NEW JERSEY CENTER
FOR TEACHING & LEARNING

Progressive Science Initiative® (PSI®)
CHEM6743: Learning and Teaching Honors Chemistry:
Thermal Chemistry and Acids & Bases

Primary Student Contact:	Dan Reinhold	daniel@njctl.org
Faculty Team:	Dr. Bob Goodman	bob@njctl.org
	Dr. Jayasree Sankar	jayasree@njctl.org
	Rebbeca Barrett	rebbeca@njctl.org
	John Ennis	john@njctl.org
	Dan Reinhold	daniel@njctl.org
	Debra Kalapodakis	debra@njctl.org

Course Credit: 3.0 NJCTL credits

Dates & Times:
This is a 3-credit, self-paced course, covering 9 modules of content. The exact number of hours that you can expect to spend on each module will vary based upon the module coursework, as well as your study style and preferences. You should plan to spend approximately 15 hours per credit working online, and up to 30 hours per credit working offline.

Graduate Student Handbook: www.njctl.org/graduate-handbook/

COURSE DESCRIPTION:
This is the last of three courses which, together, are designed for teachers who are learning the content of PSI Chemistry and how to teach that course to students. The student course is designed to be taught to introductory chemistry students who have taken algebra-based physics prior to this course. This is a mathematically rigorous chemistry course that builds upon foundational topics in physics and leads to a better understanding of biology. Topics include gases, thermochemistry, kinetics & equilibrium, acids & bases, and pH & titration.

STUDENT LEARNING OUTCOMES:
Upon completion of the course, the student will be able to:

1. Demonstrate an understanding of thermal chemistry and acids & bases, detailed in the module learning outcomes below.

2. Integrate PSI materials (including presentations, labs, practice problems, etc.) to support student learning and deliver effective instruction.
3. Create a social constructivist learning environment through the use of formative assessment questions, interpreting the results of this assessment to effectively facilitate student-led discussions that support deeper understanding of the content.
4. Integrate multiple attempts to demonstrate student mastery of content knowledge, as encouraged/fostered by the PSI pedagogy.
5. Implement learning plans that are aligned to NGSS standards and allow for differentiation based on the needs of learners.

TEXTS, READINGS, INSTRUCTIONAL RESOURCES:

Required Texts:

- PSI Chemistry uses a free digital textbook accessible at: https://njctl.org/courses/science/chemistry/
- Participants will download SMART Notebook presentations, homework files, labs, and teacher resources from the PSI Chemistry Course

Recommended Texts:

Cobb, C, Fetterolf, M. (2010). The Joy of Chemistry: The Amazing Science of Things. Amerherst, NY: Prometheus Books. ISBN-13: 978-1591027713

Holton, G. J., Brush, S. G., & Holton, G. J. (2001). *Physics, the Human Adventure: From Copernicus to Einstein and Beyond*. New Brunswick, N.J: Rutgers University Press. ISBN-13: 9780813529080

COURSE REQUIREMENTS:

In order to receive a Passing grade, the participant must complete the following course requirements:

1. Activities: A number of different learning activities will ensure participant engagement and learning in the course. These include:
    - Engage in video module lessons which demonstrate minimized direct instruction followed by frequent formative assessment
    - Completion of formative assessments aligned to learning objectives which include detailed analysis when answered incorrectly.
    - Interaction with module discussion boards that allow conversation with peers and course instructors about the module's content, delivering that content to students. Discussion boards also serve as a place to ask and answer questions related to the module's content.
2. Short Answer Assignment: Each module requires one (1) original response to a given prompt. These prompts are typically based upon course lessons and require teachers to analyze, reflect, and make connections between the module's content and their own classroom practice.
3. Mastery Exercises: For each module, these multiple-choice question quizzes assess the content knowledge gained in a module. Participants have the opportunity to retake; random questions are pulled from a larger question bank on each attempt ensuring varied questions.
4. Virtual Labs: In each module, a virtual lab write-up will be submitted. Virtual Labs are interactive lab simulations that promote a deeper understanding of the content knowledge being learned through real-world applications and analysis.

5. Module Exam: One is completed at the end of each module. It is a culminating exam consisting of multiple choice and free response questions aligned to the standards and objectives of the module.
6. Reflection Paper: At the end of the course, participants are required to reflect on the knowledge taught in the course, make connections, and compare/contrast their current pedagogy with new strategies gained in this assignment.
7. Final Exam: At the end of the course, a comprehensive exam consisting of Multiple Choice and Free Response questions assesses the content knowledge learned throughout the course.

GRADE DISTRIBUTION AND SCALE:

Grade Distribution:

Module Exams	70%
Final Exam	10%
Labs	6%
Short Answer Assignments	6%
Mastery Exercises	6%
Reflection Paper	2%

Grade Scale:

A	93 – 100
A-	90 – 92
B+	86 – 89
B	83 – 86
B-	80 – 82
C+	77 – 79
C	73 – 76
C-	70 – 72
D	60.0 – 69.9
F	59.9 or below

GRADING RUBRIC:

The following rubric is used to score:

- Short Answer Assignment – 6% of grade
- Reflection Paper – 2% of grade

The minimum possible score for this rubric is 4 points, and the score will be converted to the minimum grade available in this module (which is zero unless the scale is used). The maximum score 25 points will be converted to the maximum grade.

Intermediate scores will be converted respectively and rounded to the nearest available grade. If a scale is used instead of a grade, the score will be converted to the scale elements as if they were consecutive integers.

	Meets Expectation	Approaches Expectation	Below Expectation	Limited Evidence
	7 points	***5 points***	***3 points***	***1 point***
Content	• Demonstrates excellent knowledge of concepts, skills, and theories relevant to the topic.	• Demonstrates fair knowledge of concepts, skills, and theories.	• Demonstrates incomplete or insubstantial knowledge of concepts, skills, and theories.	• Demonstrates little or no knowledge of concepts, skills, and theories.
Depth of Reflection	• Content is well supported and addresses all required components of the assignment.	• Content is partially supported; addresses most of the required components of the assignment.	• Content contains major deficiencies; addresses some of the required components of the assignment.	• Content is not supported and/or includes few of the required components of the assignment.
Evidence and Practice	• Response shows strong evidence of synthesis of ideas presented and insights gained throughout the entire course. The implications of these insights for the respondent's overall teaching practice are thoroughly detailed , as applicable.	• Writing is mostly clear, concise, and well organized with good sentence/paragraph construction. Thoughts are expressed in a coherent and logical manner. There are no more than five spelling, grammar, or syntax errors per page of writing.	• Response is missing some components and/or does not fully meet the requirements indicated in the instructions. Some questions or parts of the assignment are not addressed. Some attachments and additional documents, if required, are missing or unsuitable for the purpose of the assignment.	• Response excludes essential components and/or does not address the requirements indicated in the instructions. Many parts of the assignment are addressed minimally, inadequately, and/or not at all.
	4 points	***3 points***	***2 points***	***1 point***
Writing Quality	• Writing is well-organized, clear, concise, and focused; no errors.	• Some minor errors or omissions in writing organization, focus, and clarity.	• Some significant errors or omissions in writing organization, focus, and clarity.	• Numerous errors in writing organization, focus, and/or clarity.

The following rubric is used to score:

- Labs – 6% of grade

The minimum possible score for this rubric is 2 points, and the score will be converted to the minimum grade available in this module (which is zero unless the scale is used). The maximum score of 14 points will be converted to the maximum grade.

Intermediate scores will be converted respectively and rounded to the nearest available grade. If a scale is used instead of a grade, the score will be converted to the scale elements as if they were consecutive integers.

	Meets Expectation	**Approaches Expectation**	**Below Expectation**	**Limited Evidence**
	7 points	***5 points***	***3 points***	***1 point***
Completeness	• Lab write-up is complete with no missing fields.	• Lab write-up has 1-2 missing fields.	• Lab write up has 3-5 missing fields.	• There are more than 5 missing fields on the lab write-up.
Calculations	• All answers are calculated correctly.	• Most answers are calculated correctly, but there are 1-2 minor calculation errors.	• Most answers are calculated correctly, but there are multiple minor calculation errors, or 1-2 gross miscalculations.	• There are calculation errors throughout the lab.

The remaining types of assignments are not scored using a rubric. These assignments are scored using percentage correct to assign a letter grade. The assignments in this manner are as follows:

- Mastery Exercises – 6% of grade
- Module Exams – 70% of grade
- Final Exam – 10% of grade

Mastery Exercises can be retaken as many times as desired to ensure a high score. Due to the nature of these assignments, each time they are taken, they will be composed of unique questions pulled randomly from a larger question bank.

Module and Final Exams are scored using a curve, which allows us to keep content exams rigorous. Module Exams can be retaken one time. Final Exams cannot be retaken.

ACADEMIC STANDING:
NJCTL has established standards for academic good standing within a student's academic program. Students enrolled in any NJCTL online course must receive an 80 or higher to successfully complete a course and receive credit for that course. An 80 is equivalent to a GPA of 2.7 or B-. Additionally, students in an endorsement program must receive a cumulative GPA of 3.0 for all courses combined in order to successfully complete the program.

ACADEMIC INTEGRITY:

Students must assume responsibility for maintaining honesty in all work submitted for credit and in any other work designated by the instructor of the course. Academic dishonesty includes cheating, fabrication, facilitating academic dishonesty, plagiarism, reusing /repurposing your own work, unauthorized possession of academic materials, and unauthorized collaboration.

CITING SOURCES WITH APA STYLE:
All students are expected to follow proper writing and APA requirements when citing in APA (based on the APA Style Manual, 6th edition) for all assignments.

DISABILITY SERVICES STATEMENT:
We are committed to providing reasonable accommodations for all persons with disabilities. Any student with a documented disability requesting academic accommodations should contact the Dean of Students, Melissa Axelsson, for additional information to coordinate reasonable accommodations for students with documented disabilities (melissa@njctl.org).

NETIQUETTE:
Respect the diversity of opinions among the instructor and classmates and engage with them in a courteous, respectful, and professional manner. All posts and classroom communication must be conducted in accordance with the student code of conduct. Think before you push the Send button. Did you say just what you meant? How will the person on the other end read the words?

Maintain an environment free of harassment, stalking, threats, abuse, insults or humiliation toward the instructor and classmates. This includes, but is not limited to, demeaning written or oral comments of an ethnic, religious, age, disability, sexist (or sexual orientation), or racist nature; and the unwanted sexual advances or intimidations by email, or on discussion boards and other postings within or connected to the online classroom.

If you have concerns about something that has been said, please let your instructor know.

CLASS SCHEDULE:

Module	Module Learning Outcomes	Assignments
1 – Gases, Pressure & Temperature	● Describe macroscopic gas behavior (expandable, compressible, low density, gas pressure) using small particle model of a gas. ● Describe the concept of pressure, atmospheric pressure, and gas pressure both macro- and microscopically. Relate pressure units and measure pressure with a barometer and manometer. ● Examine the relationships between pressure, volume, temperature and number of moles to derive and solve problems using four gas laws: Boyle's, Charles's, Avogadro's, Gay Lussac's.	● Short Answer Assignment ● Mastery Exercise
2 – Ideal Gases	● Perform calculations using the ideal gas law equation: PV=nRT. ● Explain the relationship between the number density and mass density for a given gas including quantitative calculations relating mass, MW and density. ● Use Dalton's Law of Partial Pressures to describe	● Short Answer Assignment ● Lab ● Mastery Exercise ● Exam

	the relationship between partial pressure and total pressure . ● Explain Graham's Law of Effusion and use it to determine the molar mass of a gas. ● Explain what the breakdown of the ideal gas law tells us about the assumptions of kinetic molecular theory and apply explanations to make predictions of real vs ideal gas behavior.	
3 - Energy & Enthalpy	● Describe the first law of thermodynamics in terms of changes in internal energy of the universe, system, and surroundings. ● Distinguish endothermic and exothermic processes. ● Describe enthalpy and relate to heat flow at constant pressure. ● Calculate the enthalpy change of a reaction from calorimetric data.	● Short Answer Assignment ● Lab ● Mastery Exercise ● Exam
4 – Heating Curves & Hess's Law	● Describe the change in free energy for a physical or chemical process in terms of entropy and enthalpy changes and calculate free energy at a given Gibbs free energy equation, standard free energies of formation, two or more reactions added together. ● Predict whether a physical or chemical change is spontaneous given the temperature and the enthalpy and entropy changes.	● Short Answer Assignment ● Mastery Exercise ● Exam
5 – Kinetics	● Describe the factors that affect the rate of a reaction. ● Define reaction rate and analyze concentration versus time to determine the rate law for a reaction. ● Define activation energy and describe the relationship between the rate of a chemical reaction and the frequency of reactant molecule collisions. ● Interpret potential energy diagrams to calculate change in enthalpy for a reaction and classify as endothermic or exothermic. ● Describe how a catalyst lowers the activation energy of a chemical reaction.	● Short Answer Assignment ● Mastery Exercise
6 – Equilibrium	● Describe a system at chemical equilibrium. ● Write an equilibrium constant expression for a reversible reaction in terms of reactant and product concentrations or partial pressures and interpret the meaning of k value. ● Describe LeChatelier's principle and predict the shift in equilibrium after a change in pressure, temperature, concentration, or volume.	● Short Answer Assignment ● Mastery Exercise ● Exam
7 – Acids & Bases	● Write the equilibrium reaction for the dissociation of water to produce H3O+ and OH- and, given equilibrium constant expression and experimental value of Kw determine concentrations of H3O+ and OH-. ● Define and describe Arrhenius acids and bases and determine whether a substance is an Arrhenius acid	● Short Answer Assignment ● Mastery Exercise

	or base. ● Define and describe Bronsted-Lowery acids and bases and identify the chemical species that function as the Bronsted acid, the Bronsted base, the conjugate acid and the conjugate base from the molecular equation for an acid-base reaction. ● Define and describe Lewis acid/base model. ● List the six strong acids and eight strong bases and describe the differences between strong/weak acids and strong/weak bases.	
8 – pH & Titration	● Calculate pH, pOH, [H3O+], and/or [OH-] concentration for a solution given one of the values. ● Define and describe buffer solutions and identify two necessary components of a buffer.	● Short Answer Assignment ● Lab ● Mastery Exercise ● Exam
9- Reflection & Final Exam	● Zoom meeting with instructor, as needed	● Discussion Board ● Reflection Paper ● Final Exam