

**EDUC 567: Mathematics and Science Instruction in the
Secondary Classroom Winter, 2025***Erin Spring*

Land Acknowledgement: *The University of Calgary, located in the heart of Southern Alberta, both acknowledges and pays tribute to the traditional territories of the peoples of Treaty 7, which include the Blackfoot Confederacy (comprised of the Siksika, the Piikani, and the Kainai First Nations), the Tsuut'ina First Nation, and the Stoney Nakoda (including Chiniki, Bearspaw, and Goodstoney First Nations). The City of Calgary is also home to the Métis Nation of Alberta (Districts 5 and 6).*

Class Dates: Wednesdays – January 13 to February 12, 2025

COURSE DESCRIPTION:

This course will address and deepen student understanding of both the practical aspects of teaching and theoretical underpinnings of STEM instruction in classrooms from grades 7-12.

LEARNER OUTCOMES:

By the end of the course, students will:

- 1) Develop foundational understanding of the nature of mathematics and science and mathematics and science pedagogy as related to teaching and learning at school level.
- 2) Explore and apply contemporary theory of teaching and learning mathematics with an emphasis on conceptual tasks and inquiry-based discourse to develop understanding of how to support students' meaningful, active learning and their development of deep understanding of mathematics concepts.

COURSE DESIGN AND DELIVERY: This online course is delivered through Zoom sessions and may include discussion forums in Desire2Learn (D2L). Student participation is crucial to the knowledge building in this course.

REQUIRED RESOURCES:

Alberta Education (2003/2009/2014). *Program of Study: Sciences Grades 7-8-9*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3069389/pos_science_7_9.pdf

Alberta Education (2005/2014). *Program of Study: Science 10*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3069384/pos_science_10.pdf

Alberta Education (2003/2014). *Program of Study: Science 14-24*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3069383/pos_science_14_24.pdf

Alberta Education (2007/2014). *Program of Study: Biology 20-30*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3069386/pos_bio_20_30.pdf

Alberta Education (2007/2014). *Program of Study: Chemistry 20-30*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3069388/pos_chem_20_30.pdf

Alberta Education (2007/2014). *Program of Study: Physics 20-30*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3069387/pos_phys_20_30.pdf

Alberta Education (2007/2014). *Program of Study: Science 20-30*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3069385/pos_science_20_30.pdf

Alberta Education (2014). *Program of Study: Mathematics Kindergarten to Grade 9*. Edmonton: Government of Alberta.
https://education.alberta.ca/media/3115252/2016_k_to_9_math_pos.pdf

- Alberta Education (2008). *Program of Study: Mathematics Grade 10 to Grade 12*. Edmonton: Government of Alberta.
<https://education.alberta.ca/media/564028/math10to12.pdf>
- Boaler, J. (2016a). *Mathematical Mindsets* [Chapter 3: Creativity and beauty in mathematics, pp. 21-32]. San Francisco, CA: Jossey-Bass. [on D2L]
<https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=4444210>
- Boaler, J. (2016b). *Mathematical Mindsets*, [Chapter 5: Rich mathematical tasks, pp. 57-91]. Jossey-Bass. [on D2L]
<https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=4444210>
- Gilbert, J. M. & Coomes, J. (February 2010). What Mathematics Do High School Teachers Need to Know? *The Mathematics Teacher*, 103(6), 418-423. [UC library] <https://www-jstor-org.ezproxy.lib.ucalgary.ca/stable/20876655>
- Jaworski, B. (2015). Teaching for mathematical thinking: inquiry in mathematics learning and teaching, *Mathematics Teaching*, 248, 28-34.
<https://www.atm.org.uk/write/MediaUploads/Journals/MT248/MT248-15-11.pdf>
- Kilpatrick, J., Swafford, J., & Findell, B. (Eds.) (2001). *Adding it up: Helping children learn mathematics*. Washington, DC: National Academy Press. [Chapter 4, pp. 115 – 133] http://www.nap.edu/catalog.php?record_id=9822
<https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/reader.action?ppg=136&docID=3375421&tm=1512076004993>
- Mason, J. (2010). *Effective questioning and responding in the mathematics classroom*.
<http://mcs.open.ac.uk/jhm3/Selected%20Publications/Effective%20Questioning%20&%20Responding.pdf>
2020 edition available in LCR
<https://www-taylorfrancis-com.ezproxy.lib.ucalgary.ca/chapters/edit/10.4324/9780429021015-11/effective-questioning-responding-mathematics-classroom-1-john-mason>
- Mason, J., Burton, L., & Stacy, K. (2010). *Thinking Mathematically* (2nd Edition, chapter 1). New York: Prentice Hall.
<https://www.pearsonhighered.com/assets/samplechapter/m/a/s/o/Mason%20-%20Chapter%201.pdf>
- National Council of Teachers of Mathematics *Principles to Action: Executive summary*.
https://www.nctm.org/uploadedFiles/Standards_and_Positions/PtAExecutiveSummary.pdf
- National Council of Teachers of Mathematics (2014). *Principles to Actions: Ensuring mathematics success for all* (pp. 7-12). Author, Reston, VA. <https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/reader.action?docID=6478900&ppg=18>
- National Science Teaching Association. (2022). *Grounding Practice in Research*. NSTA.
<https://www.nsta.org/grounding-practice-research>
- Rutherford, F. J. & Ahlgren, A. (1991). *Science for all Americans* (The nature of science, Chapter 1, pp. 1-14; The nature of mathematics, Chapter 2, pp. 15-24). Oxford University Press, Oxford, UK. [on D2L]
<https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=737311>
- Stockero, S. L., Van Zoest, L. R., Kinzel, M. & Cavey, L. (May, 2011). Making student thinking public. *Mathematics Teacher*, 104, 9, 704-709. <https://www-jstor-org.ezproxy.lib.ucalgary.ca/stable/20876997>
- Van de Walle, J.A., Karp, K.S., Bay-Williams, J.M., & McGarvey, L.M. (2022). *Elementary and middle school mathematics: Teaching Developmentally (6th Canadian ed.; Chapter 3: Mathematical inquiry through rich tasks and classroom discourse)*. Pearson Canada.
https://ucalgary.alma.exlibrisgroup.com/leganto/public/01UCALG_INST/citation/24186784840004336?auth=SA ML
- Wilcox, J., Lucht, C., Murano, K., McBroom, E., & Kruse, J. (2021). Launching Inquiry into Motion: Using Launch-Explore-Summarize to Explore Energy and Motion. *Science Scope*, 45(2), 30–39.
<https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=sch&AN=153491170&site=ehost-live>

ADDITIONAL RESOURCES:

National Research Council (2000). *How People Learn: Brain, Mind, Experience, and School: Expanded Edition*; (Chapter 5, pp. 114-127: Mind and Brain), The National Academy Press. Washington. <https://doi.org/10.17226/9853>
<https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/reader.action?docID=3375627&ppg=128>

Mathigon. (2020). *Polypad*. UCL Institute of Education in London. <https://mathigon.org/polypad> [virtual math manipulatives]

[GSCS Math - Thinking Classroom](#)

<https://www.nctm.org/>

<https://www.nsta.org/>

LEARNING TASKS OVERVIEW

LEARNING TASK	DESCRIPTION OF LEARNING TASK	GROUP/INDIVIDUAL	WEIGHT	DUE DATE
LT 1	Researching topics on effective mathematics/science pedagogy for secondary school mathematics Learner outcome 1	Group	50%	January 29, 2025
LT 2	Creating mathematical task and discourse for conceptual understanding Learner outcome 2	Individual	50%	February 12, 2025

Grading of each Learning Task is based on the Criteria for Assessment following the detailed description of the Learning Task.

WEEKLY COURSE SCHEDULE:

Date [2025]	Topic	Readings and Tasks	Due Dates
Week 1: January 15	Introduction Meaning of mathematics Meaning of Science Mathematical and scientific inquiry Learning Task 1	Rutherford & Ahlgren (1991): Ch.1 The nature of science Ch. 2: The nature of mathematics Boaler (2016a) Programs of Study (math and Science)	
Week 2: January 22	Principles for teaching mathematics and science Inquiry-based Instruction	Van de Walle et al. (2022) Wilcox et al. (2020) NCTM (2014) NSTA (2020)	

Week 3: January 29	Effective mathematics or science pedagogy for secondary school Learning Task 2	Presentation and discussion of LT1 Gilbert & Coomes (2010).	LT1 – Group January 29
Week 4: February 5	Conceptual understanding and inquiry-based and tasks and discourse Learning Task 2	Boaler (2016b) Kilpatrick et al. (2001) Mason, J. (2010)	
Week 5: February 12	Conceptual understanding and inquiry-based tasks and discourse	Stockero et al. (2011) Joworski (2015)	LT2 – Individual February 12

CHANGES TO SCHEDULE:

Please note that changes to the schedule may occur to meet the emerging needs and dynamics of the participants in the course.

LEARNING TASKS AND ASSESSMENT
Generative AI:

- AI tools can be used for creating assignment outlines or critiquing drafts, but the final work must be original.
- Students must not copy or paraphrase from AI applications for assignments
- AI tools will be prohibited for major assignments, or research papers but allowed for information gathering.
- All other considerations for AI use must be cleared with the instructor.

There are two required Learning Tasks for this course.

Further details of the two Learning Tasks and any clarification needed will be provided in class.

LEARNING TASK 1: Researching topics on effective mathematics or science pedagogy (Group – 50%)

DUE: January 29, 2025

You will work in groups of 4 [depending on class size] to select and research a mathematics or science pedagogy topic to develop your knowledge of effective teaching of secondary school mathematics or science. Each group will select a different topic from a list of topics provided by the instructor that address contemporary ideas and practices to teach mathematics or science meaningfully and with deep understanding. The research process will consist of exploring resources (at least 4 per group) that include relevant course readings, journals for mathematics or science teachers, and online publications on teaching and learning secondary school mathematics or science.

The group will prepare a 10 to 15 minutes [depending on number of groups] Power Point presentation to help your classmates to learn the topic based on your insights and learning; what you want them to know/learn about topic. The presentation must include:

The topic selected and rationale, the key ideas and practices found, connections or uses in the secondary mathematics or science classroom, questions or concerns that remain, and references of all resources used in APA7 format.

The presentation slides must be uploaded to D2L drop box by 11:59 pm on the due date.

Group members will receive the same grade.

CRITERIA FOR ASSESSMENT OF LEARNING TASK 1

The research report and presentation will be assessed on the following criteria:

- Quality of report, based on:
 - informative design and design elements of report.
 - sufficiency of information provided.
 - significance and relevance of resources.
 - clarity of discussion/information.
 - coherent explanation to reflect collaboration and not isolated pieces of information.
 - correct use of APA7.
- Quality of learning, based on:
 - depth of understanding of ideas and practices and influence on your pedagogical practices based on substantive evidence.
 - Well-developed depth of understanding of the topic shown through credible and respected referenced connections between theory and practice.
 - Depth of insight, based on the quality, defensibility, and incisiveness of ideas and practices.
 - Appropriateness and meaningfulness of ideas and practices for secondary school mathematics/science.
 - Depth of engagement with resources based on level of substantive, high-quality evidence included.
- Quality of presentation, based on:
 - Constructive and thoughtful ideas to engage the class.
 - Effectiveness of presentation to engage class in learning key findings.
 - Clarity and sufficiency of information provided.

LEARNING TASK 2: Creating Mathematical Task and Discourse for Conceptual Understanding (Individual – 50%).
DUE: February 12, 2025.

You will work individually to create and explain an inquiry-based conceptual task and explain discourse to support students' conceptual understanding of it for a secondary school mathematics concept based on course discussions, activities, and readings. You will select a concept in the Alberta Program of Study from a list provided by the instructor. Your report must include the grade and concept, the task you created, explanation of how/why the task is inquiry-based, explanation of what conceptual understanding students will develop through the task, and explanation of how you will engage students in meaningful discourse while working on the task. The report must be uploaded to D2L drop box by 11:59 pm on the due date.

CRITERIA FOR ASSESSMENT OF LEARNING TASK 2

The work will be assessed on the following criteria:

Quality of task and explanations, based on:

- Appropriateness of the task for the secondary school grade.
- Richness/originality of the task.
- Inquiry-based, conceptual understanding potential of the task.
- Clarity and sufficiency of description of the task and discourse.

Quality of report, based on:

- Informative design of report.
- Clarity and sufficiency of information provided.
- Academic writing style.
- Required length/depth [discussed in class].
- Use of relevant references.
- Correct use of APA7.

Quality of learning, based on:

- Depth of understanding of an inquiry-based task for conceptual understanding.
- Depth of understanding of students' conceptual understanding.
- Depth of understanding of discourse to support conceptual understanding.
- Skill demonstrated to create meaningful conceptual mathematics task.

THE EXPECTATION OF EXCELLENCE IN PROFESSIONAL WORK

Please review the Academic Calendar carefully. It describes the program and provides detailed schedules and important dates. It contains information on expectations for student work and professional conduct. In addition, procedures are described regarding concern about student performance in the program. Please pay especially careful attention to details and descriptions in the following topic areas:

- *The Importance of Attendance and Participation in Every Class*

As this is a professional program, experiences are designed with the expectation that all members will be fully involved in all classes and in all coursework experiences. As you are a member of a learning community your contribution is vital and highly valued, just as it will be when you take on the professional responsibilities of being a teacher. We expect that you will not be absent from class with the exception of documented instances of personal or family illness or for religious requirements.

- *Engagement in Class Discussion and Inquiry*

Another reason for the importance of attendance and participation in every class is that the course involves working with fellow students to share ideas and thinking. For example, each class you will work with a small group to engage fellow students in discussions on work being considered in class. You will also help other groups by providing ideas for scholarly inquiry in assignments. If you find that you are experiencing difficulties as a group collaborating, please inform the instructor.

EXPECTATIONS FOR WRITING

All written assignments (including, to a lesser extent, written exam responses) will be assessed at least partly on writing skills. Writing skills include not only surface correctness (grammar, punctuation, sentence structure, etc.) but also general clarity and organization. Sources used in research papers must be properly documented. If you need help with your writing, you may use the writing support services in the Learning Commons. For further information, please refer to the official online University of Calgary Calendar, Academic Regulations, E. Course Information, E.2: Writing Across the Curriculum: <http://www.ucalgary.ca/pubs/calendar/current/e-2.html>

MISSING OR LATE SUBMISSIONS

All late submissions of assignments must be discussed with the instructor **prior to the due date** or will not be accepted. A deferral of up to 30 days may be granted at the discretion of the Associate Dean of Undergraduate Programs prior to the end of the course with accompanying written evidence. <https://calendar.ucalgary.ca/pages/jyekfh6xwhoHwxcetCi1>

ISSUES WITH GROUP TASKS

With respect to group work, if your group is having difficulty collaborating effectively, please contact the instructor immediately. If a group is unable to collaborate effectively or discuss course materials online in a timely manner, the instructor may re-assign members to different groups or assign individual work for completion.

GRADING: <https://calendar.ucalgary.ca/pages/fc4adb8643f84441ab32300237b80df1>

Grade	GPA Value	%	Description per U of C Calendar
A+	4.0	95-100	Outstanding
A	4.0	90-94	Excellent – Superior performance showing comprehensive understanding of the subject matter
A-	3.7	85-89	
B+	3.3	80-84	
B	3.0	75-79	Good - clearly above average performance with knowledge of subject matter generally complete
B-	2.7	70-74	
C+	2.3	65-69	

C	2.0	60-64	Satisfactory - basic understanding of the subject matter
C-	1.7	55-59	
D+	1.3	52-54	Minimal pass - Marginal performance
D	1.0	50-51	
F	0.0	49 and lower	Fail - Unsatisfactory performance

Academic Misconduct

Academic Misconduct refers to student behavior which compromises proper assessment of a student's academic activities and includes cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar.

For information on the Student Academic Misconduct Policy and Procedure please visit:

<https://www.ucalgary.ca/legal-services/university-policies-procedures/student-academic-misconduct-policy>

<https://www.ucalgary.ca/legal-services/university-policies-procedures/student-non-academic-misconduct-policy>

Additional information is available on the Academic Integrity Website at: <https://ucalgary.ca/student-services/student-success/learning/academic-integrity>

Academic Accommodation

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: <https://ucalgary.ca/student-services/access/prospective-students/academic-accommodations>.

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: <https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf>

Students needing an accommodation in relation to their coursework or to fulfill requirements for a graduate degree based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the designated contact person in their faculty. The course outline should clearly list the appropriate Faculty contact person(s) and their contact details. For further information see E.1 C. Course Policies and Procedures <https://calendar.ucalgary.ca/pages/a89ecfbf758841b5983c4b67746e7846>

Research Ethics

Students are advised that any research with human participants – including any interviewing (even with friends and family), opinion polling, or unobtrusive observation – must have the approval of the Conjoint Faculties Research Ethics Board (<https://research.ucalgary.ca/conduct-research/ethics-compliance/human-research-ethics/conjoint-faculties-research-ethics-board-cfreb>) or the Conjoint Health Research Ethics Board (<https://research.ucalgary.ca/conduct-research/ethics-compliance/human-research-ethics/conjoint-health-research-ethics-board-chreb>)

In completing course requirements, students must not undertake any human subjects research without discussing their plans with the instructor, to determine if ethics approval is required. Some courses will include assignments that involve conducting research with human participants; in these cases, the instructor will have applied for and received ethics approval for the course assignment. The instructor will discuss the ethical requirements for the assignment with the students.

For further information see E.5 Ethics of Human Studies

<https://calendar.ucalgary.ca/pages/627ed88eb4b041b7a2e8155effac350>

Instructor Intellectual Property

Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

Freedom of Information and Protection of Privacy

Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary. For more information, please see: <https://www.ucalgary.ca/hr/work-compensation/working-ucalgary/freedom-information-and-privacy-act>

Copyright Legislation

All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (<https://www.ucalgary.ca/legal-services/university-policies-procedures/acceptable-use-material-protected-copyright-policy>) and requirements of the copyright act (<https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html>) to ensure they are aware of the consequences of unauthorised sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy <https://www.ucalgary.ca/legal-services/university-policies-procedures/student-non-academic-misconduct-policy>.

Sexual and Gender-Based Violence Policy

The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at <https://www.ucalgary.ca/legal-services/university-policies-procedures/sexual-and-gender-based-violence-policy>

Other Important Information

Please visit the Registrar's website at: <https://www.ucalgary.ca/registrar/registration/course-outlines> for additional important information on the following:

- Wellness and Mental Health Resources
- Student Success
- Student Ombuds Office
- Student Union (SU) Information
- Graduate Students' Association (GSA) Information
- Emergency Evacuation/Assembly Points
- Safewalk

The Freedom of Information Protection of Privacy Act prevents instructors from placing assignments or examinations in a public place for pickup and prevents students from access to exams or assignments other than their own. Therefore, students and instructors may use one of the following options: return/collect assignments during class time or during instructors' office hours, students provide instructors with a self-addressed stamped envelope, or submit/return assignments as electronic files attached to private e-mail messages.

For additional resources including, but not limited to, those aimed at wellness and mental health, student success or to connect with the Student Ombuds Office, please visit
<https://www.ucalgary.ca/registrar/registration/course-outlines>

Education Students Association (ESA) President for the academic year is Claire Gillis, esa@ucalgary.ca.

Werklund SU Representative is Tracy Dinh, educrep@su.ucalgary.ca.