General Education Foundations of Scientific Inquiry (FSI) Course Information Sheet

Please submit this sheet for each proposed course along with 1) a syllabus describing the key components of the course that will be taught regardless of the instructor and 2) assignment guidelines.

Department, Course Number, and Title Chem. & Biochem. 14BE, Gen. Chem. for Life Scientists II - Enhanced

Indicate when the department anticipates offering this course in 2020-21 and give anticipated enrollment:

Fall: Enrollment ____ Winter: Enrollment 250 Spring: Enrollment ____ Summer: Enrollment _____

As stated in the guidelines regarding courses in the Foundations of Scientific Inquiry (FSI), the aim of these course offerings is:

To ensure that students gain a fundamental understanding of how scientists formulate and answer questions about the operation of both the physical and biological world. These courses also deal with some of the most important issues, developments, and methodologies in contemporary science and technology, addressing such topics as the origin of the universe, environmental degradation, and the decoding of the human genome. Through lectures, experiential learning opportunities such as laboratories, writing, and intensive discussions students consider the important roles played by the laws of physics and chemistry in society, biology, earth and environmental sciences, and astrophysics and cosmology.

General Education FSI Student Goals: Courses fulfilling the GE FSI will provide a minimum of four units and should align with some (not necessarily all) of the following seven general goals:

1. Students will actively engage in the scientific process of inquiry, analysis, problem-solving, and quantitative reasoning.
2. Students will acquire an informed appreciation of scientists, scientific research, and technology.
3. Students will experience the interdisciplinary nature of science.
4. Students will develop information literacy.
5. Students will make evidence-based decisions in a wide array of science and non-science contexts.
6. Students will develop scientific literacy by addressing current, critical issues and topics in science that are personally meaningful in daily life and/or connected to the needs of society.
7. Students will recognize fundamental scientific principles and the connections between different domains of science.

General Education FSI Student Learning Outcomes: Each course should have student learning outcomes listed in the syllabus. These outcomes may be tied to a specific discipline but should be associated with the seven broad categories listed above (please see **Appendix I** for a sample list of possible learning outcomes supporting each goal).

General Guidelines for GE FSI Courses: GE Courses may be upper or lower division, but they should have no prerequisites. Any student should be able to take them and understand the material with the background expected from all UCLA students. While the course may include material related to the history of science and the social and cultural implications of scientific research, **at least half** of the course should be devoted to students actively engaging in the scientific process of inquiry, analysis, problem-solving, and quantitative reasoning (Goal #1).

Please indicate the area/s which you believe this course should satisfy.

Life Science: [ ] Physical Science: [x] Life Science Lab*: [ ] Physical Science Lab*: [ ]

**Please see the additional student learning outcomes and expectations for courses approved as GE FSI Labs.*

The GE FSI Assessment Project Resource Team would be delighted to meet with you to assist in filling out this form. Please contact us at RRamachandran@teaching.ucla.edu if you wish to arrange a meeting.

We are interested in understanding the alignment of your course learning outcomes with the GE FSI learning goals. First, identify measurable learning outcomes from your course and enter them in the first column of Table 1. You may add more rows as needed. If you need to state new learning outcomes, see Appendix I for a sample list of possible learning outcomes supporting each goal. Should you wish to choose any of these outcomes, you may simply indicate its number, e.g., 6a. Next, indicate how your learning outcomes relate to the GE FSI learning goals 1 through 7 (see previous page), by placing X's in the appropriate boxes. Note that all GE FSI courses must address Goal #1.

Table 1: Alignment of Course Learning Outcomes with GE FSI Learning Goals

	Your Course Learning Outcomes	**Select GE FSI Goal #**						
		1	**2**	**3**	**4**	**5**	**6**	**7**
1	Use concepts in thermodynamics to determine which chemical and physical processes occur spontaneously.	x	x	x	x	x	x	x
2	Use equilibrium constants to predict the extent of chemical reactions.	x	x	x	x	x	x	x
3	Apply concepts in acid-base chemistry to predict pH and the ionization states of acids and bases.	x	x	x	x	x	x	x
4	Explain the nature of redox reactions, calculate redox potentials, and predict redox reaction spontaneity.	x	x	x	x	x	x	x
5	Use the concepts of chemical kinetics to calculate rates and analyze mechanisms of chemical reactions.	x	x	x	x	x	x	x
6								

Considering each of the GE FSI goals that you marked with X's in the table above, please provide information about related course activities and assignments.

Table 2: Course Activities and Assignments that Support the Learning Goals

Course Learning Outcome No. from Table 1	**Course Activities** How will progress towards meeting this outcome be facilitated? In other words, what types of course activities will be provided to assist students in achieving the learning goal?	**Course Assignments** How will students in the course demonstrate their ability to meet this goal? Please describe and provide a sample assignment, such as a term paper, exam, essay prompt, etc.
1	Please see attached table 2	
2		
3		
4		
5		
6		

Please provide information on estimated weekly hours for the class.

A) STUDENT CONTACT PER WEEK (if not applicable write N/A)

Activity	Number of hours per week
Lecture	3
Discussion Section	2
Labs	
Experiential (Community-engagement, internships, other	
Field Trips	
A) TOTAL student contact per week	5

B) OUT-OF-CLASS HOURS PER WEEK (if not applicable write N/A)

Activity	Number of hours per week
General Review and Preparation	1
Reading	2
Group Projects	
Preparation for Quizzes & Exams	2
Information Literacy Exercises	
Written Assignments	2
Research Activity	
B) TOTAL Out-of-class time per week	7

GRAND TOTAL (A) + (B) must equal 12 hours/week: 12 (hours)

Please note the following:

- If you're teaching a lab, your course should be 5 units and should entail 15 hours of work/week.
- If you're teaching a summer course, your aggregated total hours should be 120 (for non-lab courses) or 150 (for lab courses). For instance, if you're teaching a 5 week lab your total in-class and out-of-class time per week should equal 30 hours.

Additional Student Learning Outcomes for experiential learning courses approved as "GE FSI Labs"

GE FSI Lab Definition and Expectations: A hands-on laboratory, computer simulation, demonstration, or field experience that involves active participation in experimental observation, data generation and collection using the techniques, methodologies, and approaches of modern-day scientists. Any lab should be conducted under sufficient supervision by the instructor or a Teaching Assistant (TA). Furthermore, the instructor and TAs should meet regularly outside of class time (minimum weekly or biweekly) to practice performing the lab procedures and/or to review the experimental results.

Please <u>select one or more</u> of the following learning outcomes for your course (select all that apply):

☐ 1. Students will design, implement, and evaluate an experimental strategy for answering scientific questions, testing a hypothesis, or solving a problem.

☐ 2. When possible, students will replicate experiments to allow testing for and interpretation of statistical significance.

☐ 3. Students will apply commonly used mathematical concepts and statistical methods (e.g., basic addition, subtraction, multiplication, division, averages, standard deviation, t-test for significance) in their analysis of different types of scientific data they collect.

☐ 4. Students will be able to visually depict a quantitative dataset as a chart, graph, table, or mathematical equation.

☐ 5. Students will be able to concisely summarize trends and patterns deduced from quantitative and qualitative data to make informed conclusions about their experimental results.

☐ 6. When interpreting their results, students will distinguish between the most important and extraneous findings (i.e. identify those that are critical to addressing a question, solving a problem, or supporting/refuting a hypothesis).

☐ 7. When interpreting their results, students will infer relationships between controls and experimental variables as well as assess causality and correlation among variables.

☐ 8. Students will be able to troubleshoot experimental procedures or methods of analysis to develop a sound scientific rationale for deducing what went wrong and why.

Please present concise explanation of how your course satisfies these criteria.

How will students in this course actively experiment and engage in the hands-on process of gathering, analyzing, and interpreting data? How will progress towards meeting the student learning outcomes for "labs" be measured/assessed? In other words, what types of assignments will be given to determine whether students are achieving the learning outcomes?	

Appendix I. Student Learning Goals with Nested Learning Outcomes for All General Education (GE) Foundations in Scientific Inquiry Courses

Course Goals (1-7) and Student Learning Outcomes (a, b, c, etc.) for all "GE FSI" courses:

1. Students will actively engage in the scientific process of inquiry, analysis, problem-solving, and quantitative reasoning.
   a. Students will explain how scientists answer scientific questions, test a hypothesis, or solve a problem.
   b. Students will make reasonable predictions of experimental outcomes based on observation, measurements, and/or prior knowledge surmised from the scientific literature or other reliable, validated, accurate information sources.
   c. Students will break down, reason through, and solve complex quantitative problem sets.
   d. Students will be confident working with numerical data.
   e. Students will estimate and complete calculations to solve a quantitative problem.
   f. Students will recognize different objects and apply units of measurement at relevant scales (quantity, size, time) and orders of magnitude.
2. Students will acquire an informed appreciation of scientists, scientific research, and technology.
   a. Students will value their academic experiences in a science course that is outside their primary field of study.
   b. Students will recognize the benefits of science to society or their everyday life.
   c. Students will express interest in contributing to the sciences (e.g., engaging in research or scientific discourse with others).
   d. Non-science students will see scientists as role models, helping them to identify as scientists themselves.
3. Students will experience the interdisciplinary nature of science.
   a. Students will investigate topics from a variety of scientific fields.
   b. Students will explore the perspectives of multiple diverse scientists.
   c. Students will make logical connections between key concepts from multiple scientific disciplines.
4. Students will develop information literacy.
   a. Students will be mindful of information they encounter, recognizing contexts or situations when it is necessary to seek out other sources or data.
   b. Students will identify, locate, and critically evaluate information sources and datasets to ensure they are reliable, validated, accurate, and scholarly (i.e. associated with citations in peer-reviewed, public research studies).
   c. Students will explain the peer-review process in science and its role in critical evaluation and validation of published, scientific findings.
5. Students will make evidence-based decisions in a wide array of science and non-science contexts.
   a. Students will distinguish between opinion and fact (i.e. recognize data-supported conclusions).
   b. Students will use reliable, validated, accurate, and scholarly information sources and datasets before accepting or formulating a conclusion.
   c. Students will draw conclusions or make judgements about experimental results informed by critical thinking, that is, a comprehensive exploration of ideas and systematic engagement with the scientific process.
6. Students will develop scientific literacy by addressing current, critical issues and topics in science that are personally meaningful in daily life and/or connected to the needs of society (e.g., climate change, vaccination, GMOs, evolution).
   a. Students will clearly state the significance or relevance of a research question or problem (i.e. state why scientists are motivated to study the issue or topic).
   b. Students will discuss societal impacts by citing examples of the ways in which scientists and scientific research contribute to society.
   c. Students will describe the interactions between humans and their physical world and the positive and negative effects of this interaction.
   d. Students will explain why issues perceived as "controversial" in the public domain are not considered "controversial" in among scientists.
7. Students will recognize fundamental scientific principles and the connections between different domains of science.
   a. Students will describe the nature, organization, and evolution of living systems.
   b. Students will explain the origin and physical processes of the planet earth and the surrounding universe.
   c. Students will differentiate between a scientific theory, hypothesis, fact, or law.

Table 2: Course Activities and Assignment that Support the Learning Goals

Course Learning Outcome	Course Activities	Course assignments
1–5	All learning outcomes will be facilitated by the following activities: • Thrice-weekly lectures. About half the lecture time will be devoted to presentation by the instructor. The remaining time will be spent in active and collaborative learning activities such as responding to and reflecting on polling questions and working with classmates to solve problems. • Weekly 2-hour discussion sections will use the "Process Oriented Guided Inquiry Learning (POGIL)" model in which students work together in assigned groups of four with assigned roles. The groups work on scaffolded worksheets designed around an "explore, invent, apply" learning cycle. • Students complete pre-class reading assignments and video watching assignments to help them acquire basic vocabulary prior to class and discussion. • Students engage in writing assignments with peer evaluation.	The class will contain a variety of formative and summative assessments. These include • POGIL worksheets turned in weekly by discussion section groups. A sample POGIL worksheet is attached. • Pre-discussion and pre-class quizzes to help student come to class prepared to engage in collaborative learning. • Weekly homework submitted through the textbook web site to further hone problem solving skills. • Several writing activities, which will be subjected to peer review using instructor-designed rubrics. • Two midterm exams with both individual and collaborative components. • A conventional final exam.

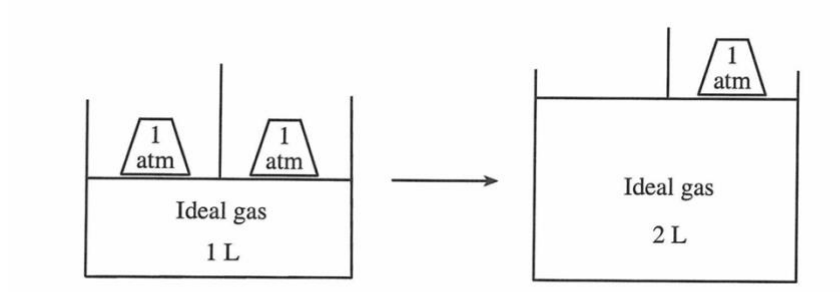
CHEMISTRY AND BIOCHEMISTRY 14BE

POGIL Worksheet #2: Work, heat, internal energy and the first law of thermodynamics
Each discussion group's recorder should turn in answers to all the focus questions, critical thinking questions, and exercises by 5 PM on Thursday afternoon. Please write the answers on your own paper and submit through the Worksheet 2 assignment activity in Gradescope.

PART I: EXPANSION WORK
Learning Objectives

- **Define work**
- **Explain the difference between reversible and irreversible paths**
- **Calculate expansion work for reversible and irreversible paths**

Focus question for Part I: Is there any work done in the process illustrated on the right? If not, why not? If so, is work done by or on the system?



Information: *Work is not a form of energy.* Rather *it is a way of transferring energy* between a system and its surroundings. We never talk about how much work a system has. Rather we talk about how much work is done in the process of going from one thermodynamic state to another thermodynamic state. Therefore, work is a *process function* or a *path function*, not state function.

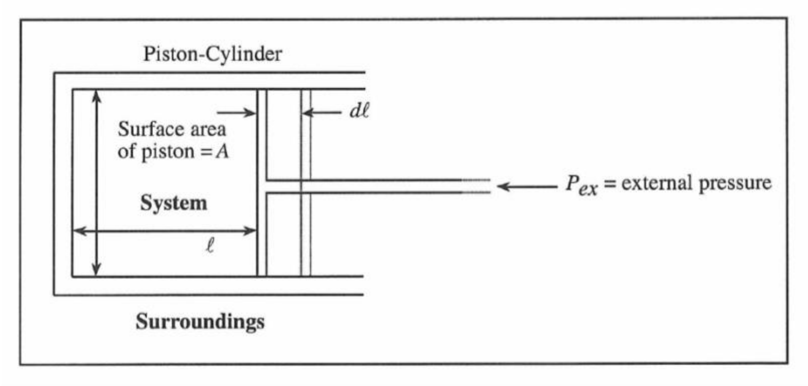
The form of work that we will focus on most in this class is *expansion work* (or pressure-volume work), which is a form of *mechanical work*. Another form of work that we will learn about later in the course is electrical work.

Mechanical work is defined by the equation: $$work = force \times distance \qquad (1)$$

In other words, as a force acts on an object, the amount of work done is the force times the distance through which the object moves as a result of that force. There are many forms of mechanical work such as the work required to push an object along a surface in opposition to the force of friction, the work required to raise a weight in opposition to the force of gravity, the work required to stir a viscous liquid, and the work that occurs as a substance increases in volume (expands) and pushes against the atmosphere. When thinking about expansion work, rather than treating work as force acting on an object to move it through space, it is more convenient to treat work as pressure operating on a system to change its volume.

In chemistry, work done on the system is considered to be positive; but when the system does work on the surroundings, the work is negative. This sign convention was chosen for a very good reason, which is that work done on the system increases the energy of the system, while work done by the system decreases the energy of the system. Despite the apparent logic of this convention, it is not universal: in physics, work done on the system is considered to be negative. Since this is a chemistry course, we will stick with the chemistry sign convention, in which work done on the system is considered to be positive.

Model 1: Work associated with expansion or compression of a gas at constant external pressure



$$\frac{force}{area} = external\ pressure;\ \frac{f}{A} = P_{ex} \qquad (2)$$

Critical thinking questions:

1) If the gas in the system in Model 1 expands, is the work positive or negative? Explain.
2) Say ℓ, the distance between the left wall and the movable wall of the system changes by an infinitesimal distance $d\ell$. Provide an expression relating the infinitesimal work, dw, to $d\ell$ and the force, f. Make sure that the sign convention described above is followed.
3) Combine your answer to the above question with equation 2 to relate the infinitesimal work, dw, to the external pressure and the infinitesimal change in volume, dV.

Information: When the piston in Model 1 moves from an initial position ℓ_i to a final position ℓ_f, the volume of the system changes from V_i to V_f. The work done during this process is:

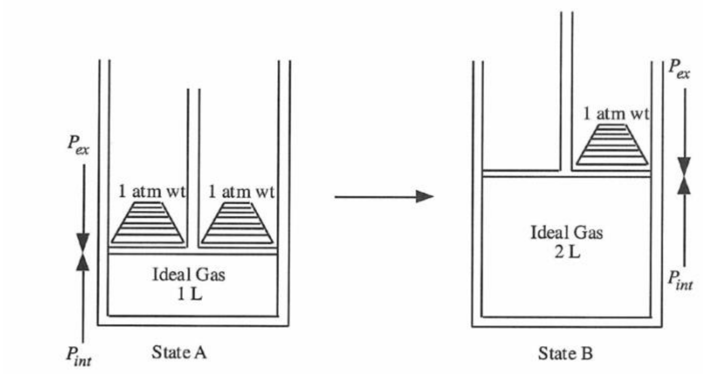
$$work = w = \int_{V_i}^{V_f} dw \qquad (3)$$

4) Derive an equation describing the relationship between work, w, and the change in volume (ΔV) for a process taking place at constant P_{ex}. (Hint: Use equation (3), your answer to CTQ3, and the following mathematical relationship: $\int adx = a \int dx = ax + constant$, where a is a constant.)

Information: There are a number of different circumstances under which gaseous systems can undergo changes. Examples are:

- Expansion or compression occurring against constant pressure.
- Expansion or compression of a gas in a process where all intermediate states are in equilibrium. This is known as a reversible process.

Model 2: Work associated with reversible expansion or compression of an ideal gas:



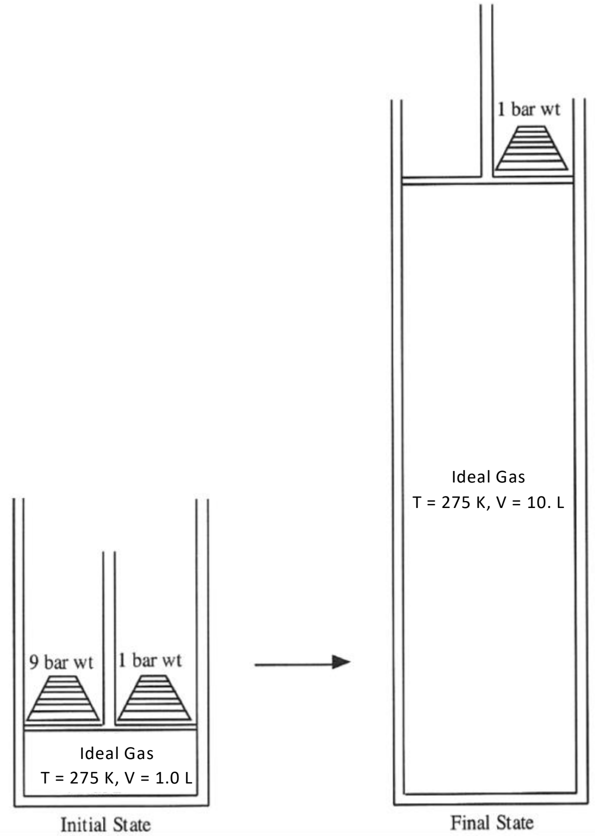
For each of states A and B, the external and internal pressures are equal; that is, the systems are at mechanical equilibrium. Both states contain the same number of moles of gas. One possible way to get from state A to state B would be to remove one of the 1 atm weights.

Critical Thinking Questions

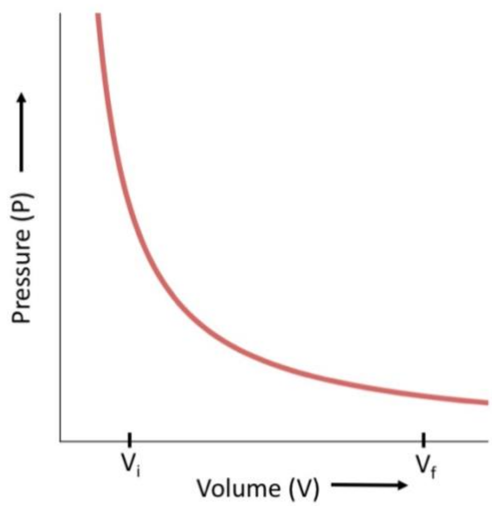
5) Based on the descriptions of states A and B in Model 2, are the two systems at the same temperature? If not, which one is at a higher temperature? Explain your reasoning?
6) What is the relationship at all times between P_{ex} and P_{int} for a reversible process?
7) Consider the removal of one of the 1 atm weights from the piston in state A:
   a) Is the system at equilibrium at the moment that the weight is removed? When the weight is removed what will happen?
   b) Does the process you described in a) occur against a constant external pressure? If so, what is this pressure?
   c) Is an equilibrium state (one in which $P_{ex} = P_{int}$) ever reached as the system changes from state A to state B? Explain.
8) Suggest a hypothetical way to get from state A to state B via a reversible process – that is, such that $P_{ex} = P_{int}$ at all times. (Hint: You can divide the weights shown in Model 2 into infinitely small pieces). Could this hypothetical path ever occur in the real world?
9) Use the ideal gas law and your answer to CTQ3 to obtain an expression relating dw to dV for a reversible expansion or compression of an ideal gas. (Hint: since $P_{ex} = P_{int}$, you can replace P_{ex} with P_{int} and then you can use the ideal gas law to replace P_{int} with an expression in terms of V, n, T, and R.)
10) Integrate both sides of the expression from CTQ9 treating all the variables except V as constants to obtain an expression that relates the work to the initial and final volumes for an isothermal reversible process. (Hint: You will need the following formula from integral calculus: $\int a\frac{dx}{x} = a\int\frac{dx}{x} = a\ln x + constant$, where a is a constant.)

Exercises

1) Consider the process illustrated on the right. Assume that the system is at equilibrium in the initial and final states.
   a) Calculate the work if the process is carried out reversibly and isothermally.
   b) Calculate the work if the process is carried out irreversibly in one step.
   c) Imagine that the 9 bar weight was cut into two 4.5 bar pieces and then the expansion occurred via the following two-step pathway. In the first step, one 4.5 bar piece was removed and the piston was allowed to expand until a new equilibrium was reached. Then in the second step the other 4.5 bar piece was removed and system was allowed to expand until the illustrated final state was reached. Calculate the work for this path.
   d) Will the work on the surroundings increase or decrease as the 9 bar weight is subdivided into smaller and smaller pieces, which are then removed one at a time? Explain your reasoning.



2) A graph of the volume versus the pressure of an ideal gas under isothermal conditions is shown on the right. (This is the graph of the ideal gas law assuming constant n and T).
   a) Indicate the region of the graph (with shading or hash marks) that represents the graphical equivalent of the amount of work done on the surroundings during a reversible isothermal expansion from V_i to V_f.
   b) Let's say that the gas expands irreversibly from the same initial to the same final volume against a constant external pressure of P_f, which is the pressure of the gas at V_f. Indicate the region on the graph that represents the graphical equivalent of the amount of work done on the surroundings during this expansion.
   c) How do we know that the work done on the surroundings by the reversible expansion is the maximum expansion work that can be done by the system in going form V_i to V_f?
   d) Based on your answers parts and b, decide if work is a state function or a path function. Explain your answer.



PART II: HEAT AND HEAT CAPACITY

Learning Objectives:

- Define heat and heat capacity
- Relate temperature changes, heat transfer, heat capacity and calorimetry measurements

Focus question for part II: Say we have a hot brick and we toss it into bucket of cold water. Will there be a transfer of energy between the brick and the water? If so, in which direction will energy transfer occur? When will the transfer of energy stop?

Information: Like work, *heat (represented by the symbol q) is not a form of energy*. Rather it *is a way of transferring energy* between a system and its surroundings. Sometimes, to make this clear, we talk about "heat transfer" rather than "heat", or we say that "energy is being transferred as heat". Heat transfer occurs when the system and its surroundings (or any two bodies in contact with one another) are at different temperatures. In this case, energy always flows as heat from the higher temperature to the lower temperature body, until the two bodies are at the same temperature at which point thermal equilibrium has been reached.

Model 1: Say you are outside on a cold winter day and your hands (which we will consider to be the system) are uncomfortably cold. You can warm them up in one of the following two ways: (a) you can vigorously rub them together, or (b) you can hold them over a heater.

Critical thinking questions:

1) Assuming that both (a) and (b) in model 1 increase the temperature of your hands by the same amount, is q the same or different for these two processes? If different, which process has the greater value of q?
2) Based on model 1 and your answer to CTQ1, are temperature and heat the same or different? Explain your answer.
3) Based on model 1 and your answer to CTQ1, is heat a path function or a state function? Explain your answer and state any assumptions you made in answering this question.

Information: The higher the heat capacity of a system, the more heat that is required to raise the temperature of the system by a given amount. In particular, the heat capacity of a system (C) is the amount of heat transfer required to raise the temperature of the system by 1 K or 1 ˚C and defined by the equations:

$$q = C\Delta T \qquad \text{or} \qquad C = \frac{q}{\Delta T}$$

Molar heat capacity (C_m) is the amount of heat transfer required to raise the temperature of one mole of a substance by 1 K or 1 ˚C, while specific heat capacity (C_s) is the amount of heat transfer required to raise the temperature of 1 g (or sometimes 1 kg) of a substance by 1 K or 1 ˚C. C_m and C_s are defined by the following equations:

$$q = nC_m\Delta T \qquad\qquad q = mC_s\Delta T$$

Note that C_m and C_s are temperature-dependent, but for many substances the variation with temperature is small enough that we can treat them as temperature-independent over narrow temperature ranges.

Model 2: Temperature rise observed when 20 J of energy is transferred to 1 mol of various substances at 25 ˚C and 1 bar pressure

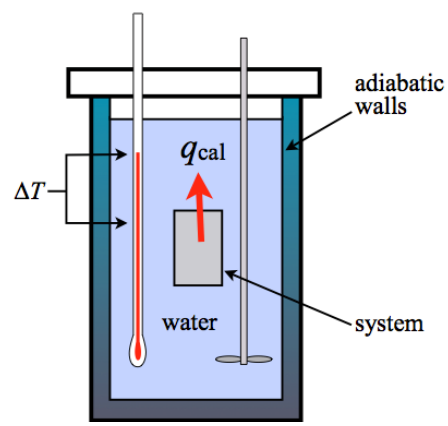
Substance	ΔT (K)
Ne(g)	1
N_2(g)	0.7
CH_4(g)	0.6
H_2O(l)	0.3

Critical thinking questions

4) Rank the four substances in Model 2 from highest to lowest molar heat capacity. Explain your reasoning.
5) Use the data in Model 2 to calculate the molar heat capacity of liquid water. Be sure to give the correct units.
6) Use the data in Model 2 to calculate the specific heat capacity of liquid water. Be sure to give the correct units.

Information: As substances undergo chemical reactions, heat can either be released into the surroundings, in which case q is negative and the reaction is said to be exothermic, or absorbed from the surroundings, in which case q is positive and the reaction is said to be endothermic. Heats of chemical reactions are measured by a technique known as calorimetry using a device known as a calorimetry

Model 3: A simple calorimeter, illustrated on the right, contains a sample chamber in which a reaction is allowed to occur (the system). The sealed sample chamber is immersed in water, and, as the reaction occurs, the release or absorption of heat changes the temperature of the calorimeter. The temperature change is combined with the heat capacity of the calorimeter to determine the heat of the reaction.



Critical thinking questions

7) Would exothermic reactions be expected to increase or decrease the temperature of the calorimeter. Explain your answer.
8) Before you can use a calorimeter, you need to calibrate it by determining it's heat capacity. This is done by carrying out a calibration reaction with a known heat of reaction (which we'll call q_{cal}) in the calorimeter and then measuring the resulting temperature change. Write an equation for the heat capacity of the calorimeter (C_{cal}) in terms of q_{cal} and the temperature change. Heat capacities are always positive, so make sure your equation will give a positive number.
9) Once you've calibrated your calorimeter you can carry out a reaction with an unknown heat of reaction in the calorimeter and measure the resulting temperature change. Write an equation for the heat absorbed or released by this reaction (q) in terms of C_{cal} and the temperature change. Make sure you that your equation will generate a negative value of q for an exothermic reaction and a positive value of q for an endothermic reaction.
10) Normally we want to report heats of reaction in units of J/mol or kJ/mol of the substance undergoing reaction. We'll call this the molar heat of the reaction (q_m). Write an equation for q_m in terms of q, m (the mass of the substance reacted), and M (the molar mass of the substance reacted).

Exercises

1) A 100. g piece of copper (C_s = 0.385 J·g^{-1}·K^{-1}) at 20.0 ˚C is dropped into 100. g of water (C_s = 4.184 J·g^{-1}·K^{-1}) at 100. ˚C. Heat is transferred from the water to the copper until thermal equilibrium is reached.
   a) Do you expect the final temperature to be closer to the initial temperature of the copper or the initial temperature of the water. Explain your answer.

b) Express the heat transfer to the copper in terms of the mass of the copper, the specific heat capacity of the copper, the initial temperature of the copper, and the final temperature.
c) Express the heat transfer to the water in terms of the mass of the water, the specific heat capacity of the water, the initial temperature of the water, and the final temperature.
d) Assuming no heat is gained or lost by the surroundings, the heat gained by the copper equals the heat lost by the water. Use this fact to determine the final temperature. Does the calculation agree with your prediction in part a?

2) Two different substances, one with a known and one with an unknown molar heat of combustion, were allowed to undergo combustion in a calorimeter with the following results:

Substance	M (g/mol)	Mass (g)	q_m (kJ/mol)	ΔT (K)
Benzoic acid	122.12	10.0	−3227	+5.20
X	113.70	5.00	Unknown	+3.82

Calculate the molar heat of combustion of substance X

PART III: THE FIRST LAW OF THERMODYNAMICS

Learning objectives:

- Define internal energy
- Using the first law of thermodynamics, relate changes in internal energy to work and heat.

Focus question for part III: If an isolated system contains 100 J of energy, how much energy will it contain in 100 years?

Information:

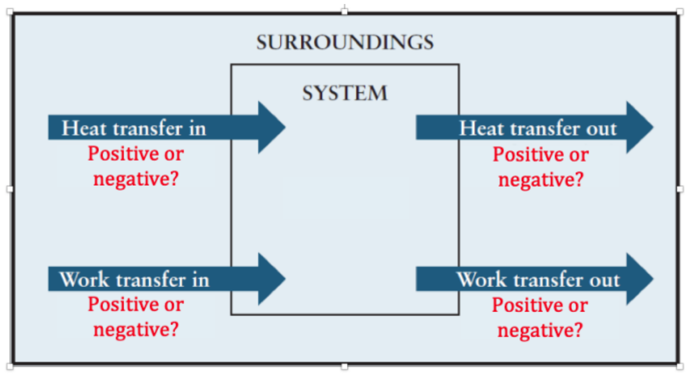
Internal energy: In thermodynamics, the **internal energy** (**U**) of a system is the energy contained within the system and is the energy necessary to create the system. It includes the kinetic energy due to the translational, rotational, and vibrational motion of the particles (molecules, atoms, ions, and subatomic particles) relative to the reference frame of the system. It also includes the potential energy due to the interactions between these particles, such as the energy due to intermolecular interactions, bond energy, and nuclear energy. Internal energy does not include the kinetic energy due to motion of the system as a whole relative to external reference frames, nor the potential energy of the system as a whole due to external force fields.

The internal energy of a system depends only on the current state of the system (i.e., the current values of all the state functions), and therefore, **internal energy is itself a state function**. Consequently, the change in internal energy in going from one state to another state depends only on the initial and final states and not on the path between these two states.

The only ways to change internal energy of a closed system are through **heat** and **work.** As you've learned, neither of these are forms of energy, but instead they are types of energy flow (i.e., ways of transferring energy between a system and the surroundings.

The first law of thermodynamics: This law states that **"The internal energy of an isolated system is conserved."** Since the universe is an isolated system, this is equivalent to the law of the conservation of energy. The first law is a "law of experience". It cannot be derived from any fundamental principle, but no experiment has ever been devised that contradicts this law and so we accept it as universally valid.

Model 1: A closed system and its surroundings: the four arrows represent four ways of changing the internal energy of a closed system

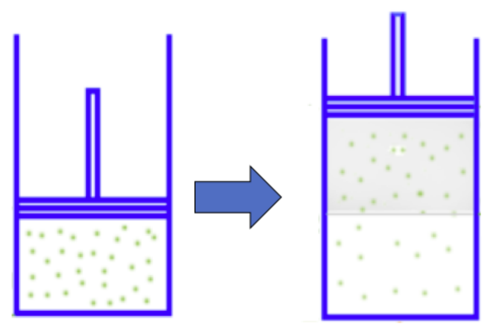


Critical thinking questions:

1) Indicate whether each of the four arrows in model 1 is associated with a positive or a negative value of the indicated path function according to the conventions used in chemistry. Why do you think chemists chose these particular sign conventions?
2) Write a mathematical equation that relates the internal energy change of a thermodynamic system (ΔU) to the heat (q) and the work (w), keeping in mind the sign conventions you gave in your answer to CTQ1. This equation is considered to be the mathematical statement of the first law of thermodynamics.
3) As mentioned earlier, physicists often use the opposite sign convention for work than the one usually used by chemists. This changes the mathematical statement of the first law. Write the equation that represents the physicists version of the mathematical statement of the first law. This form of the first law is frequently encountered (for example, see the Wikipedia entry on the first law of thermodynamics), but we won't be using it since we're sticking with the chemistry sign conventions.
4) Show how the equation that you wrote in CTQ2 can be simplified in the case of adiabatic processes.
5) Show how the equation that you wrote in CTQ2 can be simplified in the case of isochoric processes.

Information: For an ideal gas, the temperature is directly proportional to the average translational kinetic energy of the gas particles. Translational kinetic energy is given by the equation $P_K = \frac{1}{2}mv^2$, and therefore temperature is proportional to the mean square velocity of the gas particles in an ideal gas.

Model 2: Expansion of a gas. As a gas expands, the average distance between the gas molecules increases. This could result in a change in the intermolecular interactions and therefore in the potential energy of the gas. Remember that the internal energy is the sum of the potential energy and the kinetic energy of the particles comprising the system.



Critical thinking questions:

6) As ***gas*** expands, what happens to the average distance between the gas particles? Would this be expected to change the internal energy of a real gas? What about an ideal gas? Explain your answer.
7) As an ideal gas expands under isothermal conditions (or undergoes any isothermal process), do we expect a change in the kinetic energy of the gas particles? Explain your answer.
8) Do we expect a change in the internal energy for the isothermal expansion of an ideal gas, or for any isothermal ideal gas process? Explain your answer.
9) As the temperature of an ideal gas increases, will the internal energy increase, decrease, or stay the same? Explain you answer.
10) Will the adiabatic expansion of an ideal gas change the temperature of the system? If so, will the temperature increase or decrease? Explain your answer.

Exercises

1) Imagine 0.010 mol of an ideal monoatomic gas undergoing expansion from 1.0 L to 2.0 L by the different paths described below. For each case determine q, w, and ΔU (in joules) and say whether the temperature will increase, decrease, or stay the same.
   a) The expansion occurs against a vacuum. The container has diathermic walls and is immersed in a constant temperature water bath held at 25 ˚C.
   b) The expansion occurs against a vacuum. The container has adiabatic walls.
   c) The expansion occurs reversibly. The container has diathermic walls and is immersed in a constant temperature water bath held at 25 ˚C.
   d) The expansion occurs against a constant external pressure of 0.10 atm. The container has adiabatic walls.
2) Consider a system consisting of 2.00 mol of Ne(g). Assume the system exhibits ideal behavior.
   a) In one experiment, the gas is heated isobarically. The initial and final conditions are:

	Temperature	Volume
Initial	200. K	0.0200 m^3
Final	400. K	0.0400 m^3

   If the molar heat capacity of Ne(g) under the conditions of this experiment is 20.8 $J{\cdot}K^{-1}{\cdot}mol^{-1}$, what are the heat, work, and internal energy change for this process?

   b) In another experiment, the same transition occurs in the following two steps:
   Step 1: The gas is heated isochorically from 200. K to 400. K.
   Step 2: Then the gas is allowed to expand adiabatically against a vacuum to a final volume of 0.0400 m^3.

   What is the final temperature after step 2? What are the heat, work, and internal energy change for the overall two-step process. What is the molar heat capacity of Ne(g) during step 1?

Chemistry and Biochemistry 14BE
General Chemistry for Life Scientists II - Enhanced

COURSE DESCRIPTION AND LEARNING OUTCOMES

This class will introduce concepts in physical chemistry that are critical for an understanding of the molecular basis of life. This includes concepts in thermodynamics, which are required to predict what chemical reactions will occur spontaneously as well as concepts in kinetics, which are required to predict reaction rate. ***The five basic units of this course, along with the learning objectives associated with each unit, are as follows:***

- **Thermodynamics**: By the end of the course, you should be able to use concepts in thermodynamics such as enthalpy, entropy, and free energy to predict which physical transformations and chemical reactions will occur spontaneously under any given set of conditions.
- **Chemical equilibria**: By the end of the course you should be able to explain the nature of the equilibrium constant and use equilibrium constants to predict the extent of chemical reactions.
- **Acid-base equilibria:** By the end of the course you should be able to apply concepts of acid-base chemistry to predict such things as pH and the ionization state of acids and bases.
- **Redox chemistry:** By the end of the course you should be able to explain the nature of redox reactions, calculate redox potentials, and use redox potentials to calculate the equilibrium constants of redox reactions.
- **Chemical kinetics:** By the end of the course you should be able to use the concepts of chemical kinetics to calculate the rates of chemical reactions and explain how catalysts can influence the rates of chemical reactions.

Course organizational details

- **Instructor**: Albert Courey
- **Class time and location**: 1 hour MWF, time and location TBD
- **Teaching assistants**: TBD
- **Instructor's and TA's Office Hours**: TBD
    - The office hours are distributed throughout the week so that all students can find office hours that fit their schedule. Attendance is strongly encouraged. Office hours provide a great opportunity to ask questions about the course materials, work through the problems, and get to know your instructor, TAs, and fellow students.
- **Course web site:** All course materials (including PowerPoints, worksheets, and online quizzes) will be posted here. ***You should check it several times a week.*** Your grades will also be available through this web site.
- **Webcasts:** Webcasts of the class sessions will be available through Bruincast. A link to the webcasts can be found on the course web site. The discussion sections will not be webcast.
- **Correspondence:** This course will use https://piazza.com/ for any course-related questions/discussions. Piazza is a discussion forum that will allow you to quickly get your questions answered as well as answer or comment on other students' questions. Rather than email a general course-related or content-related question to your instructor or TA, you are encouraged to post your question to Piazza instead. Piazza is FERPA (Family Education Rights and Privacy Act) compliant and you can post anonymously. If you have

any personal matters you wish to discuss that should be handled privately, please email the instructor directly.

Discussion sections

- **Times and locations**: Each student is assigned to a weekly two-hour discussion section
- **Discussion section activities:** During discussion section, students will work in teams on highly structured worksheets that explore more in-depth coverage of course topics and that hone your problem-solving skills. Each week, one of your teammates (the recorder) will upload the team's worksheet onto Gradescope. Additionally, one of your teammates (the reflector) will complete a short survey on CCLE each week.

Attendance

- **Lecture attendance:** Attendance at all lectures is strongly encouraged. The lectures include active learning activities for which participation points will be awarded. But to get these points you must be in attendance.
- **Discussion section attendance:** Attendance at two-hour weekly discussion sections is required. Working with your classmates on the challenging weekly worksheets is the best way to learn and prepare for the exams.

GE Credit Acknowledgment

Upon successful completion of this course, students will satisfy one General Education course requirement in the Foundations of Scientific Inquiry area, physical sciences subgroup.

Textbook

Chemical Principles: the Quest for Insight by Atkins, Jones, and Laverman. The 7th edition is preferred, but if you already own the 6th edition, you don't need to buy the 7th edition. The reading assignments from the text are given in the Class Schedule at the end of this syllabus.

- Reading the textbook is important for a number of reasons including the following:
  - By reading the assignments prior to the class for which they are assigned, you will come to class better prepared to participate and to absorb the material I present in class.
  - By re-reading the assignments after the class for which they are assigned, you will reinforce what you learned in lecture.
- The textbook is available in multiple formats including e-book, hardcover, and loose leaf, all of which are fine. Multiple copies of this book are on reserve in Powell library.
- The textbook contains hundreds of problems. Every week I will post the numbers of recommended problems that you are encouraged to work through on your own or with classmates.

i>clicker

The i>clicker response system allows you to respond to questions posed during class. The goal is to get you to think actively about what you are learning and to help the instructor gauge student understanding. To respond to the questions, you need to purchase and register an i>clicker. These are available through the bookstore.

Grade components/Grade cut-offs

- **Pre-class quizzes:** To encourage you to read relevant sections of the textbook and review the slides and other posted reading assignments before lecture and discussion, there will be frequent pre-class quizzes posted on CCLE. You can work on these with your classmates and you will be allowed multiple attempts.
- **Writing assignments with calibrated peer review:** There will be four writing assignments in which you will be asked to discuss and apply important Chem 14B concepts. Each assignment will be graded by three classmates using an instructor-designed rubric. Students will be asked to reflect on the usefulness of the feedback they received from their graders. Each student's grade on each assignments will be determined by the scores they received from the graders as well as the quality of their grading efforts as determined by an AI-driven platform.
- **Midterms:** There will be two midterms, one at the end of week 4 and the other at end of week 8. Each midterm will have an individual component (worth 75% of the grade) and a collaborative component (worth 25% of the grade).
- **Final exam:** This will be comprehensive.
- **Weekly discussion worksheets:** These are described above under "Discussion Sections".
- **Participation:** Part of your course grade is based on participation. There are several ways that you can earn participation points:
  - Completion of pre-course survey: 2 points
  - Volunteering to contribute in class: up to 20 points
  - Completion of midterm course evaluation: 3 points
  - Minute papers: up to 10 points
  - Contributing to the data-base of chemists from under-represented groups
- **i>clicker:** You will be awarded participation points for i>clicker responses. To get full credit for i>clicker, you only need to answer 75% of the questions.
- **Weighting of the grade components**

Midterm 1	10%
Midterm 2	15%
Final Exam	30%
Worksheets	5%
Writing assignments	10%
Quizzes	15%
Participation	10%
i>clicker	5%

Grade cut-offs

A+/A	**93-100%**
A-	90-92.9%
B+	87-89.9%
B	83-86.9%
B-	80-82.9%
C+	77-79.9%
C	73-76.9%
C-	70-72.9%
D	60-69.9%
F	0-59%

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Collaborative learning

Learning works best if it is a collaborative process. The best way to master a difficult concept is to explain it to someone else. Therefore, I strongly encourage you to form study groups and to work together with your classmates on the homework problems and on coming to grips with all the course material. The course is not graded on a curve. So you are not competing with your classmates for a limited pool of A's. In principal, the whole class can get A's if the whole class demonstrates sufficient mastery of the material. Here's the bottom line: **there is a huge amount of upside and no downside to helping your fellow 14BE students learn the course material!!**

Student conduct

A) **Academic integrity:** Students suspected of academic dishonesty as defined in the Student Conduct Code will be reported to the Dean of Students. Possible penalties include probation, suspension, and dismissal. Academic dishonesty includes, but is not limited to the following:

Cheating: Unauthorized acquiring of knowledge of an examination or part of an examination

- Allowing another person to take a quiz, exam, or similar evaluation for you. This includes allowing another person to submit iClicker responses for you.
- Using unauthorized material, information, or study aids in any academic exercise or examination – textbook, notes, formula list, calculator, etc.
- Unauthorized collaboration in providing or requesting assistance, such as sharing information
- Unauthorized use of someone else's data in completing a computer exercise
- Altering a graded exam or assignment and requesting that it be regraded

Plagiarism: Presenting another's words or ideas as if they were one's own

- Submitting as your own through purchase or otherwise, part of or an entire work produced verbatim by someone else
- Paraphrasing ideas, data or writing without properly acknowledging the source
- Unauthorized transfer and use of someone else's computer file as your own
- Unauthorized use of someone else's data in completing a computer exercise

Multiple Submissions: Submitting the same work (with exact or similar content) in more than one class without permission from the instructor to do so. This includes courses you are currently taking, as well as courses you might take in another quarter

Facilitating Academic Dishonesty: Participating in any action that compromises the integrity of the academic standards of the University; assisting another to commit an act of academic dishonesty

- Taking a quiz, exam, or similar evaluation in place of another person
- Allowing another student to copy from you
- Providing material or other information to another student with knowledge that such assistance could be used in any of the violations stated above (e.g., giving test information to students in other discussion sections of the same course)

Fabrication: Falsification or invention of any information in an academic exercise
- Altering data to support research
- Presenting results from research that was not performed
- Crediting source material that was not used for research

While you are here at UCLA, you may find yourself in a situation where cheating seems like a viable choice. You may rationalize to yourself that “Everyone else does it”…Well, they don’t. And will that matter when YOU get caught? NO! If you are unsure whether what you are considering doing is cheating, just ask yourself …how would you feel if your actions were public, for anyone to see? Would you feel embarrassed or ashamed? If the answer is yes, that’s a good indicator that you are taking a risk and rationalizing it to yourself.

If after reviewing the information above, you are still unclear about any of the items – **don’t take chances**, don’t just take your well-intentioned friend’s advice – ASK your TA or your Professor. Know the rules - Ignorance is NO defense. In addition, avoid placing yourself in situations which might lead your TA or Professor to **suspect you of cheating.** For example, during an exam don’t sit next to someone with whom you studied in case your answers end up looking “too similar.”

Alternatives to Academic Dishonesty
- **Seek out help** – meet with your TA or Professor, ask if there is special tutoring available.
- **Drop the course** – can you take it next quarter when you might feel more prepared and less pressured?
- **Ask for an extension** – if you explain your situation to your TA or Professor, they might grant you an extended deadline.
- **See a counselor** at Student Psychological Services, and/or your school, college or department – UCLA has many resources for students who are feeling the stresses of academic and personal pressures.

Remember, **getting caught cheating affects more than just your GPA**. How will you explain to your parents, family and friends that you have been suspended or dismissed? How will it affect your financial aid award and/or scholarship money? Will you be required to, and be able to pay back that money if you are no longer a student? If you live in the residence halls, where will you go if you are told you can no longer live there? You have worked very hard to get here, so don’t cheat! If you would like more information, please go to the Dean of Students’ Office in 1206 Murphy Hall, call them at (310) 825-3871, or visit their website at www.deanofstudents.ucla.edu.

B) **UCLA policies that support tolerance: All students are asked to treat one another with kindness and respect (the golden rule applies).** Harassment and discrimination based on:

- race, ethnicity, ancestry, color;
- sex, gender, gender identity, gender expression, sexual orientation;
- national origin, citizenship status;
- religion;
- disability, pregnancy, medical condition, genetic predisposition;
- domestic partnership/marital status;
- age;
- veteran status

may violate UCLA regulations and lead to serious consequences. Information on how to obtain redress or counseling if you are subjected to such harassment or discrimination can be found at https://equity.ucla.edu/report-an-incident/.

UCLA is bound by Title IX, a federal law that applies to any education program receiving federal assistance. Title IX prohibits gender discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking. Students who have experienced sexual harassment or sexual violence can receive confidential support and advocacy at the CARE Advocacy Office for Sexual and Gender-Based Violence, 1st Floor Wooden Center West, CAREadvocate@caps.ucla.edu, (310) 206-2465. You can also report sexual violence or sexual harassment directly to the University's Title IX Coordinator, 2241 Murphy Hall, titleix@conet.ucla.edu, (310) 206-3417.

Campus Resources Available to Students

- **Academic Achievement Program:** AAP advocates and facilitates the access, academic success, and graduation of students who have been historically underrepresented in higher education; informs and prepares students for graduate and professional schools; and develops the academic, scientific, political, economic, and community leadership necessary to transform society. Learn more at http://www.aap.ucla.edu/
- **Academics in the Commons at Covel Commons:** (310) 825-9315 free workshops on a wide variety of issues relating to academic & personal success http://www.orl.ucla.edu (click on "academics")
- **Bruin Resource Center:** Includes services for transfer students, undocumented students, veterans, students with dependents, and more. In addition, the Bruin Resource Center Offers access to peer-to-peer coaching through the GRIT program; http://www.brc.ucla.edu/
- **Career Center:** Don't wait until your senior year – visit the career center today for career counseling! http://www.career.ucla.edu/
- **Center for Accessible Education (CAE):** Facilitates academic accommodations for regularly enrolled, matriculating students with documented permanent and temporary disabilities. Accommodations are designed to promote successful engagement in the UCLA academic experience. If you are interested in receiving disability-based academic accommodations, you may schedule an appointment to

meet with an intake counselor in order to determine your eligibility for services. A255 Murphy Hall: (310) 825-1501, TDD (310) 206-6083; http://www.cae.ucla.edu/

- **College Tutorials at Covel Commons:** (310) 825-9315 free tutoring for ESL/math & science/composition/and more! http://www.college.ucla.edu/up/ct/
- **Counseling and Psychological Services Wooden Center West:** (310) 825-0768 http://www.caps.ucla.edu
- **Dashew Center for International Students and Scholars 106 Bradley Hall:** (310) 825-1681 http:// www.internationalcenter.ucla.edu
- **Dean of Students Office; 1206 Murphy Hall:** (310) 825-3871; http://www.deanofstudents.ucla.edu/
- **Discrimination Prevention Office**
- **Equity Advisor, Division of Physical Sciences**:
- **Lesbian, Gay, Bisexual and Transgender Resource Center Student Activities Center, B36:** (310) 206-3628 http://www.lgbt.ucla.edu
- **Letters & Science Counseling Service:** A316 Murphy Hall: (310) 825-1965 http://www.college.ucla.edu
- **Library**: Get help with your research, find study spaces, attend a workshop, rent a laptop, and more. Learn more: http://www.library.ucla.edu/
- **Students in Crisis:** From the Office of the Dean of Students: Faculty and Staff 911 Guide for Students, commonly known as the "Red Folder." This tool is intended to provide you with quick access to important resources for assisting students in need.
- **Student Legal Services; A239 Murphy Hall:** (310) 825-9894; http://www.studentlegal.ucla.edu
- **Title IX Office:** See information in section XI-B of this syllabus
- **Undergraduate Research Portal:** The Undergraduate Research Portal helps students and faculty connect over research opportunities. It's available now under the Academics tab on MyUCLA and can be directly accessed at, http://urp.my.ucla.edu
- **UCLAONE.com**: UCLA ONE is UCLA's interactive, online gateway for mentorship, professional networking, peer driven career advice and exclusive job leads. (Similar to LinkedIn for the UCLA community)
- **Undergraduate Writing Center:** Peer learning facilitators (PLFs) are undergraduates who understand the challenges of writing at UCLA. Scheduled appointment and walk-in options are available, see http://www.wp.ucla.edu/uwc for more information about writing programs and to get assistance with your writing.
- **Undocumented Students Program:** Provides support for undocumented students; http://www.usp.ucla.edu/

Class Schedule

Week	Date	Topic	Readings
1	Jan 4	Thermodynamic systems and the gas law	3B, 4A.1
	Jan 6	Work	4A.2, 4A.3
	Jan8	Heat	4A.5
2	Jan 11	1st law of thermodynamics	4B.1 – 4B.3
	Jan 13	Enthalpy	4C
	Jan 15	Thermochemistry I	4D.1 – 4D.3
3	Jan 20	Thermochemistry II	4D.4 – 4D.6, 4E
	Jan 22	2nd law of thermodynamics: classical view	4F, 4H
4	Jan 25	2nd law of thermodynamics: statistical view	4G
	Jan 27	Entropy and spontaneity	4I
	Jan29	**Midterm I**	
5	Feb 1	Gibbs free energy	4J
	Feb 3	Equilibrium constants	5G.1, 5G.2, 5H
	Feb 5	Equilibrium constants and free energy	5G.3, 5G.4
6	Feb 8	Equilibrium calculations	5I
	Feb 10	Le Chatelier's principle	5J
	Feb 12	Acids and bases – autoprotolysis	6A, 6B
7	Feb 17	Weak acids and bases – the conjugate seesaw	6C, 6D
	Feb 19	Buffers	6G
8	Feb 22	Acid-base titrations	6H.1, 6H.2
	Feb 24	Polyprotic acids	6E, 6H.3
	Feb 26	**Midterm II**	
9	Mar 1	Redox equations	6K
	Mar 3	Galvanic cells	6L
	Mar 5	Electrochemical potentials	6M, 6N
10	Mar 8	Reaction rates, rate laws	7A, 7B
	Mar 10	Reaction mechanisms, collision theory	7C, 7D
	Mar 12	Catalysis	7E

UCLA Course Inventory Management System

Main Menu Inventory Reports Help Exit

New Course Proposal

	Chemistry & Biochemistry 14BE General Chemistry for Life Scientists II - Enhanced
Course Number	Chemistry & Biochemistry 14BE
Title	General Chemistry for Life Scientists II - Enhanced
Short Title	GEN CHEM LSII-ENHNC
Units	Fixed: 4
Grading Basis	Letter grade or Passed/Not Passed
Instructional Format	Lecture - 3 hours per week Discussion - 2 hours per week
TIE Code	LECS - Lecture (Plus Supplementary Activity) [T]
GE Requirement	No
Major or Minor Requirement	Yes
Requisites	Enforced requisite: course 14AE with grade of C- or better. Enforced requisite or corequisite: Life Sciences 30B or Mathematics 3B or 31B with grade of C- or better.
Course Description	Lecture, three hours; discussion, two hours. Enforced requisite: course 14AE with grade of C- or better. Enforced requisite or corequisite: Life Sciences 30B or Mathematics 3B or 31B with grade of C- or better. Not open to students with credit for course 14B, 20B, or 30A. Introduction of concepts in physical chemistry that are critical for understanding of molecular basis of life. Includes concepts in thermodynamics, which are required to predict what chemical reactions occur spontaneously, and concepts in kinetics, which are required to predict reaction rate. P/NP or letter grading.
Justification	Chem 14AE and 14BE would introduce general chemistry to students who did not have chemistry in high school or whose exposure to the subject prior to college has been only moderate, whereas the existing courses (14A and 14B) would cover the same content but for students whose exposure to the subject prior to college has been substantial
Syllabus	File *New Chem 14BE Syllabus.docx* was previously uploaded. You may view the file by clicking on the file name.
Supplemental Information	Approved on behalf of Catherine Clarke, Chair, Chemistry & Biochemistry
Grading Structure	See Attached Syllabi
Effective Date	Winter 2020

Instructor	Name	Title
	Daniel Neuhauser	Professor
	Al Courey	Professor
Quarters Taught	☑ Fall ☑ Winter ☑ Spring ☐ Summer	
Department	Chemistry	
Contact	Name	E-mail
Routing Help	DENISE MANTONYA	dmm@chem.ucla.edu

ROUTING STATUS

Role:	Registrar's Office
Status:	Processing Completed

Role:	Registrar's Publications Office - Livesay, Blake Cary (blivesay@registrar.ucla.edu) - 61590
Status:	Added to SRS on 4/5/2019 9:36:59 AM
Changes:	Description
Comments:	Equivalent to Chem 14B and not open to students with credit for course 14B, 20B, or 30A per Denise. Course description edited into official version.

Role:	Registrar's Scheduling Office - Lin, Jessica (jlin@registrar.ucla.edu) - 58253
Status:	Added to SRS on 3/27/2019 4:53:47 PM
Changes:	Short Title
Comments:	No Comments

Role:	FEC School Coordinator - Ries, Mary Elizabeth (mries@college.ucla.edu) - 61225
Status:	Returned for Additional Info on 3/19/2019 8:50:00 AM
Changes:	No Changes Made
Comments:	no changes

Role:	FEC Chair or Designee - Tornell, Aaron (tornell@econ.ucla.edu) - 41686
Status:	Approved on 3/17/2019 6:13:27 PM
Changes:	No Changes Made
Comments:	No Comments

Role:	UgC Coordinator - Ries, Mary Elizabeth (mries@college.ucla.edu) - 61225

Status:	Returned for Additional Info on 3/11/2019 10:59:43 AM
Changes:	No Changes Made
Comments:	No changes. Routing to Aaron Tornell for FEC review and approval.

Role:	Dean College/School or Designee - Garcia-Garibay, Miguel A (mgarciagaribay@college.ucla.edu) - 53159, 53958
Status:	Approved on 3/11/2019 10:54:59 AM
Changes:	No Changes Made
Comments:	No Comments

Role:	L&S FEC Coordinator - Ries, Mary Elizabeth (mries@college.ucla.edu) - 61225
Status:	Returned for Additional Info on 3/5/2019 2:45:38 PM
Changes:	No Changes Made
Comments:	no changes. Routing to Dean Garcia-Garibay for review and approval. Note: Course LO are included in course description.

Role:	Initiator/Submitter - Mantonya, Denise M (dmm@chem.ucla.edu) - 54660
Status:	Submitted on 3/5/2019 1:53:31 PM
Comments:	Initiated a New Course Proposal

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publications@registrar.ucla.edu or (310) 825-6704