Lecture 1: Introduction to Chem 31A

Welcome to Chem 31A.

Introduce Professors Chidsey and Dai, Dr. Schwartz, Marissa Caldwell and the rest of the instructional team.

A major goal of this course is to help you discover how science works and how to assess and participate in it yourself. That goal is much tougher than telling you in a dogmatic way what something is made of or how it works. Science is a challenge -- like a sport -- fun but hard to learn. We can at best coach you as you begin to figure out the process of science.

Chem 31A Philosophy

- Two week learning cycle
- Introduce new phenomena
- Develop conceptual models
- Build problem solving skills
- Assess mastery in an hour exam every other week
- Course **grade is absolute**, not on a curve
- **You are not competing with each other**

Logistics

- Chem 31X Placement Test 7:00pm Braun Lecture Hall.
- Enroll in either Chem 31A or 31X, but not both. Easy to switch.
- **Required midterm exams at 7:00pm on Wednesdays**
- **Required final exam Wednesday Dec. 9, 3:30pm.**
- Public website: chem31a.stanford.edu (show on-line)

- Syllabus (show from public homepage)
- CourseWork (show from public homepage)
- Required text: Spencer, Bodner and Rickard *Chemistry: Structure and Dynamics*.
- The optional solution manual is not essential
- **Required PRS RF transmitter** – old IR transmitter will **not** be used.
- Enter your SUNetID into your PRS transmitter
- Required section on Thurday or Friday – **starts this week**.
- List your preferences for section time at link on CourseWork website by 5:00pm Tuesday.

Calendar (show from public homepage)

- Shortened first cycle with the **first exam next Wednesday**
- Much to do before the first exam
- First exam is only **5% of the course grade**
- Low risk ramp up
- Assigned **reading and reading problems** for W and F.

Quantities in science

- Chemistry, and science in general, involves lots of q**uantities.** They always represent the **amount of something**.
- The quantity may or may not have a **dimension**. Dimension is the answer to the question "What is the quantity a measure of?" In the case of the distance to San Francisco, the dimension is "length".
- **Pure numbers** are said to be **dimensionless**. When you multiply a quantity by a pure number, you do not change the dimension.

- The **value of a quantity** is made up of the **numerical portion** and possibly a **unit**.
- If the distance to San Francisco is $1.8x10^5$feet, then the numerical portion of that value is $1.8x10^5$. **The numerical portion of a dimensioned quantity makes no sense by itself.** Never omit the units from the value of a dimensioned quantity – even in intermediate work. You will get yourself into a mess in this course if you are sloppy about this issue.
- **Dimensioned quantities** always contain a **unit**, like “feet” or “kilograms” or “miles per hour”.
- Dimensionless quantities (i.e. pure numbers) may or may not contain a **dimensionless unit**. Examples of dimensionless units are: “dozen” (= 12), “gross” (= 144), “percent” (= 10^{-2}) and “parts per million” (=10^{-6}). So “33%” is a dimensionless quantity with a unit.
- Dimensionless units can be included with dimensioned units. For instance, “5.5% per year” is a dimensioned quantity with the dimension of “per unit time” or “reciprocal time”

Standard units of measurement

Time

- 1s – about the time between heart beats for a human at rest.
- Define: 1second ≡ 1day/(24x60x60) = 1day/(2^7x3^3x5^2).

  “≡” means “defined to be”
- Thus the “day” is the conceptual basis of the standard unit of time.

Length

- 1m – about a human stride.
- French Academy of Science wanted to make the meter more accurate by tying it to the second.
- Define: 1m ≡ length of pendulum with a half-period of 1s.

Mass

- 1g -- about the mass of 1/4 teaspoon of water
- Define: 1g ≡ mass of $1cm^3$ of water
- 1kg = mass of $1dm^3$ of water.
- 1metric tonne = 1Mg = mass of $1m^3$ of water.

Be intuitive about units.

BE CAREFUL with powers of units!!!! How many cubic centimeters are in a cubic meter? 100? Think again.

Notice that because the second is a fraction of the day, and the meter is the length of a pendulum with a half-period of a second, and the gram is the mass of a cubic centimeter of liquid water, all units are conceptually tied to the day!

For modern, accurate use, the length of a day, the acceleration due to gravity and the density of liquid water all vary too much to be modern standards, so more accurate standards have been adopted over the years. However, the old standards are still accurate enough to provide a good conceptual understanding of the units.

Wednesday we will start to talk about atomic scale units. I want you to have just as firm a conceptual understanding of them as you do of the second, the meter and the gram.

Standard prefixes for units

You will be expected to know the following standard prefixes for the units. They are just pure numbers (**memorize them)**:

name	symbol	value	name	symbol	value
tera	T	10^{+12}	deci	d	10^{-1}
giga	G	10^{+9}	centi	c	10^{-2}
mega	M	10^{+6}	milli	m	10^{-3}
kilo	k	10^{+3}	micro	μ (u in email)	10^{-6}
			nano	n	10^{-9}
			pico	p	10^{-12}
			femto	f	10^{-15}

Course Expectations for Unit Conversions, Significant Figures and Scientific Notation

Dr. Schwartz, as the Outreach Instructor, discusses what she will be covering in the Outreach workshop this evening.

Reminders

1. Enter your SUNetID into your PRS transmitter
2. Sign up for section at link on CourseWork website by 5pm Tuesday. First section meets this week on Th or F
3. Complete assigned reading and reading problems for W and F.