 IOWA STATE UNIVERSITY

School of Education

**EDUC 446/546-** **Advanced Pedagogy in Science Education**

**Spring 2023, Friday 9:00am – 11:50pm**

**0550 Lagomarcino Hall**

**Course Instructor: Dr. Kristina Tank**

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**Student/Office Hours:** T 10:00 – 11:00 and by appointment

**Course Description:**

This 3 – credit dual-listed course is an advanced examination of pedagogy, emphasizing teacher behaviors and strategies, methods of self-assessment, models of inquiry teaching, and current issues and trends in science education.

**446 Course Objectives:** By the completion of this course, successful students will:

* Expand their understanding of inquiry-based science teaching across K-8.
* Develop a repertoire of strategies to investigate students’ prior knowledge in science
* Develop the knowledge and skills to design and implement sequences of science learning experiences that constitute inquiry investigations, are informed by students’ prior knowledge and catered for individual differences
* Plan for assessing student learning in science

**546 Course Objectives:** By the completion of this course, successful students will:

* Expand their understanding of inquiry-based science teaching across K-8.
* Deepen their understanding of the research-based practices and skills that lead to designing and implementing effective science learning experiences that constitute inquiry investigations and are informed by students’ prior knowledge and individual differences
* Expand their understanding of student learning and assessment in science and how it informs the practice of teaching.

**ISU Educator Preparation Conceptual Framework:** The ISU educator preparation program is founded on the land grant commitment of access and opportunity when serving the people of Iowa, the nation, and the world. Additional information about the framework can be found [here](https://education.iastate.edu/current-students/educator-preparation-program/resources/conceptual-framework/).

**Iowa State University Teaching Standards:** The School of Education at Iowa State University assures the Iowa Department of Education that each student recommended for initial teacher licensure has an understanding of the [12 InTASCstandards](https://iastate.box.com/s/7zi3rj2sm95ywzg8k6ao3txz3h89y41q). This course addresses the teacher education standards, but there is not a specific standard designated as a “standards assessment” for this course.

[**Iowa State Educator Preparation Professional Attributes:**](https://iastate.box.com/s/as7ls3q8qsvcgaj69qvi35trskg7pifu)The Iowa State Educator Preparation has identified key professional attributes aligned to becoming a successful educator.  You are expected to develop and demonstrate these attributes during educator preparation program.

**Teacher Education Shared Course Expectations:**

This course incorporates shared behavioral expectations with other courses in the undergraduate teacher education program. Following these expectations is the responsibility of the student.

* Be There/Stay There – *attend class*
* Be Prepared – *complete assignments on time*
* Be Engaged – *participate in class*
* Be Respectful – *treat others as you wish to be treated*
* Be Ethical/Professional – *prepare to be an educator*

**Educator Preparation Grade Requirement**: Candidates pursuing Educator Preparation are required to earn a minimum of a “C” in ALL Education (EDUC), Human Development and Family Studies (HD FS), and Special Education (Sp Ed) courses and all other program-specific pedagogy coursework. **This includes this course.**  In addition, Educator Preparation candidates are expected to maintain a 2.5 cumulative GPA throughout the program in order to continue being eligible for educator preparation courses.

**Required Course Materials:**

* Krajcik, J.S. & Czerniak, C. M. (2018). *Teaching Science in Elementary and Middle School: A project-based approach*. Routledge. 5th ed
* Non-textbook readings will be assigned and posted on Canvas.
* Canvas site - will contain information, articles, handouts, etc,. Please plan to refer to that site frequently for class materials and to submit assignments.
* Digital Science Notebook (linked in canvas & shared with instructor)

Access to:

* **Iowa Science Standards:** <https://educateiowa.gov/standard/science/science>
* **Next Generation Science Standards (NGSS)**:

<http://www.nextgenscience.org/next-generation-science-standards>

**Grading:**

Final grade will be determined using the following scale. The number represents percentages of possible points earned. See Canvas for the grading of individual assignments.

|  |  |  |
| --- | --- | --- |
| **A 100-94** | **B- 82 – 80** | **D+ 69 – 67** |
| **A- 93 – 90** | **C+ 79 – 77** | **D 66 – 63** |
| **B+ 89 – 87** | **C 76 - 73** | **D- 62 - 60** |
| **B 86 - 83** | **C- 72 - 70** | **F < 60** |

**Assignments are due at the beginning of class on the due date (submitted through Canvas).** Teachers need to be organized and prepared to run on tight deadlines because you will be responsible to teach multiple lessons each day with very little downtime. All late assignments will be reduced by 10% for every day they are late. Extensions are only granted for extenuating medical/illness or emergency family issues. These need to be communicated with the instructor prior to the due date, otherwise the late assignment will be downgraded accordingly.

**Attendance/Tardy Policy**

Attendance and punctuality is essential for educators – students will not just sit quietly and wait for their teacher to arrive. Therefore, this class will start and end on time. I will respect your time, and I expect that you will respect our class time. This means that arriving late or packing up early will disrupt our learning environment and these unprofessional behaviors will detrimentally impact course grades if they occur.

**Course Assignments: 1000 pts total** (see Canvas for details and grading rubrics):

**ALL students will complete the same general assignments listed below.**

**\*EDUC 446 will have a more practice-oriented focus**

**\*\* EDUC 546 will have a research-based focus in addition to the practice-orientation and will complete additional components of the assignments listed below**

**Class Participation (30%, 300 points):** Please note that a substantial portion of your grade is based on being present and actively participating in small AND whole class discussion. These discussions allow us to share our thinking and learn from each other. Because this class is experienced-based, it is difficult to “make up” missed class sessions and can only be done in extenuating circumstances. To receive full participation points, the expectation is that you are present, participating, and documenting your experience in your digital notebook. Please devote your full attention when attending class, limiting distractions such as email, text messaging, homework etc.

**Reading Responses (13%, 130 points).** Complete the assigned readings and associated reading reaction questions before the class in which they are to be discussed. You may want to also make **brief** notes or highlights as you read that you can use in your final paper.

* Non-text based readings for EDUC 446 will mainly be from practitioner articles to give the classroom perspective
* Additional non-text based readings for EDUC 546 will be focused on the research behind the highlighted pedagogy and practices helping to connect research and practice

**Science Unit Portfolio: (25%, 250 points).** You will be selecting a unit topic and then over the course of the semester you will complete several assignments that will become part of this larger science portfolio. Some parts of the portfolio will be started in class and others will be completely out-of-class assignments. Each of the following parts will be discussed in class in more detail and will have a template, example and rubric on Canvas:

* Background and Common Misconceptions - (50 points)
* Anchoring Phenomena and Driving Question - (50 points)
* Conceptual Storyline - (100 points)
* 5E Lesson Example - (50 points)

**POE (Predict-Observe-Explain) Lesson: (7%, 70 pts).** This assignment is designed to give you the opportunity to plan and practice teaching an inquiry-based *POE (Predict-Observe-Explain) Lesson*. In EDUC 449, you experience planning and teaching a 5E lesson, which is one of several inquiry-based teaching models that are common in science teaching. The POE strategy is another model that is more commonly seen in middle school and high school classrooms that can supplement both traditional and kit-based curriculum.

* For EDUC 446 - This assignment contains 2 parts: teaching, and reflecting on a POE lesson.
* For EDUC 546 - This assignment contains 3 parts: background, teaching, and reflecting on a POE lesson.

**Case Study: (100 points, 10%).** Near the end of the semester, you will receive a teaching case study. Your task is to analyze this teaching session thoroughly, using the big topics that we will discuss in class. In addition, you will make recommendations for improvement based on what we cover in class. These changes and recommendations should take the form of an annotated video and annotated lesson plan. Your analysis should reflect what you have learned in the course about teaching and learning. More information will be provided in class and on Canvas.

**Final Paper – Science Teaching Framework: (150 points, 15%).** Using examples from the readings, class activities, and class assignments as the basis for your science teaching framework, you will respond to the following prompt:

*Your have been asked you to be part of the science leadership team for your district. As part of that team, you are responsible for developing a science teaching framework for improving K-8 science and helping all teachers become better science teachers.*

We will talk more about this in class, more detailed prompts will be provided as this will be a pulling together of what you have learned over the semester.

**Spring 2023 Class Schedule**

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| --- | --- | --- | --- |
| **Week** | **Topic** | **Readings**  **(due by the start of class)**  **\*Additional 546 readings** | **Assignment**  **(due by the start of class)** |
| **1**  Jan 20 | Current state of Science Education  Nature of Science  3D learning in science |  |  |
| **2**  Jan 27 | Student Understanding in Science | * Text – Ch. 1 & Ch. 2 * Donovan & Bransford, Ch. 9 (p 397-415) |  |
| **3**  Feb 3 | Models of Science Teaching  5E Learning Cycle | * Banchi & Bell (2008), * Campbell, Schwarz & Windschitl (2016) * Donovan & Bransford, Ch. 10 OR 12 (based on area/level of study) | Be ready to choose topic for unit in class |
| **4**  Feb 10 | Anchoring Phenomena  Driving Questions | * Text - Ch 3 * Deverel-Rico & Heredia (2018) * Driver et al. (1994)- seminal article on conceptual change | Unit - Background and Common Misconceptions |
| **5**  Feb 17 | Learning Progressions & Storylines in Science | * Lipsitz et al (2017) * Text - Ch 10. – P.310-343 * Hanuscin et al (2016) | Unit - Anchoring Phenomena and Driving Question |
| **6**  Feb 24 | Eliciting Student Ideas & Collaboration | * Text – Ch 6 * Eliciting Student Ideas PDF * Windschitl et al., (2012) |  |
| **7**  Mar 3 | Science Talk & questioning | * Ferris (2015), * Text- Ch. 7 p. 201-215 * Hand et al (2015) |  |
| **8**  Mar 10 | Science writing and argumentation | * What’s your Evidence – Ch. 1 & 2 * Chen et al (2017) | Unit – Conceptual Storyline |
| ISU Spring Break – No Classes Mar 13 - 17 | | | | |
| **9**  Mar 24 | Assessment | Text – Ch. 8 | Unit – 5E Lesson Example |
| **10**  Mar 31 | Curriculum analysis |  |  |
| **11**  Apr 7 | Teaching Middle School Science, part 1 | * Ed Week article & Radio episode * Intro to MS * Donovan & Bransford, Ch. 11 | 446 - POE lesson DUE  546 - POE background & lesson DUE |
| **12**  Apr 14 | Teaching Middle School Science, part 2 | * PDF - Teaching Science * PDF – Science Learning Environment | POE reflection DUE |
| **13**  Apr 21 | Integrating Science with Other Areas | Cervetti & Barber (2009)  Park (2014)  Fulton et al (2017)  Pearson et al (2010) | Case Study DUE |
| **14**  Apr 28 | Science & Engineering | Ehlers & Coughlin (2015)  Lottero-Perdue et al (2015) |  |
| **15**  May 5 | Science & STEM | Bledsoe (2012)  Trauth-Nare & Austen (2015) |  |
| **Finals**  **Week** |  |  | **Final Paper – Science Teaching Framework** |

**Additional Information and University Policies:**

[**Ed Prep Syllabus Statement: Misuse of Course Materials in the Educator Preparation Program**](https://iastate.box.com/s/a6wm2xxpmoyc9inmahofhfpt6vktjmb9)

**University Policies:**

**Free Expression**

Iowa State University supports and upholds the First Amendment protection of [freedom of speech](https://www.studentconduct.dso.iastate.edu/know-the-code-resources/resources-for-students/harassment-and-free-speech/free-speech) and the principle of [academic freedom](https://www.iowaregents.edu/plans-and-policies/board-policy-manual/310-academic-freedom) in order to foster a learning environment where open inquiry and the vigorous debate of a diversity of ideas are encouraged. Students will not be penalized for the content or viewpoints of their speech as long as student expression in a class context is germane to the subject matter of the class and conveyed in an appropriate manner.

**Academic Dishonesty:**

The class will follow Iowa State University’s policy on academic misconduct ([5.1 in the Student Code of Conduct](https://www.policy.iastate.edu/policy/SDR)). Students are responsible for adhering to university policy and the expectations in the course syllabus and on coursework and exams, and for following directions given by faculty, instructors, and Testing Center regulations related to coursework, assessments, and exams. Anyone suspected of academic misconduct will be reported to the [Office of Student Conduct in the Dean of Students Office](https://www.studentconduct.dso.iastate.edu/academic-misconduct/armfacultystaff). Information about academic integrity and the value of completing academic work honestly can be found in the [Iowa State University Academic Integrity Tutorial](https://iastate.pressbooks.pub/academicintegrity/).

**Accessibility Statement**

Iowa State University is committed to assuring that all educational activities are free from discrimination Iowa State University is committed to advancing equity, access, and inclusion for students with disabilities. Promoting these values entails providing reasonable accommodations where barriers exist to students’ full participation in higher education. Students in need of accommodations or who experience accessibility-related barriers to learning should work with Student Accessibility Services (SAS) to identify resources and support available to them. Staff at SAS collaborate with students and campus partners to coordinate accommodations and to further the academic excellence of students with disabilities. Information about SAS is available online at [www.sas.dso.iastate.edu](https://sas.dso.iastate.edu/), by email at [accessibility@iastate.edu](mailto:accessibility@iastate.edu), or by phone at 515-294-7220.

**Discrimination and Harassment**

Iowa State University does not discriminate on the basis of race, color, age, ethnicity, religion, national origin, pregnancy, sexual orientation, gender identity, genetic information, sex, marital status, disability, or status as a U.S. Veteran. Inquiries regarding non-discrimination policies may be directed to Office of Equal Opportunity, 3410 Beardshear Hall, 515 Morrill Road, Ames, Iowa 50011, Tel. 515-294-7612,  Hotline 515-294-1222, email [eooffice@iastate.edu](mailto:eooffice@mail.iastate.edu)

**Prep Week**

This class follows the Iowa State University Prep Week policy noted in section 10.6.4 - [Faculty Handbook](http://www.provost.iastate.edu/resources/faculty-handbook).

**Public Health**

If you are not feeling well, you should stay home and focus on your health. Should you miss class due to illness, it is your responsibility to work with your instructor to arrange for accommodations and to make up coursework, as consistent with the instructor’s attendance policy. Other wellbeing resources for students are available at:  <https://www.cyclonehealth.iastate.edu/wellbeing-resources/>

**Regarding a student’s name, gender identity, and/or gender expression:** Class rosters are provided with each student’s legal name. I will gladly honor requests to address you by an alternate name or gender pronoun. Please advise me early in the semester so that I may make appropriate changes.

**Religious Accommodation**

Iowa State University welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request the reasonable accommodation for religious practices. In all cases, you must put your request in writing. The instructor will review the situation in an effort to provide a reasonable accommodation when possible to do so without fundamentally altering a course. For students, you should first discuss the conflict and your requested accommodation with your professor at the earliest possible time. You or your instructor may also seek assistance from the [Dean of Students Office](http://www.dso.iastate.edu/sa/) at 515-294-1020 or the [Office of Equal Opportunity](http://www.eoc.iastate.edu/) at 515-294-7612.