have missed this survey, go to <http://cehd.gmu.edu/endorse/ferf> to sign up for your placement. It is recommended that students take Methods I in the same semester as they enroll in EDUC 672, Human Development. Clinical Orientation for all students in Methods I will be held as a new event called “SEED Workshop” held on September 14 from 4:30 to 7:00 pm in room TBA

University Catalog Course Description: Provides study of methods, materials, content, and organization of science programs. Emphasizes curriculum planning, current methodologies, safety, and trends in secondary schools.

Course Overview: EDCI 573 is the first course in a two-part sequence of science methods courses for pre-service and provisionally licensed science teachers seeking a secondary school teaching license in earth science, biology, chemistry, or physics. The course builds upon students’ knowledge of their subject matter and previous education coursework to construct fundamental knowledge of science teaching and learning including standards-based curriculum design and research-based teaching strategies. The course focuses on developing inquiry-based lessons for students to investigate science and assessing student understanding of science and the nature of science. The teachers will plan lessons for students to learn science, implement lessons in a high school classroom, observe students learning, and evaluate their teaching and student outcomes.

Course Delivery Method: 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.

Emergency Procedures: You are encouraged to sign up for emergency alerts by visiting the website <https://ready.gmu.edu/masonalert/>. 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/>.

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

- 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 have required readings from an NSTA class bundle, consisting of various books and journals (and sometimes webinars) from the National Science Teacher Association (NSTA) – our national organizing body. We suggest you purchase the year-long course pack (\$99) if you plan to take Methods 2 next semester, as that course also uses the course pack. If you want to purchase the course pack for just this semester it is (\$79).



Instructions for purchasing the NSTA Learning Center class bundle

The purchase of these electronic materials also gives you a membership to NSTA, which opens a great deal of 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 of their work, so their professional development materials are the best available – and the biggest body of materials as well

To get the readings for the class, got to following collection - [Burton GMU Classes - Methods in Teaching Science in the Secondary School Collection](#). I have set it as public, so you should all be able to have access to add this in one click. You may also find and save other items to your learning center account – most of the materials are free – including science objects and webinars.

Course Materials Online: For dissemination of information, I am sharing a Google Folder (see QR Code to left). 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 be used primarily for submitting final drafts of assignments. Use the same login as your GMU email for the Blackboard Sites.



Link to SEED 573 Folder: Use this link to access all materials from the course as they become available.

Course Performance Evaluation: Students are expected to submit all assignments on time in the manner outlined by the instructor (e.g., Blackboard, VIA, hard copy).

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 incompletes to letter grades.

Other Requirements: Every student registered for any Secondary Education course with a required VIA performance-based assessment (designated as such in the syllabus) must submit this/these assessment(s) (Original Lesson Plan assignments) to VIA through 'Assessments' in Blackboard (regardless of whether a course is an elective, a one-time course or part of an undergraduate minor). Failure to submit the assessment(s) to VIA (through Blackboard) will result in the course instructor reporting the course grade as Incomplete (IN). Unless this grade is changed upon completion of the required VIA submission, the IN will convert to an F nine weeks into the following semester.

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 improve your class experiences. Toward 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 focus on the following big ideas 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

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 (and links to describing them) can be found in the calendar below.

Assignment	Points	Due Date
Research Review	5	September 25
Scientific Investigation/ Nature of Science	5	October 6
Lesson Critique and Revision	10	October 20 & 27
Safety Assignment	5	October 16
"Original" Lesson Plan	20	November 17
Microteaching & Reflection	15	December 1
Clinical Experience Project	10	December 5

Professionalism	30	All Classes
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SEED 573 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 will learn 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 (follow the link to get a detailed description of the assignment).

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

Objective	Assignment (linked)
Methods I students will explain the role of a learning theory in instructional practice, using evidence from the literature.	Research Review
Methods I students will explain why Constructivism has become the “Grand Unifying Theory” for science education, using evidence from the literature.	Research Review
Methods I 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.	Lesson Plan Revision “Original” Lesson Plan

Goal 2: Do science to understand how science is done

Objective	Assignment
Methods I students will use authentic science and engineering practices (SEP) to answer a scientific research question	Scientific Investigation/ Nature of Science
Methods I students will integrate authentic science and engineering practices (SEP) into their instruction that explicitly develops students understanding of how science and engineering is undertaken.	Lesson Plan Critique Lesson Plan Revision “Original” Lesson 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 and ethical and safe manner.

Objective	Assignment
Methods I students will describe the major safety and ethical concerns associated with conducting science in the classroom.	Safety Assignment

Methods I students will describe means to reduce the potential safety risks involved in conducting scientific investigations in the classroom while not compromising the benefit that conducting science and engineering has for student cognition.	Safety Assignment
Methods I students will design lessons that clearly indicate within the lesson any safety concerns, how to reduce them and what to do when accidents	"Original" Lesson Plan

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

Objective	Assignment
Methods I students will develop inquiry-based lessons that incorporate scientific practices and advance students' content knowledge.	Lesson Plan Revision "Original" Lesson Plan

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

Objective	Assignment
Methods I students will use backwards design principles to create a lesson	"Original" Lesson Plan
Methods I students will write measurable objectives using the ABCD format correctly	"Original" Lesson Plan
Methods I students will create assessments evaluating student achievement that are clearly aligned with the measurable objectives	"Original" Lesson Plan
Methods I students will design instructional activities that support student achievement of the measurable objectives	"Original" Lesson Plan

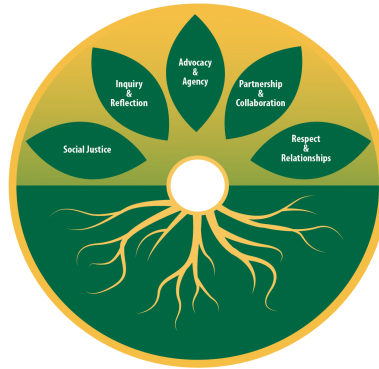
Goal 6: Develop skills as reflective practitioners.

Objective	Assignment
Methods I 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	Clinical Experience Project
Methods I students will evaluate efficacy of a lesson by using data from assessments aligned with the objectives.	Microteaching & Reflection

Tentative Calendar and Online Calendar (subject to change based on student needs):	
Date	Topic
Mon – Aug 22	What is Learning? What is important for student to learn?
Thurs – Aug 25	Research Review Part 1 – Question 1 Due
Sun – Aug 28	Research Review Part 1 – Question 2 & 3 Due
Mon – Aug 29	Science Lesson – Inquiry Tubes What is the role of models in the science classroom? Models-Based Science Teaching How does social justice relate to science? NSTA Blog
Thurs – Sept 1	Research Review Part 2 – Question 1 Due
Sun – Sept 4	Research Review Part 2 – Question 2 Due
Mon – Sep 5	Science Lesson - Electrolysis How can students communicate their models? Scientific Argumentation
Thurs – Sept 8	Research Review Part 3 – Question 1 & 2 Due
Mon – Sep 12	NO CLASS – LABOR DAY
Thurs – Sept 15	Research Review Part 4 – Question 1 Due
Sun – Sept 18	Research Review Part 4 – Question 2 Due
Mon – Sep 19	Science Lesson - Pendulums How can we help students develop both content knowledge AND science process skills? Teaching with inquiry
Thurs – Sept 22	Research Review Part 4 – Question 3 Due
Sun – Sept 25	Research Review Part 4 – Question 4 Due
Mon – Sep 26	Science Lesson - What do effective teachers do to encourage learning? Backwards Design, Objectives, Assessment
Mon – Oct 3	Science Lesson – Spork and Bean What approach to writing lessons reflect the current understanding of how students learn? Learning cycle and 5-E Does constructivism, the learning cycle, and 5-E approach help with a diverse student population? Kaliampos Article
Thurs – Oct 6	Scientific Investigation/ Nature of Science Due
Mon – Oct 10	FALL BREAK – CLASS MEETS TUESDAY
Tue – Oct 11	NO FORMAL CLASS – Work on Safety Assignment
Sun – Oct 16	Safety Assignment DUE
Mon – Oct 17	Work Time - Lesson Critiques
Thurs – Oct 20	Lesson Critiques Due
Sun – Oct 23	Lesson Revision Assignment – Identify Lesson

Mon – Oct 24	Work Time - Lesson Revision
Thurs – Oct 27	Lesson Revision Assignment Due
Mon – Oct 31	Managing the Inquiry Classroom
Thurs – Nov 3	VDOE Cultural Competency Training Module – Will be required for your licensure (save your certificate) - Complete the training module at https://bit.ly/3BZeTMS
Mon – Nov 7	Work Time – Lesson Plan Development
Mon – Nov 14	Work Time – Lesson Plan Development
Thurs – Nov 17	“Original” Lesson Plan Due
Mon – Nov 21	Microteaching
Mon – Nov 28	Microteaching
Thurs – Dec 1	Clinical Experience Project Due
Mon – Dec 5	Microteaching
Thurs – Dec 8	Due Microteaching Reflection Paper

The Secondary Education (SEED) Program “Seeds”



As illustrated by the model above, 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>“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>Multi-Genre Blog</p> <p>The multi-genre blog is a collection of self-contained artifacts, representing multiple genres, united by a common theme. Each piece included in the collection must represent an aspect of the teacher candidate’s teaching philosophy, and be drawn from their research, clinical and life experience, and class discussions. The blog must demonstrate the teacher candidate’s understanding of why and how they will advocate for their students’ well-being and success and help their students develop greater agency in</p>

<p>Methods I</p>	<p 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 everyone’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</p>	<p 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 integrate justice concepts/ content into their instruction.</p>
<p>“Human Development and Learning”</p>	<p 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 key to effective instruction. Their instruction will contribute to</p>	<p 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</p>
<p>Methods II</p>	<p 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 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; individualizes learning to accommodate the strengths and needs of students; and provides 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</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 why teachers collaborate with other education professionals, students, families and caregivers and others to</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