# *GEORGE MASON UNIVERSITY*
## COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
## OFFICE OF EDUCATION SERVICES

**EDPD502.6R3: Scientific Inquiry: Physical Science**
**Fall/2016**
**Tuesdays 3:45-6:45**
**September 13 – December 13, 2016**
**Colgan High School**

**Instructor:** *Dr. Erin E. Peters-Burton*

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**COURSE DESCRIPTION:**
Incorporates understanding about scientific inquiry in the context of physical science in grades 6-12 classrooms. Builds fundamental knowledge of:

1) classroom curriculum and instruction involving investigations and experiments in which variables are measured, analyzed, and evaluated
2) pedagogy that involves analyzing data and making sense of data
3) pedagogy that involves communicating scientific results in both verbal and written formats

**COURSE PURPOSE AND INTENDED AUDIENCE:**
The purpose of this course is to give secondary physical science teachers experiences in learning curriculum and instruction in their content area taught in an inquiry format. Once mastered, the secondary teachers will then design their own inquiry-based physical science lessons.

**COURSE FORMAT:**
The course format can be segmented into three types of activities:

- in-class participation in inquiry-based activities and assessments on physical science topics
- evaluation of inquiry-based activities and assessments on physical science topics
- development of a rubric focused on inquiry in physical science classrooms
- application of learned techniques in individual classrooms

**STUDENT OUTCOMES:**
The goal of this course is to provide secondary teachers with the knowledge and skills necessary to implement inquiry-based science instructional activities in their classrooms. To that end, the course objectives are to:

- extend and strengthen participants' knowledge of inquiry-based lessons in the classroom
- enhance participants' ability to design and implement inquiry-based lessons that are aligned with state and school division curriculum documents; and,
- emphasize the nature of science, particularly in terms of helping students to think, act, and communicate.

**PROFESSIONAL STANDARDS (if applicable):**

National Board for Professional Teaching Standard, Core Proposition 2
INTASC Standards 1-10
NSTA Standards: Research, Safety, Inquiry

**REQUIRED/SUPPLEMENTAL/RECOMMENDED TEXTS AND/OR READINGS:**

Required Texts: Current Science Textbook from classroom

Supplemental Readings:

- McComas, W. (2004). Keys to teaching the nature of science. *The Science Teacher*, retrieved from http://www.nsta.org/publications/news/story.aspx?id=49929
- Issue brief, *Inquiry-based teaching*, retrieved from http://www.inspiredteaching.org/wp-content/uploads/impact-research-briefs-inquiry-based-teaching.pdf
- Virginia Mathematics and Science Coalition, *Scientific Inquiry and the Nature of Science Task Force Report*, retrieved from www.vamsc.org/projects/vmsc_inquiry_and_nos_**white_paper**_5_11_10.doc

Additional Resources:

- Will be provided electronically by the instructor on the course web site.
- Because this course is flexible to the needs of the teacher candidates, other articles/handouts than the ones indicated on this syllabus may be distributed in class or posted on-line at the course website.
- It is expected that the readings assigned for the class will be completed before the class meeting.

**COURSE REQUIREMENTS, PERFORMANCE-BASED ASSESSMENTS, EVALUATION CRITERIA, AND GRADING SCALE:**

Due to the interactive nature of this course, attendance is required at all sessions. If an emergency situation occurs (e.g., accident, illness), please contact the instructor as soon as possible to discuss possible make-up work. Repeated absences will result in loss of course credit.

Course grades will be based equally on participation in class activities (discussions, labs, etc.) and two inquiry-based lesson plan (with iterative feedback from the instructor and peers) that participants present on the last days of class. See the assignment rubrics for more information.

**GRADING SCALE:**

A = 93-100%
A- = 90-92%
B+ = 88-89%
B = 80-87%
C = 70-79%
F = Below 70%

**COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT STATEMENT OF EXPECTATIONS:**

The Graduate School of Education (GSE) expects that all students abide by the following:

Students are expected to exhibit professional behavior and dispositions. See gse.gmu.edu for a listing of these dispositions.

Students must follow the guidelines of the University Honor Code. See http://www.gmu.edu/catalog/apolicies/#TOC_H12 for the full honor code.

Students must agree to abide by the university policy for Responsible Use of Computing. See http://mail.gmu.edu and click on Responsible Use of Computing at the bottom of the screen.

Students with disabilities who seek accommodations in a course must be registered with the GMU Disability Resource Center (DRC) and inform the instructor, in writing, at the beginning of the semester. See www.gmu.edu/student/drc or call 703-993-2474 to access the DRC.

**PROPOSED CLASS SCHEDULE:**
**Class sessions, readings and assignments may change according to the needs of the class**

| Date | Topic/Learning Experiences | Readings/Assignments |
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| **September 13** | • Syllabus<br>• Inquiry definition and rationale<br>• Nature of Science | Forethought Form |
| **September 20** | • Development of a Content map<br>• Sharing across grade levels<br>• Questions about Inquiry<br>• Sharing of lesson ideas to be adapted (must have data and making sense of data) | Readings on class website<br>Bring in 2 lessons to be adapted for inquiry-based instruction |
| **September 27** | • The 5Es as inquiry<br>• Case Study Analysis<br>• Example lesson – Construction Materials<br>- Noting key characteristics of inquiry<br>- Drafting rubric for lessons | Readings on class website |
| **October 4** | • Comparing traditional and science-based classrooms<br>• Example lesson – History of the Atomic Model<br>- Noting key characteristics of inquiry<br>- Drafting rubric for lessons | Readings on class website |
| **October 11** | • Integrating Inquiry-Based Activities<br>• Making time for inquiry<br>• Peer reviews of Lesson Plan #1 | Lesson Plan #1 due for feedback<br>Readings on class website |
| **October 18** | • Assessing Inquiry<br>• Peer reviews of Lesson Plan #1<br>• Example Lesson – Car Crashes<br>• Noting key characteristics of inquiry<br>• Drafting rubric for lessons | Readings on class website |
| **October 25**<br>**Online class** | • Example Chemistry Lesson<br>• Finalize inquiry rubric | |

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| | • Performance form<br>• Work on Lesson #1 | |
| **November 1** | Work day – work on your own – no class meeting – work on Lesson #1 | |
| **November 8** | • Example Physics Lesson<br>• Peer Review of Lesson Plan #1<br>• Reporting out of peer review | Lesson Plan #1 revised due |
| **November 15** | • Lesson Plan Sharing<br>• Work on Lesson Plan #2<br>• Conferences about Lesson Plan #1 | Bring in Lesson Plan #2 ideas |
| **November 22** | Work day – no class meeting - work on your own on Lesson #2 | |
| **November 29** | • Peer Review of Lesson Plan #2<br>• Reporting out of peer review | Lesson Plan #2 due for feedback |
| **December 6** | • Present lesson plans<br>• Whole group peer review | Lesson Plan Presentations |
| **December 13** | • Present lesson plans/peer review<br>• Self-reflection form<br>• Celebration<br>• Next Steps<br>• Evaluation of the Course | Lesson Plan Presentations<br>Lesson Plan #2 revised due |

**Example Inquiry Lesson Plan Rubric**

| Unacceptable (0 points) | Needs Work (1 point) | Developing (2 points) | Proficient (3 points) |
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| **A. Guiding Question(s):** The goal of your lesson should be inquiry oriented. Students' attention should be focused on answering one or two key questions based on empirical evidence. Remember that teacher simply asking lots of questions does not an inquiry lesson make. | | | |
| Guiding question(s) not included | Guiding question(s) are included but are not appropriate to student inquiry and/or very poorly worded. | Guiding question(s) are included, are appropriate, but poorly worded. | Guiding question(s) are included, appropriate, and well worded. |
| **B. Student Performance Objective(s):** What, more specifically, are the students expected to know and be able to do at the end of the lesson? Include content knowledge, intellectual skills, and dispositions as appropriate. Your objectives should have readily observable behaviors or performance tasks. Students must be made aware of day-to-day objectives. Objectives should include BOTH content objectives and nature of science objectives. | | | |
| Poorly written objectives; written more like teacher goals; not performance-based; or not provided. Only NOS or only content objectives are provided. | Objectives are a mix of teacher goals and student performance-based tasks; objectives exhibit poor word choice and uses terms such as "understand" or "able to" for performance task. Only NOS or only content objectives are provided. | States unit's major and minor science content and intellectual process skills objectives using observable behaviors. Includes both NOS and content objectives | Developing plus includes due consideration for student dispositions. Includes both NOS and content objectives. |
| **C. Science Content and Standards:** List here the order of science content as it will be taught as well as the corresponding Virginia Standards of Learning. | | | |
| Fails to include alignment table between student activities and Virginia SOLs. | Includes a table showing alignment between some student activities and SOLs, but not all. | Includes a table showing alignment between major and minor student activities and SOLs. | Developing plus includes National Science Education Standards A-L in alignment table as appropriate. |
| **D. Alternative Conceptions:** List here any alternative conceptions (preconceptions that students might bring to this subject matter and misconceptions that they might develop) as a result of studying the content of this lesson. Be certain to cite your reference(s). | | | |

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| Little to no consideration for alternative conceptions. | Lists only a very limited array of students' alternative conceptions; doesn't not cite reference(s). | Lists a good variety of preconceptions and misconceptions that students have in relation to subject matter of unit. Clearly referenced. | Developing plus links various alternative conceptions to specific classroom activities. |
| **E. Instructional Approach(es):** Indicate which active learning strategies you will employ in this inquiry lesson such as discovery learning, interactive demonstration, inquiry lesson, inquiry lab, hypothetical inquiry, problem/project based learning, case study, discussion, etc. Good inquiry-oriented lessons also will include activities from each of the three following categories: individualized, small group, and whole group. | | | |
| More emphasis on didactic teaching; less emphasis on students constructing understanding from experiences; little to no consideration for student groupings. | A roughly equal mix of teacher-centered and student-centered pedagogy; equal emphasis on transmitting knowledge and discovering knowledge; some consideration for student groupings, but does not show planning required to use them effectively. | Provides a detailed overview of diverse and effective teaching procedures that are student student-centered; addresses classroom atmosphere and student management; explains how a variety of diverse student groupings will be used to construct meaning from science experiences and develop dispositions for further inquiry and learning. | Developing, and clearly includes use of formal cooperative learning strategies. |
| **F. Focus of nature of science (NOS) and Inquiry:** Research demonstrates that to teach NOS effectively the lessons must be both explicit for the students AND allow the students to be reflective about their scientific thinking. Indicate how your lesson addresses both explicit | | | |

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| and reflective NOS activities. | | | |
| Fails to provide explicit or reflective NOS instruction. | Provides either explicit or reflective NOS instruction but not directly connected to the content in the lesson. | Provides either explicit or reflective instruction but not both. Connected with the content in the lesson. | Provides both explicit and reflective instruction that is directly connected to the content of the lesson. |
| **G. Checking for Understanding:** How will you as teacher determine if the student performance objective(s) for the day's lesson has been achieved? How will you assess the objectives in an informal though meaningful manner? | | | |
| No consideration shown for student comprehension or no review of lesson's student performance objectives. | Reviews the lesson objects for students, but teacher conducts summary of student learning without involving students. | Reviews the lesson objectives for students, but does a poor job of eliciting students' input or alternative conceptions; provides some of the summary for the students. | Reviews the lesson objectives for students, and does a good job of eliciting students' understanding in relation to the lesson's student performance objectives including alternative conceptions. |
| **H. Extensions/Homework:** Explain how you will teach explicitly about the nature of science, its unifying concepts, the philosophy of science, issues of science and technology and/or the processes of science during your lesson. What projects or homework activities will you assign to your students to help them internalize and better understand the intended learning of this lesson? | | | |
| No consideration given to any form of extension; no homework suggested. | Only extension or homework given, not both. | Gives both extension and homework information, but is a bit sketchy. | Gives both extension and homework information, and provides enough detail about the extension work that anyone could teach it given the information provided. |
| **I. Materials and Safety:** What materials will you need to teach your lesson? Do any of your materials represent a safety hazard? If so, what precautions will you take to protect your students? | | | |

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| No consideration given for the use of materials. | Makes very limited use of instructional materials; no mention of safety considerations. | Make considerable use of only a limited amount of instructional materials; notes safety precautions as appropriate. | Uses a variety of material resources to conduct lesson including such things as demonstrations and/or simulations to provide for multiple modes of learning as appropriate; notes appropriate safety precautions if appropriate. |
| **J. Backup Plan:** No lesson plan should be written without considering the possibility that students will complete their tasks faster than expected. Every lesson plan should, therefore, include meaningful back up activities. The backup plan should not consist of having students work on an assignment intended for homework. | | | |
| No consideration given for activities that can be used to fill extra time in a meaningful fashion. | Uses homework for a back-up plan. | Provides an insubstantial or meaningless activity as a back-up plan. | Makes excellent use of extra time to introduce valuable and meaningful extension activities (e.g., NOS case studies) . |