**Course Syllabus**

**Welcome to Chemistry 340, Physical Chemistry I, Fall 2021**

**Instructor information**

[Steven NeshybaLinks to an external site.](http://www.pugetsound.edu/faculty-pages/nesh), [nesh@pugetsound.edu](mailto:nesh@pugetsound.edu), 253-879-3379  
Office Hours (Thompson 355D, or on [Zoom (Links to an external site.)](https://pugetsound-edu.zoom.us/j/9648741789?pwd=Q2tmblU1T1FHbDZ1TGlHV3JVOGJDZz09)): Immediately after class (or by appointment)

**About This Course**

Chem 340 focuses on thermodynamic aspects of physical chemistry. We examine chemical reactions and other transformations in light of ideas about energy conservation and the direction of spontaneous change. Molecular, mathematical, and statistical-mechanical underpinnings are emphasized as appropriate. Long-term, the goal is that as a result of this course you’ll be able to

* use thermodynamic theory to make meaningful chemical predictions;
* use thermodynamic principles to shape new questions in chemical research (e.g., living systems, climate studies); and
* take on similarly challenging, mathematically-dense scientific formalisms (like quantum mechanics).

At an even higher level, it will be useful for you be aware of your own learning strategies, including new ones you develop during this course. This includes systematic analysis of assumptions, and use of numerical methods to extend your mathematical reach.

**Resources**

* Our text will be [*Physical Chemistry, McQuarrie and Simon (Links to an external site.)*](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Map%3A_Physical_Chemistry_(McQuarrie_and_Simon))
* Math 280 & Phys 121 are required, but can be taken concurrently
* You'll need a laptop that you can bring to class on a regular basis
* Wifi and GlobalProtect
* A dedicated notebook (hardbound or spiral)

**Rhythm of the week**

**Monday**

Introduction of new ideas and equations for the week, mainly via lectures.

**Wednesday**

Little CGI sessions -- calculating numbers, managing units, other tricks of the trade, in Python. We'll also develop methodologies for scientific programming.

**Thursday**

Big CGI sessions -- visualizations, also mainly in Python. We'll also have demos during this time.

**Friday**

Pen-and-paper work (math, interpretations) & wrap-up discussions.

**What are CGI sessions?**

Computational Guided Inquiry is a scaffolded technique for learning. Lots of times that will mean that you'll see a worked example, then modify or expand on it to do something similar. Sometimes you'll be asked build on techniques you learned in a previous CGI session -- so you'll need to internalize these examples too! The CGI approach was actually invented *for* learning thermodynamics, because at a fundamental level, thermodynamics is all about the geometry of objects called *thermodynamic surfaces*, which be learning how to construct and visualize. All the CGIs in this course will be done in the Python computer programming language within an environment called *Jupyter Notebooks*. It's an environment well worth mastering even if you don’t intend to continue in physical chemistry.

**What's up with all that math?**

First, physical chemists, like all chemists, tend to be a very interested in what's happening at a molecular scale. Physical chemists are a little different in that we like to apply quantitative methods: if you really know what's going on, you should be able to put a number on it. Related to this is that there are relationships between quantities a chemist is interested in, that are not immediately evident. Who knew, for example, that baked into the equation *PV=nRT* is the implication that the energy of a gas is a function of its temperature, but not its volume! Additional benefits of practicing all that math is that you'll become a more strategic problem-solver, integrate what you know about math or physics, and train yourself to identify and find resources you need to solve a given problem.

**Real-world applications**

We’ll be spending a little time on real-world applications of thermodynamics. For example, we'll look at the thermodynamics underlying the thermal expansion of water as a contributor to sea level rise.

**What to do if you miss class?**

* You need to notify me at least 24 hours in advance, otherwise it will count as an unexcused absence.
* Afterward, get notes from another student and review them carefully to see what you missed, then check in with me.
* If your attendance drops below 20%, you will be withdrawn from the course.
* There will be no new material after Thanksgiving -- but there will be one-on-one interviews.

**Evaluation**

* Python Notebooks (25%)
* Quizzes (20%)
* One-on-one interviews (30%)
* Attendance and participation (25%)

**Grade breakdown**

* 90-100% A-/A
* 80-90% B-/B/B+
* 70-80% C-/C/C+
* 60-70% D-/D/D+
* <60% F

**Academic honesty**

There is an expectation of academic integrity. Violations of academic integrity include:

* Plagiarism or cheating on exams or quizzes
* Unauthorized collaboration with other students on course work
* If you are ever unsure about whether or not an activity is a violation of academic integrity, consult with your instructor. For additional details see the “Academic Integrity” section of the [University Academic HandbookLinks to an external site.](https://www.pugetsound.edu/files/resources/academichandbook2017-2018.pdf).

**Classroom emergency response**

* Please review university emergency preparedness and response procedures posted at [www.pugetsound.edu/emergency/Links to an external site.](http://www.pugetsound.edu/emergency/). If building evacuation becomes necessary (e.g. earthquake), meet your instructor at the designated gathering area so she/he can account for your presence. Then wait for further instructions. Do not return to the building or classroom until advised by a university emergency response representative.
* If confronted by an act of violence, be prepared to make quick decisions to protect your safety. Flee the area by running away from the source of danger if you can safely do so. If this is not possible, shelter in place by securing classroom or lab doors and windows, closing blinds, and turning off room lights. Stay low, away from doors and windows, and as close to the interior hallway walls as possible. Wait for further instructions.

**Disability accommodation**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact the [Office of Student Accessibility and AccommodationsLinks to an external site.](https://www.pugetsound.edu/academics/academic-resources/accessibility-accommodation/contact-the-office-of-accessib/), 105 Howarth Hall, 253-879-3399. She will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

**Topic schedule (by week)**

1. Gas laws
2. Thermodynamic surfaces
3. Probability density functions
4. Internal energy and the 1st Law
5. Interviews
6. Heat engines and heat pumps
7. Enthalpy
8. Phase diagrams (and Fall Break)
9. Arctic ice
10. Entropy and the 2nd Law
11. Gibbs energy
12. Chemical potentials
13. Maxwell's equations (and Thanksgiving)
14. Interviews
15. Wrap-up