EDCP 352A Curriculum and Instruction in General Science--Secondary

COURSE DESCRIPTION

This course is about curriculum, pedagogy and assessment in secondary science education. We seek to foster an understanding of scientific ways of knowing by recognizing that learning arises from paradigms of inquiry and from conversations *across* as well as *within* diverse and inclusive communities. Engaging science teacher candidates in these debates enables them to inquire into historical and current discussions related to teaching science as an intellectual and an ethical and socially just endeavour, a process that requires that they reflect upon their own position in relation to these debates as a standpoint from which to perceive their future students.

Teacher candidates will be introduced to the concept that science teaching is the act of promoting student learning of science through inquiry and are given the opportunity to model, engage in, and reflect upon inquiry teaching in the science classroom. Effective science pedagogy integrates knowledge about science with teachers' understandings about how knowledge is constructed and how children develop and learn, as well as developing an appreciation for the implications of science on society and the environment. Focus will be placed on providing teacher candidates with opportunities to integrate planning and application of developmentally-appropriately teaching strategies and resources. The principles, concepts, and practices for teaching secondary science at the junior and general level that are introduced in this course will be further developed and extended in companion Curriculum and Pedagogy courses that examine the teaching and learning of senior level science (i.e. EDCP 354, 355, 356, and 357).

COURSE OBJECTIVES

This course will assist teacher candidates with:

1. Addressing the challenges associated with the teaching of science to adolescents, including learning how to effectively plan, teach, assess, and manage the learning experiences of adolescents.
2. Integrating sound pedagogical theory and classroom practice in the teaching of science.
3. Inquiring into the nature of science and its implications for the teaching of science.
4. Articulating and examining their personal philosophy and rationale for teaching science and the role of science in the secondary school curriculum.
5. Becoming familiar with the rationale, organization, and content of the secondary science curriculum (I.R.P.) in British Columbia and developing skills in using this resource in planning for instruction.

6. Developing skills in the selection, evaluation and use of methods, materials, and resources appropriate for learning science.
7. Adopting safe science practices inside and outside of the classroom.
8. Developing strategies for assessing understanding of science content, scientific reasoning, laboratory process, and problem solving.
9. Acquiring skills in promoting student interest in science and understanding of the role of science in society.
10. Recognizing the diversity of students' needs, perspectives, and beliefs present in science classrooms, and developing strategies for addressing this diversity in the teaching and learning of science.

COURSE STRUCTURE, APPROACH, AND CORE PERSPECTIVES

Class sessions will consist of lecture, large and small group discussions, laboratory practice, and projects. Students will be expected to engage intellectually, work collaboratively and to participate in respectful discussion and debate. The following core perspectives underpin the course approach:

1. Articulating, questioning, understanding, and sharing our beliefs about teaching and learning are fundamental to improving teaching practice
2. Learning about teaching and learning occurs best when we are placed in a context where we are both teachers and students. The pathway to understanding is built on both experience and action.
3. Personal understanding and professional growth is enhanced through writing about and discussing our beliefs with others.
4. Our teaching is improved by listening to ourselves, our colleagues, and our pupils, and by thinking about and acting on what has been said.
5. The quality and meaningfulness of science instruction are improved when students are active and mindful participants in their learning.
6. The instructor's role is to facilitate and guide learning and teaching experiences.
7. The course and its learning activities are intended to serve as models that may be used effectively in teaching practice.

COURSE OUTLINE

Week 1: Nature of Science	
Guiding Questions	***What is the nature of science?***
Key	- The tentative nature of science and scientific theory

Notions	- Re/examining the role of “the scientific method”.
Readings	Halpin, M. J. & Swab, J. C. (1990). It’s the Real Thing—The Scientific Method” *Science and Children*, April.
Week 2: Constructivist Perspectives of Learning	
Guiding Questions	***How do we learn? An introduction to constructivist theory and the construction of knowledge.***
Key Notions	- Constructivist learning theory - Construction, re/construction, and metacognition in learning - “Children’s Science” and Students' alternate conceptions of scientific phenomena -
Readings	Brooks, J. G (1990). Teachers and students: Constructivists forging new connections, *Educational Leadership*, February. Gurney, B. F. (1988). *Conceptual change through negotiation*, Proceedings of the Canadian Society for Studies in Education, Windsor, ON.
Further Reference	Osborne, R. & Freyberg, P. (1985). *Learning In Science: The Implications of Children's Science.* Aukland: Heinemann.
Week 3: Constructivism for Science Teachers	
Guiding Questions	***What are the implications of constructivist learning theory for science teaching?***
Key Notions	- What is meaningful learning? - How do we teach to promote meaningful learning and conceptual change? - The role of inquiry teaching and learning in promoting conceptual change; - Demonstrations and the “Un-Demo” in science teaching.
Readings	Watson, B. & Konicek, R. (1990). Teaching for conceptual change: Confronting childrens’ experience, *Phi Delta Kappan*, 71, 680-685
Further Reference	Baird, J.R. and Mitchell, I.J (Editors) (1987). *Improving the quality of teaching and learning, An Australian Case Study- The PEEL Project.* The PEEL Group. Melbourne, Australia

	Crouch, C., Fagen, A., Callan, J. & Mazur, E. (2004). Classroom demonstrations: Learning tools or entertainment? *American Journal of Physics,* 72(6), 835-843. Driver, R., Guesne,E. & Tiberghien, A. (Eds.) (1985). *Children's ideas in science,* Philadelphia: Milton Keynes Open University Press. Liem, T. L. (1992). *Invitation to Science Inquiry, Second Edition.* Chino Hills, Calif. Science Inquiry Enterprises. Osborne, R. & Freyberg, P. (1985). *Learning In Science: The Implications of Children's Science.* Aukland: Heinemann.
Week 4: The Curriculum of General Science in B.C.	
Guiding Questions	***What is the curriculum of secondary science in British Columbia?***
Key Notions	- The nature of science curriculum (grades 8-10) in British Columbia - Articulating and critiquing goals and objectives in planning for science instruction
Readings	*Instructional Resource Package, Science 8-10*, (2006). Victoria, BC: B.C. Ministry of Education. *Pan Canadian Science Framework*, Council of Ministers of Education of Canada, http://publications.cmec.ca/science/framework/Pages/english/CMEC%20Eng.html
Week 5: Science Instructional Strategies I	
Guiding Questions	***Instructional strategies in science I: What is understanding and how do we recognize and promote understanding of science?***
Key Notions	- What does it mean to understand science? How do we recognize understanding? - Flexible performance capacity and its implications for planning science instruction and the assessment of student learning
Readings	Baird, J. & Northfield, J. (Eds.) (1992). *Learning from the PEEL Experience*, Melbourne VC: Monash University Printing Services. Boix Mansilla, V. (2005). Assessing student work at disciplinary crossroads. *Change, January/February, 14-21.*

	Perkins, D. (1993). An apple for education: Teaching and learning for understanding. American Educator, 17(3). 8, 28-35. www.exploratorium.edu/IFI/resources/workshops/teachingforunderstanding.html
Week 6: Teaching, learning and safety in the Science laboratory	
Guiding Questions	***What are the issues associated with teaching, learning, and safety in the Science laboratory?***
Key Notions	- Organizing for laboratory work, a proactive approach - Identifying and addressing cognitive overload in laboratory activities - Promoting meaningful learning - Safety in the science classroom and laboratory
Readings	*Science Safety Resource Manual*, B. C. Ministry of Education, 2002 Johnstone, A.H. & Wham, A. J. B, (1982). The Demands of Practical Work, *Education in Chemistry*, 19(3), 71-73.
Week 7: Science Instructional Strategies II	
Guiding Questions	***Instructional strategies in science II: What types of strategies promote understanding of science?*** ***What should a repertoire of strategies for promoting understanding include?***
Key Notions	- Translation activities and the personal construction of knowledge - Cooperative learning and the social construction of knowledge - Direct instruction and alternatives
Readings	Bennett, B. & Rolheiser, C. (2001). *Beyond Monet, The artful science of instructional integration*. Toronto ON: Bookation. Kagan, S. (1989). The Structural Approach to Cooperative learning, *Educational Leadership,* Dec. 47, 12-15.
Further Reference	Baird, J. & Northfield, J. (Eds.) (1992). *Learning from the PEEL Experience*, Melbourne VC: Monash University Printing Services. Keeley, P. (2008). *Science formative assessment: 75 practical strategies for linking assessment, instruction, and learning*. Thousand Oaks, CA: Corwin Press. Marzano, R. J. (2007). *The art and science of teaching: A comprehensive framework for effective instruction*. Alexandria, VA: Association for Supervision & Curriculum Development.

	White, R. & Gunstone, R. (1992). *Probing Understanding*. London: Falmer Press.
Week 8: Lesson and Unit Planning in Science	
Guiding Questions	***How do we plan to promote understanding of science? What is your big vision and storyline?***
Key Notions	- Strategies and designs for Lesson planning - Strategies and designs for Unit planning - Articulating learning objectives in lessons and units
Readings	Brandl, K. (2008). Principles of communicative language teaching and task-based instruction. In *Communicative language teaching in action: Putting principles to work* (pp. 1-39). Upper Saddle River, NJ: Pearson Education.
Further Reference	Keeley, P. (2008). *Science formative assessment: 75 practical strategies for linking assessment, instruction, and learning*. Thousand Oaks, CA: Corwin Press. Marzano, R. J. (2007). *The art and science of teaching: A comprehensive framework for effective instruction*. Alexandria, VA: Association for Supervision & Curriculum Development. Wiggins, G., & McTighe, J. (1999). Understanding by design. Alexandria, VA: Association for Supervision & Curriculum Development.
Week 9: Questioning Strategies in Science Teaching and Learning	
Guiding Questions	***How do we promote and assess science understanding through questioning?***
Key Notions	- Questioning and levels of cognition - Bloom's taxonomy as a tool for planning, instructing, and assessing uderstanding - Conducting teacher-student-class interactions
Readings	Wassermann, S. (1992). *Asking the Right Question: The Essence of Teaching*, Bloomington, IN: Phi Delta Kappa Forte, Imogene and S. Schurr. (1997). *The All-New Science Mind Stretchers: Interdisciplinary Units to Teach Science Concepts and Strengthen Thinking Skills*. Cheltenham, Vic.: Hawker Brownlow. http://www.kurwongbss.eq.edu.au/thinking/Bloom/blooms.htm

Week 10: Classroom Management	
Guiding Questions	***How do we manage teacher-student-class dynamics and interactions?***
Key Notions	- Reactive and proactive classroom management - Critical case studies of classroom events
Readings	
Week 11: Assessment and Evaluation	
Guiding Questions	***How do we know what students have understood and learned?*** ***In what ways can we gather evidence for, of, and as learning?***
Key Notions	- Assessment and evaluation of learning – is there a difference? - Formative and summative assessment - The subjective nature of assessment - Authentic assessment - Performance assessment - Traditional assessment and testing
Readings	Cooper, D., O'Connor, K., and Wakerman, N. (2010). "Redefining "Fair": Assessment and Grading for the 21st Century", *Reflections*, Vol. 10, Manitoba Association for Supervision and Curriculum Development, 30-37. http://www.mbascd.ca/publications.htm
Further Reference	Keeley, P. (2008). *Science formative assessment: 75 practical strategies for linking assessment, instruction, and learning*. Thousand Oaks, CA: Corwin Press. Perrone, V. (1991). *Expanding student assessment*. Alexandria, VA: Association for Supervision & Curriculum Development.
Week 12: Introduction to STSE curriculum and pedagogy	
Guiding Questions	***What is the nature of a Science, Technology, Society and Environment curriculum?***
Key	- Examining the rationale, curriculum and objectives for teaching STSE

Notions	- Examining and critiquing strategies and resources for teaching STSE
Readings	*Instructional Resource Package*. *Science, Technology, Society and the Environment*, (2009). Victoria, BC: B.C. Ministry of Education.
Week 13: The Inclusive Science Classroom	
Guiding Questions	***How should we teach in the inclusive science classroom?***
Key Notions	- Who is our audience in science? - Strategies for addressing diverse learners in science education
Readings	Gibbons, P. (2002). Reading in a second language. In *Scaffolding language, scaffolding learning: Teaching second language learners in the mainstream classroom,* (pp.77-101). Portsmouth, NH: Heinemann. Snively, G., & Corsiglia, J. (2001). Discovering indigenous science: Implications for science education. *Science Education. 85, 6-34.*

ASSESSMENT
Student performance in this course is evaluated using a Pass/Fail scale.
A mark of "Pass" is equivalent to at least B+ (76% in UBC's standard marking system)

Expectations regarding performance

The Pass/Fail system of evaluation used for this course reflects our expectation that students are committed to a high level of performance. Achieving a passing mark is contingent on a high standard of performance in all learning experiences. Assessment criteria for specific assignments or activities will be provided well in advance of due dates so that students will be aware of expectations.

Assessment Elements:
Regular Attendance
Successful completion of this course is contingent on regular attendance. Attendance every class is expected as described in the Faculty of Education B.Ed Program Policy Handbook http://teach.educ.ubc.ca/resources/current-students/policies.html)
Class Participation
Participation in class includes: Engagement in individual and group class activities, completion of course readings, contribution to in-class discussions of teaching and learning issues, and completion of minor homework tasks.

Course Assignments:
A. The "UNdemonstration": Introduction to Interactive Science Inquiry

The purpose of this mini-teaching assignment is to provide practice in using inquiry teaching to promote student thinking, and to gain experience in using a specfic teaching episode as the focus for critical analysis. Each student will prepare and conduct a short interactive science inquiry (a.k.a. the "UnDemo") with a group of students, which will be digitally recorded. Evaluation will be based on a written summary and critique of how this pedagogical episode helped to advance 'their pupils' understanding of a science concept through inquiry.

B. Laboratory Session: Promoting Learning in Lab Settings

The purpose of this assignment is to investigate and mitigate the complexities of student learning in the laboratory setting. Students will complete a science laboratory activity from the junior science curriculum (choice provided) and will prepare a written critique of the lab. The critique will identity and address safety concerns, present a plan for organizing equipment and conducting this lab with a class, and discuss sources of "cognitive overload" and strategies to mitigate these issues and promote deep understanding of the science concepts underlying the lab activity.

C. Planning and Assessment of Meaningful Student Learning

The purpose of this assignment is to create a lesson plan that incorporates one or more student learning activities that encourages meaningful learning of science concepts as well as a coherent plan or plans for student assessment.