Course Outline
University of Calgary – Werklund School of Education
Bachelor of Education, Fall 2016
EDUC 427.03: STEM Education - Secondary

Coordinator: Dr. Krista Francis
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Section	**Time**	**Instructor**	**Email**
EDUC 427.03 S01	TR 8:00-9:15	Christy Thomas	cthoma@ucalgary.ca
EDUC 427.03 S02	TR 8:00-9:15	Olive Chapman	chapman@ucalgary.ca
EDUC 427.03 S03	TR 8:00-9:15	Marie-Claire Shanahan	mcshanah@ucalgary.ca
EDUC 427.03 S04	TR 9:30-10:45	Christy Thomas	cthoma@ucalgary.ca
EDUC 427.03 S05	TR 9:30-10:45	Olive Chapman	chapman@ucalgary.ca
EDUC 427.03 S06	TR 9:30-10:45	Armando Preciado Babb	apprecia@ucalgary.ca

All office hours are by appointment only

Term Dates: September 12th to December 9th, 2016 (11 weeks)
Field Experience Dates: October 24th to November 4th, 2016
Reading Days November 10th to 13th, 2016

Visit to Telus Sparks on Friday, September 16, 2016 from 9 a.m. - 12:00

Optional: Field Trip to Biogeoscience Institute, Kananaskis Field Station, University of Calgary on September 9-11, 2016. Learn how to develop STEM Inquiries in the field. Fee is $150 for Accommodation, Meals and Programming. Transportation costs will be extra depending on the size of the group travelling. Only 56 spots available. Please contact upe@ucalgary.ca to register

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Course Description

EDUC 427 (STEM Education): This course provides an introduction to key elements of Science, Technology, Engineering, and Mathematics (STEM) education, including curriculum, pedagogy, standards and assessment. This interdisciplinary course is for all first year education students. The intent of the course is to foster an understanding of how STEM can inform and be used to shape teaching and learning across grade levels and subject areas. In so doing, participants will attend to STEM's role in culture and society.

Learning Outcomes

Over the course of the semester, students will:

1) Develop a foundational understanding of the nature of discourse in STEM disciplines as related to teaching and learning, including STEM literacy, STEM identity, and transferring understandings across disciplines;
2) Understand and appreciate how the engineering design process can contribute to teaching and learning mathematics and science;
3) Design learning environments in STEM;
4) Identify concepts and make explicit the connections across disciplines; and,

5) Apply introductory literature related to the teaching of STEM with an emphasis on the implementation of resources, the classroom environment, diverse and innovative methods of teaching within STEM, and an introduction to the Alberta Program of Studies.

Course Design and Delivery

The course consists of three modules for class work and assignments. Modules 1 and 2 will alternate timing within sections. Modules include readings, class projects and assignments. Further details follow, including readings, assignments with grading schemes, and any required additional information.

Required Readings

Textbooks:

Davis, B., Francis, K., & Friesen, S. (pre-publication version). STEM by Design. [posted in D2L]

Articles:

Francis, K. & Poscente, M. (pre-publication version). Building number sense with Lego Robots. [posted in course's D2L]

Metz, M. (2014) *What does 2x3x4 mean?* (unpublished) [posted in D2L]

Recommended Readings

To find e-books in the library, enter the title in the *search box* on the library's home page at http://library.ucalgary.ca/

Alberta Education (2010) Career and technology studies: Media, design, and communication arts.

https://education.alberta.ca/teachers/program/cts/program-of-studies/mdc/

Banks, F. & Barlex, D. (2014) *Teaching STEM in the secondary school: Helping teachers meet the challenge.* New York, NY: Routledge.
http://site.ebrary.com.ezproxy.lib.ucalgary.ca/lib/ucalgary/detail.action?docID=10897096

Francis, K., Poscente, M., Friesen, S. & Davis, B. (2014). EV3 Robots: Introduction to programming. Available: http://ucalgary.ca/IOSTEM/teachers/ev3-robots-introduction-programming
Alternative:
http://www.ucalgary.ca/IOSTEM/ev3-programming/ev3-robots-introduction-programming

Gura, M. (2011). *Getting started with Lego robotics: A guide for K-12 educators*. Eugene, Or: International Society for Technology in Education.

Hoachlander, G., & Yanofsky, D. (2011). Making STEM real. *Educational Leadership*, *68*(6), 60–65. http://ezproxy.lib.ucalgary.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=58688613&site=ehost-live

Resnick, M. (2012). *Let's teach kids to code*. Retrieved from http://www.ted.com/talks/mitch_resnick_let_s_teach_kids_to_code

Truesdell, P. (2014). The engineering design process. In *Engineering essentials for STEM instruction: How do I infuse real-world problem solving into science, technology, and math?* (p. 7-15) Alexandria, VA: ASCD. [library e-version available]
http://site.ebrary.com.ezproxy.lib.ucalgary.ca/lib/ucalgary/reader.action?ppg=12&docID=10883057&tm=1470339945682

Zemplén, G. Á. (2009). Putting sociology first - Reconsidering the role of the social in "nature of science" education. *Science & Education*, *18*(5), 525-559. doi:10.1007/s11191-007-9125-3 http://link.springer.com.ezproxy.lib.ucalgary.ca/article/10.1007%2Fs11191-007-9125-3

Software:

Free software downloads are available for:

NXT -http://www.lego.com/en-us/mindstorms/downloads
EV3 - http://www.lego.com/en-us/mindstorms/downloads

Learning Tasks Overview

LEARNING TASK	DESCRIPTION OF LEARNING TASK	PERCENT OF FINAL GRADE
Robotics	Robotics Design Process and Curriculum Connections (individual and group) Due Week 4: October 6th, 2016	35
Concept Study: STEM (for secondary sections)	STEM Paper Concept Study Digital Slide Show (group) Due Week 8: November 17th, 2016	35
STEM Integration (all sections)	STEM Integrations Showcase (group) Showcase Friday, December 9, 2016 **11 a.m. to 1 p.m.**	30

Weekly Course Schedule

Robotics:

Robotics	Topics/Themes	Readings and Assignments
Week 1	What is STEM?	Read Davis, Francis & Friesen. Chapter 1: What is STEM? Tweet #WerkSTEM when you see STEM in the world
Week 2	From Using to Designing	Read Davis, Francis & Friesen. Chapter 4 – Technology: from using to designing Read Locating, orienting, mapping and coding Tweet #WerkSTEM when you see STEM in the world
Week 3	From Applying to Innovating	Read Davis, Francis & Friesen. Chapter 5 – Engineering: beyond applying to innovating Read Building number sense with Lego Robots Tweet #WerkSTEM when you see STEM in the world
Week 4	Robots and STEM	Tweet #WerkSTEM when you see STEM in the world **Robotics Assignment Due**

Concept Study:

STEM	Topics/Themes	Readings and Assignments
Week 5	What is a Rich Task?	Read Davis, Francis & Friesen. Chapter 2: What is Inquiry? Form Groups for Learning Task Tweet #WerkSTEM when you see STEM in the world
Week 6	From Calculating to Modelling	**In Class Task: Metz et al. (2014). What does 2x3x4 mean?** Read Davis, Francis & Friesen. Chapter 3 – Mathematics: from calculating to modeling Tweet #WerkSTEM when you see STEM in the world
Week 7	From Method to Inquiry	Read Davis, Francis & Friesen. Chapter 6: Science beyond method to inquiry Tweet #WerkSTEM when you see STEM in the world
Week 8	Concept Study	Tweet #WerkSTEM when you see STEM in the world **Concept Study: Mathematics Assignment DUE**

STEM Integration:

STEM Integration	Topics/Themes	Readings and Assignments
Week 9	STEM	Read Davis, Francis & Friesen. Chapter 7: STEM Tweet #WerkSTEM when you see STEM in the world
Week 10	Teaching STEM	Tweet #WerkSTEM when you see STEM in the world
Week 11	Teaching STEM	Tweet #WerkSTEM when you see STEM in the world **STEM Showcase in Mac Hall**

- Schedule may change at instructor's discretion

Learning Tasks

Robotics Design Process (35%: 15% for group concept map & 20% for individual narrative)

Module 1 introduces a STEM design process. By the end of this module you will:

- Learn about inquiry;
- Learn about the design process;
- Learn about situating the design process within inquiry;
- Learn how to identify the STEM concepts for teaching with robotics;
- Learn how to identify multiplication within scaling and measurement within a robotics task;
- Learn how the design process is relevant to other disciplines and is useful for educators;
- Learn how the design process relates to the Alberta Programs of Study.

Your Task:

1. Work with 2 other individuals (in teams of 3), to create a *robot challenge scenario* following the *robot design process* instructions on the Galileo Educational Networks website http://www.galileo.org/robotics/design.html
2. Identify a guiding focus question/issue/problem for your *robot challenge scenario*
3. Design, build, and program a robot that can complete your challenge.
4. Identify three concepts from the STEM disciplines that are addressed in your Robot Design Process (THREE concepts with three people in a group. If there are more members in the group the number of concepts should incrementally increase). Create a concept map that identifies STEM topics and concepts addressed in the design of robots.

Concept maps are graphical representations of knowledge and ideas. They are distinguished from other types of knowledge maps by hierarchical arrangement of concepts and the inclusion of linking words and phrases. Their construction is usually guided by a specific focus question. Concept maps include concepts, which are contained in circles, and relationships, which are represented by lines. Words on each line specify the relationship. See the concept map resources in D2L.

Suggested concept mapping tools:

- Inspiration concept Mapping Software http://www.inspiration.com/ is available in the library and has a 30 day free trial. Inspiration is available on all Doucette Library computers.
- cMap http://cmap.ihmc.us/ is freeware.

5. Compose an individual narrative (500 words maximum) that supplements your concept map and reflects on the nature of participatory work. The medium for this narrative is open. Use the narrative as a tool to clarify what seems less obvious in your concept map. Between the concept map and the narrative, audiences should be able to readily discern:
   - Your group's rationale for constructing the concept map the way you did.
   - The depth of your understanding in your group of THREE core STEM concepts that you have chosen to feature in the robotics activity.
   - Explicit ways in which these concepts, the activity as a whole, and/or its component parts are meaningfully applicable in and relevant to each participant's particular area of specialization
   - The keys ways in which this robotics design connects to the design process and STEM curricular intentions as explicated in the front matter of the STEM disciplines' programs of study.
6. Share your Robot Challenge Scenario and robot with your peers during class.
7. Assess your team using the Guide to Assessing Teamwork and Collaboration that is posted in the D2L site for this course.

Robotics Concept Map - Group (15%)

Assessment Criteria	**Excellent (A)**	**Good (B)**	**Satisfactory (C)**	**Unsatisfactory**
Concept Map	Problem/issue/question is clearly articulated. One mathematical concept is clearly identified and modelled/illustrated within the task. Two other relevant, key concepts are clearly identified and modelled/illustrated within the task.	Problem/issue/question is articulated. One mathematical concept is identified within the task. Two other relevant concepts are identified and identified within the task	Problem/issue/question is not clearly articulated. Mathematics concept is identified but not connected to the task Two other relevant concepts are identified but not connected to the task	Problem/issue/question is not articulated. No mathematics concept is identified No other concepts are identified
Presentation	Concept map is visually appealing, well-organized, easily viewed and understood.	Concept map is organized, adequately viewable and understandable.	Concept map is confusing.	Concept map is incomplete.

Assessment Criteria	Excellent (A)	Good (B)	Satisfactory (C)	Unsatisfactory

Robotics Narrative - Individual (20%)

Assessment Criteria	Excellent (A)	Good (B)	Satisfactory (C)	Unsatisfactory
Rationale	Rationale is convincing, specific and insightful	Rationale is convincing	Rationale is ambiguous	No rationale
Depth of understanding of STEM concepts	Key feature(s)/element(s), about the concepts, that the learners should understand are clearly explained.	Feature(s)/element(s), about the concepts, that the learners should understand are explained.	Feature(s)/element(s), about the concepts, that the learners should understand are inadequately explained.	Feature(s)/element(s), about the concepts, that the learners should understand are not explained.
Design Process	How the design process is integrated into the task is clearly explained.	How the design process is integrated into the task is explained.	How the design process is integrated into the task is insufficiently explained.	How the design process is integrated into the task is not explained.
Composition of the Narrative	Concise, clear clean wording and composition render the work accessible, unambiguous, and sufficiently engaging. References (if used) are correctly cited. Adheres to word limit	The wording and composition render the work accessible, mostly unambiguous, and sufficiently engaging. References (if used) are correctly cited. Adheres to word limit	The wording and composition are too ambiguous, and/or insufficiently engaging. References (if used) are correctly cited. Does not adheres to word limit	The wording and composition are too ambiguous, and/or insufficiently engaging. References (if used) are correctly cited. Does not adheres to word limit
Connections	Connections between the robotics task, the design process, and the front matter of the STEM sub-disciplines' Programs of Study are clear, accurate, and demonstrate deep understanding.	Connections between the robotics task, the design process, and the front matter of the STEM sub-disciplines' Programs of Study are accurate and demonstrate understanding.	Connections between the robotics task, the design process, and the front matter of the STEM sub-disciplines' Programs of Study are unclear and/or inaccurate.	No connections are made between the robotics task, the design process, and the front matter of the STEM sub-disciplines' Programs of Study

Concept Study

What is a concept?

Concepts are dynamic phenomena.

Concepts are particular to individuals. For instance, different individuals will hold different concepts of something like snow. One's concept of snow may change over time with experience, engagement, and study. For example friends from tropical countries describe their understanding of snow as being cold and then are surprised to learn that snow is also ‘wet.’ They are astonished at the experiential and phenomenological differences between packing snow and dry snow. On the other hand the Inuit in the Arctic have several words for different types of snow, which are distinguished by other properties.

What is Concept Study?

Concept study is a collective, deep study of a major concept or topic comprising its: (a) historical development; (b) cognitive obstacles and student's common mistakes and misunderstandings; (c) images, analogies, metaphors and exemplars used for mathematics and mathematics education; and (d) contemporary role/place outside school; and (e) development through the whole curriculum.

Concept Study is a collaborative process focused on the actual subject matter (content) of teaching. It involves conscious and deliberate efforts to frame understandings and explanations of concepts in terms of *open definitions*. Open definitions reflect the understanding that concepts are dynamic and adaptable. With respect to teaching, an open definition of a concept is one that acknowledges the current adequacy of a particular definition at a given grade (or developmental) level while being aware of and its likely inadequacy in anticipating the possibilities in future elaborations of the concept.

Consider for example the concept of multiplication. In the early years of schooling, the metaphorical description “multiplication is repeated addition” is adequate for dealing with positive integers. When one encounters multiplication of fractions (e.g. $\frac{1}{2}\times\frac{5}{3}$) and later irrational numbers (e.g. $\sqrt{2}\times\Pi$) the metaphor of “repeated addition” proves inadequate to making sense of the concept.

There are two streams for Module 2: elementary and secondary. The elementary stream focuses on mathematics concept study and the secondary stream focuses on STEM concept study. Ensure that the correct stream is followed.

Concept Study: STEM (35%, group)

This unit introduces *concept study* and what STEM disciplinary knowledge that teachers need to know for teaching. By the end of this unit you will be able to:

- Identify STEM concepts within ‘good’ problems and tasks;
- Begin to connect STEM concepts;
- Find additional problems related to the concept to strengthen and extend student understandings.

Concept Study: STEM Task. Imagine that your group will be teaching a STEM task to students. Pick a rich STEM problem/issue/question from within your textbook or from the resources identified below. Make sure that within your identified problem issue or task enables your imagined students to engage in the engineering design process (design, build test revise): Create a narrated and animated digital slide show presentation that:

- States the problem/task, grade level and rationale for choosing the problem (one illustrated slide);
- Identifies and explains a mathematical concept, a science concept, and a concept from a third discipline that are addressed in the problem (three illustrated slides);
- Incorporates the engineering design process
- Illustrate how the problem addresses the concepts (three slides - one for each concept);
- Articulates how the disciplines are integrated into STEM perspective (one slide).

Assessment Criteria	**Excellent (A)**	**Good (B)**	**Satisfactory (C)**	**Unsatisfactory**
Task/Problem	• Clearly stated; Accurately APA referenced • Rich, meaningful and relevant; A STEM professional might tackle a similar question • Task is accurately mapped to the curriculum • Academically, intellectually and personally challenging for students	• Stated; APA referenced • Facilitates acquisition and application of information. • Determined by the curriculum, but takes student interests into consideration • Academically challenging for students	• Not stated or unclear; improperly referenced • Provides for acquisition of factual or known information. • Is determined by the mandated curriculum or follows textbook • Task is not challenging	• Not stated or unclear; not referenced. • Task is not mathematical • Task is not scientific • Task has no curricular connections. • Task is irrelevant.
Rationale	• Rationale is convincing, specific and insightful	• Rationale is convincing	• Rationale is ambiguous	• No rationale
Mathematics Concept	• Mathematical model of mathematical concept is insightful and accurately depicted/illustrated within the task • Mathematical concept is eloquently and accurately explained and represented. • Key feature(s)/element(s), about the concept, that the learners should understand are clearly stated. • Viable solution(s) with accurate mathematics are explained clearly and concisely. The math concept is insightfully	• Mathematical concept is illustrated, but connection to the task is unclear • Mathematical concept is accurately explained and represented • Feature(s)/element(s), about the concepts, that the learners should understand are clearly stated. • Viable solution(s) are explained clearly, concisely and scientifically accurate.	• Concepts are not illustrated • Concept is not related to the mathematics problem. • Feature(s)/element(s), about the concepts, that the learners should understand are inadequately stated. • A solution is inadequately explained and/or solution is incorrect.	• Concepts are not illustrated • No concepts identified • No Solution • No stated understandings • No practice problems

Assessment Criteria	Excellent (A)	Good (B)	Satisfactory (C)	Unsatisfactory
	identified within the solution(s).			
Science concept	• Science concept is insightful and accurately depicted/illustrated within the task • Science concept is eloquently and accurately explained. • Key feature(s)/element(s), about the concept, that the learners should understand are clearly stated. • Viable solution(s) are explained clearly, concisely and scientifically accurate. The concept is insightfully identified within the solution(s).	• Science concept is illustrated, but connection to the task is unclear • Science concept is explained • Feature(s)/element(s), about the concept, that the learners should understand are stated. • Viable solution(s) are explained clearly, concisely and scientifically accurate.	• Concepts are not illustrated • Concepts are not related to the problem. • Feature(s)/element(s), about the concepts, that the learners should understand are unclear. • A solution is inadequately explained and/or solution is incorrect. • The two or three practice problems provided do not address understandings of identified concepts.	• Concepts are not illustrated • No concepts identified • No Solution • No stated understandings • No practice problems
Math, Science or other Discipline Concept	• Concept is insightful and accurately depicted/illustrated within the task • Concept is eloquently and accurately explained and represented. • Key feature(s)/element(s), about the concept, that the learners should understand are clearly stated. • Viable solution(s) are explained clearly, concisely and accurate. The concept is	• Concept is illustrated, but connection to the task is unclear • Concept is explained • Feature(s)/element(s), about the concept, that the learners should understand are stated. • Viable solution(s) are explained clearly, concisely and scientifically accurate.	• Concepts are not illustrated • Concepts are not related to the problem. • Feature(s)/element(s), about the concepts, that the learners should understand are unclear. • A solution is inadequately explained and/or solution is incorrect. • The two or three practice problems provided do not address understandings	• Concepts are not illustrated • No concepts identified • No Solution • No stated understandings • No practice problems

Assessment Criteria	Excellent (A)	Good (B)	Satisfactory (C)	Unsatisfactory
	insightfully identified within the solution(s).		of identified concepts.	
Engineering Design Process	• Clearly articulates how students will engage in the engineering design process (design, build, test, revise)	• Engineering design process is superficial and not integral to the issue/problem/question.	• Does not articulate an engineering design process	• Does not articulate an engineering design process •
Presentation details	• Contains eight slides that follow specifications. • Style and design enhances presentation. • Images enhance explanations. Where appropriate, annotations enhance explanation. • Animations are well chosen and support communication. • Narrations are concise (fewer than three minutes), audible, enhance the content and are engaging.	• Contains more (or less) than eight slides that follow specifications. • Style and design supports presentation. • Images enhance explanations. • Animations support communication. • Narrations are concise (fewer than three minutes), audible, and enhance the content.	• Contains more (or less) than eight slides that follow specifications. • Style and design compromise presentation. • Images do not enhance explanations. • Animations do not support communication • Narrations are not concise and/or audible	• There are not eight slides and specifications are not consistently followed. • Style and design compromise presentation. • No images. • No Animations • No Narration

Resources for STEM problems and tasks

PBS Teachers. (2014). STEM education resource center. Retrieved from http://www.pbs.org/teachers/stem/

MIT. (2012). *STEM concept videos*. Retrieved from http://tll.mit.edu/help/stem-concept-videos

National STEM Center. (2010). Key stage three resource tasks. National STEM Center. Retrieved from http://www.nationalstemcentre.org.uk/elibrary/resource/1023/key-stage-three-resource-tasks

NSTA (2013). STEM classroom archive. Retrieved from http://www.nsta.org/publications/archive-stem.aspx

STEM Integration: Showcase Project Demonstration (30%, group)

Now that you have learned about the design processes and how to unpack concepts within a task, you will apply this knowledge in Module 3. In small groups (two to three people), you will develop your own STEM inquiry project for teaching. By the end of this module you will:

- Apply the engineering design process to develop a STEM inquiry for teaching;
- Unpack the mathematics and science concepts contained within the STEM inquiry
- Begin to articulate classroom teaching strategies: i.e group/individual work, collaboration and communication of assignments, developing habits of mind;
- Appreciate how integrating design processes are important beyond the STEM disciplines.
- Learn how to work as a team to develop inquiry teaching approaches.

STEM Integration Task

- Develop an idea for STEM project involving the design process learned in Module 1. It cannot be the same as your Module 1 or 2 assignments, but it can be a robotics task.

Create a poster and prototype/demonstration to illustrate how you would teach this project. The demonstration:

  - o Incorporates engineering design process – design, build, test and revise.
  - o Includes a problem/issue/question in which your students will engage;
  - o Includes a prototypical solution to the problem/issue/question;
  - o Explains your project's STEM integration perspective ;
  - o Identifies, shows, and develops the STEM concepts intrinsic to the problem;
  - o Attends to the how children will engage in the task.

- Assess your team using the Guide to Assessing Teamwork and Collaboration that is posted in the D2L site for this course.

Prompts and considerations:

- How does your project make integration explicit?
- How does your project develop student's subject knowledge; that is, how does it provoke students to make new sense and/or to expand the example space of sense already made? Here we are referring to Specific Learner Expectations & the concepts flagged therein.
- What strategies does your project incorporate to encourage student's ability to transfer knowledge – to take what they know and apply it in another context?
- What is your role when you are teaching this project?

Assessment Criteria	**Excellent (A)**	**Good (B)**	**Satisfactory (C)**	**Unsatisfactory**
Issue/problem/question that students will engage in is:	• Clearly stated; Accurately APA referenced • Maps to the relevant Programs of Study. • Rich, meaningful and relevant; i.e. someone in the discipline might actually tackle a similar issue/problem/question • Essential questions are reflected within the rich task. • Academically, intellectually and personally challenging for students	• Stated; APA referenced • Determined by the curriculum, but takes student interests into consideration • Facilitates acquisition and application of information.	• Not stated or unclear; improperly referenced • Is determined by the mandated curriculum • Provides for acquisition of factual or known information.	• Not stated; not referenced • Not connected to curriculum • Irrelevant
Teaching strategies	• Require students to gather evidence, find patterns and connections, and understand why it matters. • Require students to engage in active exploration in ways that are central to the discipline; • Formative assessment strategies that support learning are clearly articulated.	• Require students to become proficient with information and procedures and find connections between concepts • Require students to gather information about a topic and demonstrate their knowledge. • Formative assessment strategies that support learning are articulated.	• Require to students to memorize and recall procedural information • Require students to receive information about a topic • Formative assessment strategies are generic.	• Require to students to memorize and recall procedural information • How students learn/engage a topic is not specified • No assessment strategies.
Engineering Design Process	• Clearly articulates how learners will recognize and apply the components of the engineering design process.	• Engineering design process is superficial to the issue/problem/question.	• Engineering design process is not integral to the issue/problem/question.	• Does not articulate an engineering design process

Assessment Criteria	**Excellent (A)**	**Good (B)**	**Satisfactory (C)**	**Unsatisfactory**
Mathematics and Science Concepts*	• Science concepts are clearly identified and developed within the problem/issue/question. • The ways that the science and connect to the issue/question/ problem are clearly explained. • Model of mathematics is clearly explained within the problem/issue/question. • The ways that the math concepts are situated/understood within the mathematical model are clearly articulated.	• Science concepts are identified and developed within the problem/issue/question. • The ways that the science concepts are addressed by the problem/issue/question are sufficiently explained. • Math concepts are identified and developed within the problem/issue/question. • The ways that math concepts are addressed by the problem/issue/question are sufficiently explained	• Science concepts are insufficiently identified and/or underdeveloped. • The ways that the science concepts are addressed by the problem/issue/question are ambiguous. • Mathematics concepts are insufficiently identified and/or underdeveloped. • The ways that the math concepts are addressed by the problem/issue/question are ambiguous.	• Science concepts are not stated. • The ways that the science concepts are addressed by the problem/issue/question not stated. • Mathematics concepts are not stated. • The ways that the math concepts are addressed by the problem/issue/question are not stated.
Poster details	• Design and layout, images and annotations enhance the demonstration, support communication, and are aesthetically pleasing. • Draws visitors in. • Printed digital poster 48”x36”	• Design and layout, images and annotations enhance the demonstration and support communication. • Conveys information, but does not grab attention • Printed digital poster	• Design and layout, images and annotations do not enhance the demonstration and do not adequately support communication. • Information is confusing and does not grab attention • Poster board/trifold	• Poster does not have images or annotations • Is aesthetically unpleasing • Poster board/trifold

Assessment Criteria	Excellent (A)	Good (B)	Satisfactory (C)	Unsatisfactory
Prototype	• Provides an example/product of what students will replicate • Provides opportunities for children/visitors to engage in topic/task	• Provides a partial example of what students will replicate • Provides an explanation of the topic/task	• Provides an description of what the students will replicate • Explanation of topic/task is unclear	• No prototype or description • Does not provide opportunities for children/visitors to engage in the topic/task

- ***(Total number of concepts equals number of individuals in group)

Resources for STEM Problems and Tasks

Moyer, R., Everett & S. A., Simpson, R. L., (2012). *Everyday engineering [electronic resource]: putting the E in STEM teaching and learning*. Arlington, Va.: NSTA Press.

National STEM Center. (2010). *Key stage three resource tasks.* Retrieved May 22, 2014, from http://www.nationalstemcentre.org.uk/elibrary/resource/1023/key-stage-three-resource-tasks

National Science Teachers Association (2013). *STEM classroom archive.* Retrieved from http://www.nsta.org/publications/archive-stem.aspx

PBS Teachers. (2014). *STEM education resource center*. Retrieved from http://www.pbs.org/teachers/stem/

PBS Teachers. (2014). STEM education resource center. Retrieved from http://www.pbs.org/teachers/stem/

Truesdell, P. (2014). *Engineering essentials for STEM instruction: How do I infuse real-world problem solving into science, technology, and math?* ASCD. [library e-version available]
http://site.ebrary.com.ezproxy.lib.ucalgary.ca/lib/ucalgary/detail.action?docID=10567541

Yager, R. & Brunkhorst, H. (Eds.). (2014) *Exemplary STEM programs: Designs for success.* Arlington, VA: NSTA Press. [on reserve in Doucette Library]

Resources for Assessment

GENA (2014). Inquiry and assessment. Retrieved from http://galileo.org/teachers/designing-learning/resources/inquiry-and-assessment/

Grading scheme

Must include a numerical to letter grade conversion for final grade
This should be consistent among the courses. The following is the university's for undergraduate program, which we should use.

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

Students in the BEd must have an overall GPA of 2.5 in the semester to continue in the program without repeating courses.

Students must complete and submit each assignment on or before the day it is due. Late work will not be accepted unless except in cases of documented personal or family medical emergencies.

Students must pass each assignment in order to successfully complete the course. Writing proficiency will be considered in the assessment of the assignments and the exams.

Academic Accommodation: Students with a disability, who require academic accommodation, need to register with Student Accessibility Services http://www.ucalgary.ca/access/ MacEwan Student Centre 452, telephone 220-8237. Academic accommodation letters need to be provided to course instructors no later than fourteen (14) days after the first day of class. ***It is a student's responsibility to register with the Student Accessibility Services and to request academic accommodation, if required.*** Students who have not registered with the Student Accessibility Services are not eligible for formal academic accommodation.

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.

Intellectual honesty/Plagiarism:

Intellectual honesty is the cornerstone of the development and acquisition of knowledge and requires that the contribution of others be acknowledged. As a result, cheating or plagiarism on any assignment or examination is regarded as an extremely serious academic offence, the penalty for which may be an F on the assignment and possibly also an F in the course, academic probation, or requirement to withdraw.

The University of Calgary Calendar states that plagiarism involves submitting or presenting work as if it were the student's own work when it is not. Any ideas or materials taken from another source written, electronic, or oral must be fully and formally acknowledged.

Plagiarism includes but is not limited to:

(a) The work submitted or presented was done, in whole or in part, by an individual other than the one submitting or presenting the work (this includes having another impersonate the student or otherwise substituting the work of another for one's own in an examination or test),
(b) Parts of the work are taken from another source without reference to the original author,
(c) The whole work (e.g., an essay) is copied from another source, and/or,
(d) A student submits or presents work in one course which has also been submitted in another course (although it may be completely original with that student) without the knowledge of or prior agreement of the instructor involved.

While it is recognized that scholarly work often involves reference to the ideas, data and conclusions of other scholars, intellectual honesty requires that such references be explicitly and clearly noted. Plagiarism is an extremely serious academic offence. Plagiarism occurs not only when direct quotations are taken form a source without specific acknowledgement, but also when original ideas or data form the source are not acknowledged. A bibliography is insufficient to establish which portions of the students' work are taken form external sources; footnotes or other recognized forms of citation must be used for this purpose.

Cheating is an extremely serious academic offence. Cheating at tests or examinations includes but is not limited to dishonest or attempted dishonest conduct such as speaking to other candidates or communicating with them under any circumstances whatsoever; bringing into the examination room any textbook, notebook, memorandum, other written material or mechanical or electronic device not authorized by the examiner; writing an examination or part of it, or consulting any person or materials outside the confines of the examination room without permission to do so, or leaving answer papers exposed to view, or persistent attempts to read other students' examination papers.

Other Academic Misconduct includes, but is not limited to, tampering or attempts to tamper with examination scripts, class work, grades and/or class records; failure to abide by directions by an instructor regarding the individuality of work handed in; the acquisition, attempted acquisition, possession, and/or distribution of examination materials or information not authorized by the instructor; the impersonation of another student in an examination or other class assignment; the falsification or fabrication of clinical or laboratory reports; the non- authorized tape recording of lectures.

Any student who voluntarily and consciously aids another student in the commission of one of these offences is also guilty of academic misconduct.

Emergency Evacuation/Assembly Points: For the Education Block and Education Tower**:**

Scurfield Hall [Primary Assembly Point]; Atrium Professional Faculties Food Court [Alternate
Assembly Point]

Safewalk: Promoting Campus Safety and Awareness: Twenty four hours a day, seven days a week, Safewalk volunteers walk people safely to their destination on campus. This service is free and available to students, staff and campus visitors. Safewalks are done in male/female pairs. The volunteers walk anywhere on campus (including McMahon Stadium, Health 16

Sciences, Student Family Housing, the Alberta Children's Hospital and the University LRT station). To request a Safewalk volunteer to walk with you,

- Call 403-220-5333 (24 hours a day/seven days a week, 365 days a year)
- Use the Help Phones (they are not just for emergencies)
- Approach an on-duty Safewalker and request a walk.

Student Union Representative: The Werklund School of Education representative, 2016 – 2017, is Carson Reveen, careveen@ucalgary.ca, educrep@su.ucalgary.ca

Education Students Association (ESA) President: Christopher Klune, cmklune@ucalgary.ca

Student Ombudsman's Office: http://www.ucalgary.ca/provost/students/ombuds