Physics for K-8 Teachers – Motion, Forces and Energy

Course Information

Department and course number: SCI595 and C&I595

Credits: 4 graduate credits

Course meeting dates and times: June 15th – 19th and June 22nd – 26th from 8:30AM to 4:30PM

Course location: Salish Kootenai College, Beaverhead Building 116

Course Instructors	e-mail	Office	Phone
Instructor of record: Dr. Tim Olson Division of Math and Sciences Salish Kootenai College	tim_olson@skc.edu	AMathias Bldg Room 125	(406) 275-4898
Additional instructors: Dr. Roger Dilts Biological and Chemical Sciences Salish Kootenai College	Roger_Dilts@skc.edu	Beaverhead Bldg Room106	(406) 275-4944
Dr. Jeff Crews Science Education Specialist Adjunct Faculty, the University of Montana at Missoula	jeff@spatialsci.com	Home Office Lolo, MT	(406) 360-6340
Regina Sievert Indigenous Math and Science Institute Salish Kootenai College	regina_sievert@skc.edu	IMSI Office SKC Campus	(406) 261-7412

Course Description

The primary focus of this course is the deepening of K-8 teachers' understanding of fundamental concepts associated with physics. Teachers enrolled in the course will engage in a variety of investigation based learning experiences designed to develop their conceptual understanding of motion, forces, energy, and waves and how they apply to our everyday lives. Topics for the course will be aligned with the Montana Science Content Standards, Benchmarks and Learning Expectations.

The secondary focus of the course is on the development of teacher professional knowledge and skills that support rigorous K-8 science instruction, including pedagogical methods, cultural competency and teacher leadership. Teachers will increase their competence in these elements of science instruction through critical examination of science education issues and the research literature, professional discourse with course participants, and the production and sharing of artifacts such as inquiry based learning cycles, and physics learning progressions. Course activities will model effective instructional methods and assessments, providing opportunities for teachers to experience, critique, and adapt activities and methods for use in their own classrooms.

Course Learning Outcomes

Through the successful completion of this course students will

1) deepen their understanding of physics content knowledge,
2) improve their ability to use scientific skills employed in the discipline of physics,
3) improve their understanding of the nature of science and how scientific knowledge is generated,
4) heighten their awareness of the interaction of science and society,
5) improve their ability to use educational technology that supports physics education,
6) gain professional skills and knowledge that support the design and implementation of rigorous science instruction,
7) improve cultural competency in supporting science learning in American Indian students,
8) improve their ability to use the Montana Science Standards to guide instruction and
9) develop skills as science teacher leaders.

Course Materials

Students will receive their texts and other reading materials prior to the course and will be assigned pre course readings.

Books

Robertson, W. & Diskin, B. 2003. *Light: Stop Faking It! Finally Understanding Science So You Can Teach It.* Arlington, VA: National Science Teachers Association Press.

Robertson, W. & Diskin, B. 2003. *Sound: Stop Faking It! Finally Understanding Science So You Can Teach It.* Arlington, VA: National Science Teachers Association Press.

Robertson, W. & Diskin, B. 2002. *Energy: Stop Faking It! Finally Understanding Science So You Can Teach It.* Arlington, VA: National Science Teachers Association Press.

Robertson, W. & Diskin, B. 2002. *Force and Motion: Stop Faking It! Finally Understanding Science So You Can Teach It.* Arlington, VA: National Science Teachers Association Press.

Stephens, S. 2000. *Handbook for Culturally Responsive Science Curriculum*. Fairbanks: Alaska Native Knowledge Network.

Supporting Materials

Articles & handouts will be provided by the course instructors, and include but are not limited to:

Barnhardt, R. & Kawagley, O. 2005. Indigenous knowledge systems and Alaska Native ways of knowing. *Anthropology and Education Quarterly*, 36:1, pp. 8-23.

Garroutte, E. M. 1999. American Indian science education. *American Indian Culture and Research*, 23:4.

Windschitl, M. 2009. Cultivating 21st century skills in science learners: How systems of teacher preparation and professional development will have to evolve. Paper presented at the National Academies of Science Workshop on 21st Century Skills, February 5-6, 2009.

Course Content

Week 1: Motion and Force	
Day	**Topics and Activities**
Day 1	Course Welcome, Introduction and Expectations

	Forces, Energy and Motion Pretest/Cultural Competent Survey
	Motion Investigation 1: Position vs. time for constant velocity
	Motion Investigation 2: Velocity
	Motion Investigation 3: Position change/velocity relationship
	Daily Synthesis, Feedback and Assessment
Day 2	Review and Pre Assessment
	Motion Investigation 4: Acceleration
	Motion Investigation 5: Falling motion
	Culturally Competent Instruction I
	Motion Investigation 6: Projectile motion
	Daily Synthesis, Feedback and Assessment
Day 3	Review and Pre Assessment
	Force Investigation 1: Concept of Force and Newton's 1st law of motion
	Force Investigation 2: Newton's 2nd law of motion
	Looking at Western and Indigenous Cultures
	Force Investigation 3: Friction forces
	Daily Synthesis, Feedback and Assessment
Day 4	Review and Pre Assessment
	Force Investigation 4: Forces acting on falling and projectile motions
	Force Investigation 5: Forces acting on a rotating object
	Western Science and Science Education – Reading: *Cultivating 21st Century Science Skills*
	Daily Synthesis, Feedback and Post Assessment – Overview of BSSP 2009-20
Day 5	Review and Pre Assessment
	Force Investigation 6: Forces between objects
	Kootenai Bow and Arrow – Cultural significance and demonstration
	Bow and Arrow Force and Motion Inquiry
	What is Inquiry Based Teaching and Learning?
	Motion and Force in Native Games and Dances, Yesterday and Today - Summative Assessment

Week 2: Energy and Waves	
Day	**Topics and Activities**
Day 6	Energy Investigation 1: Energy of position and motion
	Indigenous Science Panel
	Energy Investigation 2: Simple machines
	History and demonstration of the atatl
	Energy Investigation 3: Changing energy by doing work – Investigating the atlatl
	Daily Synthesis, Feedback and Post Assessment
Day 7	Review and Pre Assessment
	Bridging Western and Indigenous Science
	Robotics and Simple Machines - Technology in Physics Education
	Energy Investigation 4: Thermal energy
	Energy Investigation 5: Other forms of energy
	Daily Synthesis, Feedback and Post Assessment
Day 8	Force, Energy and Motion Post Test
	Introduction to Waves and Energy Transfer

	Wave Characteristics – The relationships between frequency, speed, amplitude and media
	Wave Behavior – Exploring wave reflection, diffraction, refraction and interference
	Introduction to the curriculum product assignment
	Daily Synthesis, Feedback and Post Assessment
Day 9	Review and Pre Assessment
	Properties of Light Investigations I – Reflection & Refraction
	Properties of Light Investigations II – Absorption and Color
	Color in American Indian Cultures
	Skills and Strategies for Science Teacher Leadership
	Daily Synthesis, Feedback and Post Assessment
Day 10	Review and Pre Assessment
	Sound Circus/Speed of Sound Waves
	Sound Wave Behavior
	Sound Waves, Resonance and American Indian Musical Instruments
	Unit Framework & Leadership Planning Time
	Course Evaluation/Feedback

Evaluation
Students enrolled in the course will receive a traditional letter grade. Students will be evaluated using multiple methods and **all** assignments must be completed to at least a minimum standard of proficiency specified by instructors in order to receive a passing grade for the course. All course assignments must be completed by the **due dates specified in the table below**. **No late assignments will be accepted.**

Assignments, Due Dates, and Point Values

Assignment	Due Date	Maximum Point Value
Science assessments - Daily short assessments - 48 points - Motion and force summative assessment – 8 points	In class assessments, due the day that they are assigned	56
Reflection on bridging Indigenous and Western Science	By July 10	12
Physics conceptual sequence	June 26, last day of class	6
Inquiry Based Teaching and Learning Assessment	June 23, the day the physics inquiry is completed in class	6
Framework for Culturally Competent Curriculum Product - Conceptual sequencing of lessons – 10 points - Explanation of Science Concepts - 10 points	By July 24	20
Leadership Plan	By July 17	20
Total Possible Points		**120**

Grades Assignment

90 to 100% = A
80 to 89% = B
70 to 79% = C

60 to 69% = D
< 60% = F

Descriptions of Assessments

Science Content Assessments

1) **Daily formative assessments** of students' understanding of the physics concepts, use of physics science skills, and grasp of the nature of science will be conducted. The format of the assessments will vary to best assess the concepts or skill in question. Assessments will model best pedagogical practice, particularly for teaching American Indian students, and will include embedded assessments, performance based assessments, and metacognitive exercises.
2) A **summative assessment** will be administered on force and motion concepts at the culmination of Week One. Students will be asked to apply and demonstrate their understanding of force and motion concepts in an inquiry based activity focusing on tools and processes relevant to Montana Indian cultures.

Reflection on Bridging Indigenous and Western Science

Students will submit a **reflective essay** discussing their current understanding of each of the following:

- The nature of Indigenous Science
- The nature of Western Science
- The benefits of teaching science in a culturally competent manner
- The potential challenges of bridging Indigenous and Western Science perspectives
- Specific examples of ways to bridge Indigenous and Western Science in their classrooms that will support American Indian students' science achievement

The essay should be a minimum of three single spaced pages, typed in Word in Times New Roman 12 point font, and submitted electronically to Regina_Sievert@skc.edu.

Physics Conceptual Sequence

Students will begin studying the development of sound physics learning progressions during this course. They will begin working in class, individually or in small groups, to develop a **conceptual sequence for a major physics concept**. The sequence must include a minimum of four stages, be grade level specific, and contain enough detail to clearly show the sequence of ideas and how they connect to foster students' conceptual understanding of the chosen concept. Examples of conceptual sequences will be generated in class. Further assignment details including a template for use in developing the conceptual sequence will be distributed and discussed in class. This assignment should be typed in Word in Times New Roman 12 point font and submitted electronically to Regina_Sievert@skc.edu.

Inquiry Based Teaching and Learning Assessment

Student groups will actively engage in completing a culturally competent physics inquiry cycle designed to model sound pedagogical strategies as they relate to science and inquiry. In the post inquiry activity, students will work in small groups and as a whole class to deconstruct the cycle and identify the elements of inquiry instruction. They will synthesize and demonstrate their understanding of inquiry based instruction by working in small groups to design a **physics inquiry cycle** for use with a specific grade level, identifying the integral elements of inquiry based instruction and explaining how each element supports students' construction of physics understanding. Groups will be asked to share their designs with the class and the written product will be submitted for a grade at the end of the day.

Framework for the Culturally Competent Physics Curriculum Product

Students will work individually or collaboratively to generate a framework for a **culturally competent physics curriculum product** designed to support physics learning in American Indian students at a specific grade level. The required elements for the product will include an overview, clear learning objectives aligned with Montana Benchmarks and Learning Expectations, a detailed conceptual sequence, formative and summative assessments, and cultural competence. The conceptual sequence will include a detailed explanation of the science concepts and how they connect in the unit to support construction of conceptual understanding. A handout outlining the product framework criteria will be distributed and discussed in class. Students will have an opportunity to begin working on the product framework in class, with course instructors available for feedback. Inservice teachers are encouraged to use the framework assignment as the basis for a fully developed unit that can be used for the Scoop notebook (required in the 2009-10 academic year). The framework must be typed in Word in Times New Roman 12 point font and submitted electronically to Regina_Sievert@skc.edu.

Leadership Plan

All students enrolled in the course will begin to study the elements of science teacher leadership and submission of preliminary **Leadership Plans** will be required. Students will be asked to work in teams (often grade level, school, or district based) to research and assess high priority needs for strengthening their school's/district's science education programs and to generate school year action plans designed to address identified needs. Students (i.e., teachers) will work with their school/district administrators and other colleagues to identify needs and formulate their plans. Further instructions and a leadership plan template for use in writing the plan will be provided during this course.

As part of the assignments for the next course in this sequence, students will implement their plans during the 2009-2010 academic year and will submit quarterly reports providing detailed assessments of their progress, challenges, and successes in regards to their plan implementation. A template for use in writing up the progress reports will also be provided during this course so that students can anticipate the reporting requirements for the academic year course.

Attendance

Regular attendance is expected and recommended in order for students to have access to a rich and comprehensive learning experience. Fifty two percent of the points for the final grade are based on in class assignments, therefore regular attendance is also recommended for the successful completion of the course with a passing grade.

Academic Integrity

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code. The Code is available for review online at http://www.umt.edu/SA/VPSA/index.cfm/page/1321