Science-1A Lecture: Week-1, Monday, August 9, 2021

Welcome to Science-1A. I'd much rather be jumping up and down in front of your smiling faces, but that would be a bad idea these days so we must manage with online instruction. I explain best when I can wave my hands and show quick demonstrations, but I will try to explain what I would have done in written lecture and lab notes.

Most course information will be on my website at
https://yosemitefoothills.com/Science-1A
which I can easily update. There, you will find the following sections:

Online Class Lesson and Communication News
Links to new postings, e-mails sent, and other information are found here, with a date and time for each entry. I will try to also send the most important information via e-mail.

COVID-19 News
These are links to official COVID-19 information from the state, school, and Kaiser Permanente, and anything else I think might be helpful.

Miscellaneous Links
Some links to relevant items that do not fit in other categories are here. For example, this section has a link to a video about two new teachers that know a lot about cooperation:
https://www.youtube.com/watch?v=VKrvtq5vDmk

Handouts and Links
I reference the textbook, but depend most heavily on handouts which are listed here in sections by book chapter. Also listed are some links to additional sources of teaching information.

Online Lecture and Lab Notes
This is where I post notes for 2 lectures and 1 lab each week. Those notes contain links to the material in other parts of this website and to useful outside web pages and videos. It is essential to carefully study the postings here along with their links.

Laboratory Activities
Explanations of each week's laboratory activities will be placed here. This will also contain descriptions of the demonstrations I usually do in person, animations I have created to explain certain concepts, and links to relevant YouTube videos. The Online Lecture and Lab Notes will point to these as needed.

Quiz and Test Preparation
I am a big believer that people learn from seeing examples. Quiz and test preparation consists of studying example questions listed in this section. Each set of examples contains many more questions and solutions than you will be confronted with on the actual quizzes, midterms, and final exam. Those tested questions, will be similar, but usually changed enough to avoid being a test of pure memorization skills.

There will be no real surprises among the quiz and test questions. Students make plenty of errors without my creating "gotcha" questions.

This section also contains the "Equation Sheet", Periodic Table of Elements, and a page of advice for solving calculations questions. The "Equation Sheet" and Periodic Table can be consulted during quizzes and tests. You must use this Periodic Table, not a different one from the web.

Animated Gifs of Molecules

This heading links to a page of animated gifs showing the rotating 3-dimensional structure of many interesting molecules. During the chemistry part of the course, we would normally build molecular models in the laboratory – a great hands-on activity which is unfortunately not possible online.

If my lecture, lab and handout notes are not adequate, you should send me an e-mail to *science1a@yosemitefoothills.com* with CC to *craig.vandegrift@scccd.edu* with any questions. If I cannot explain it well in a reply, I can (reluctantly) set up a Zoom meeting or I can prepare a new handout or video explanation.

I plan to make use of the PBS Crash Course in Physics, one of the many excellent rapid free courses at *https://www.youtube.com/user/crashcourse* . The 46 10-minute video clips on physics are designed for a full semester physics course that utilizes some trigonometry and calculus mathematics. Our course only uses algebra and the physics part must fit in half of a semester. So each time I refer to one of the Crash Course clips, I will mention which parts are relevant to our course and which you are not expected to absorb. As an old man (76 years old), I find those clips rather fast, but apparently you young folks take in video material much faster than I. Still, the nice part about those clips is that they can be backed up or replayed as necessary to catch missed concepts. Also, their speed may be adjusted to fit your needs.

Still, seeing and hearing more than you are required to retain does not hurt. Kids do most of their language learning from scratch by hearing words they do not understand; they absorb vocabulary from context and repetition. So I will present you with much more than I will test for, and hope you will soak up the bonus material like a young kid.

You will need to learn how to do scientific notation and logarithms on a calculator, but an expensive graphing calculator is not necessary. We will have a lab on this on August 18. 100 points will be earned by mastering the Calculations Test which allows redo's until mastered.

I run a computer server *https://yosemitefoothills.com* from my house that will be your primary source of course information. For example, the course syllabus is at *https://yosemitefoothills.com/Science-1A/Syllabus-81154-81155.pdf* .
The point system used to assign grades is explained there. Most points are from 8 quizzes, 2 midterm tests, and a final exam, but additional points are for lab participation and mastering how to use a scientific calculator.

By the end of the course, I must assign a grade to certify that you learned some basic physics and chemistry. You therefore need to know which material is required and which is bonus knowledge. That distinction is clear: the material in the Practice Quizzes and two pages of extra midterm test questions test the required knowledge. Those questions are all presented with solutions since I believe that we really learn by seeing examples. The graded Quizzes, Midterm tests and Final Exam are based entirely on the questions in that practice material, altered somewhat to avoid making it a test of pure memorization. The actual quizzes and tests are much shorter than the practice quizzes.

Many of you worry about the math you will need to do in this course, especially in the physics part. In the initial couple of weeks I will guide you through the math required which is far less than you were expected to learn in your Algebra course, but which has an added emphasis on measurement units.

When doing quizzes and tests, you will have access to a 6-page sheet of equations and unit help (Equation Sheet) and also to a Periodic Table of Elements. You will, however, need to memorize the powers of 10 associated with 10 unit prefixes (T-, G-, M-, k-, c-, m-, μ-, n-, p-, and f-), know that the

area of a circle is πr^2 , the circumference of a circle is $2\pi r$, the area of a rectangle is *lw*, and the volume of a rectangular parallel-piped is *lwh*.

The 10 unit prefixes (unit multipliers) you must memorized are discussed in
https://yosemitefoothills.com/Science-1A/Handouts/Week-01/UsingUnits.pdf
They will be freely used in quiz and test questions, and points will be deducted from answers where they are ignored or used incorrectly. A practice page and solutions for these is at
https://yosemitefoothills.com/Science-1A/Handouts/Week-01/PracticeWithUnitPrefixes.pdf .
(Both of these pdf files are also in the Week-01 section of the printed handouts packet.)

You will be graded on how well you correctly arrange the calculation problems. This is shown in the handout at
https://yosemitefoothills.com/Science-1A/QuizAndTestPractice/AdviceForSolvingCalculations.pdf
which is also at page 121 of your "PhysicsAndPracticeQuizHandouts" packet of printed handouts.
Many questions, especially math-related questions, are graded with partial credit. Leaving a question completely blank gets no points, but a good-faith effort is rewarded accordingly. The final answer should have 4 significant digits. For example 1.2536 m and even 1.254 are OK, but 1.23 m, and 1.3 m are not. If the answer were just a single digit, like 5 m, I would expect it to be written as 5.000 m, but I am not too fussy about those single- or two-digit exact answer cases.

The copy of the 6-page Equation Sheet in the Week-01 section of your printed handouts is your study copy. You should feel free to write notes on it. An additional copy of the Equations Sheet at pages 122-127 should left pristine without any notes. It is for use during the Quizzes and Tests.

A Periodic Table that will be passed out as we finish the Physics half of the course will be needed for the Chemistry Quizzes and Tests. Again, there will be two copies, one for you to mark up with your notes, and another to keep pristine for used during the Quizzes and Tests.
No other notes are allowed during the quizzes and tests.

There are two identical sections for this course, 81154 and 81155 . Each section has an entry on the school Canvas system, but I will make sure that they all have the identical course content and are treated identically.

Week-1 Handouts

Don't be scared by all these handouts, this first week has many more handouts than later weeks.

All these are in *https://yosemitefoothills.com/Science-1A/Handouts/Week-01/*

Algebra Refresher ** Very Important ******

Most sections of this note are supplemented by a short video explanation available from the Canvas program for the course. Those videos are best viewed in order. They are entitled:

DividingByAFraction.mp4
UnitsAreHelpful.mp4
WorkingWithExponents-Intro.mp4
PowersOfPowers.mp4
RearrangingEquations.mp4
MeasurementUnits.mp4

Areas and Volumes ** For use when teaching K-7 ******

This should be useful when teaching K-7 students about areas. Think about this when dividing up a pizza.

Special Note on the Pythagorean Theorem ** For use when teaching K-7 ******

This describes a paper and scissors method for proving the Pythagorean Theorem once the area formulas for a square and triangle are known.

Calculations Using Scientific Notation ** Very Important ******

These two pages were written to help with understanding the use of scientific notation. Scientific notation is essential for science because we must often deal with exceedingly large or small numbers.

Using Units ** Very Important ******

I emphasize the importance of units in this course and require proper uses of units when answering questions. Pay careful attention to the units shown in the solution sheets for the practice quiz questions. Don't lose points by being careless with units.

Practice with Unit Prefixes - Fill in the Blanks ** Very Important ******

Use the table of prefixes in section 5 of the Algebra Refresher to answer these problems. The correct answers are on the second page.

Big and Small Numbers

Science must deal with very large numbers and very small numbers. I first wrote this when volunteering at a small school near where I live. This note starts with a story about how rapidly numbers can grow by doubling. Later, we will see how this can relate to chemical and nuclear explosions, and how a virus can spread exponentially.

There is then a discussion about counting things. Counts must often be estimated, and this section discusses ways of doing that. I like to demonstrate in lab the 4th method, tagging, a method used to count fish in a lake. I put a few hundred marbles in a jar to represent fish in a lake. I then take a couple of handfuls out, count those, and replace them with colored marbles that represent tagged fish. I then shake the jar for a minute letting my tagged "fish" mix with the others. Finally, I catch some more "fish" and count the proportion that are tagged. I can then use that proportion to estimate the number of fish in the lake (marbles in the jar). This is explained on page 2 of that handout.

The next pages discuss how to count by weight or volume. ABC blocks are easy, but the marbles in a jar or grains of salt in a jar only yield estimates.

Sizes of Things - Atoms, the Solar System and Galaxies

These pages give examples of large and small things illustrating why scientific notation is essential for science. Refer to this note when having students make Solar System models so you can explain the true relative sizes and distances in the Solar System.

Rules for Teachers - 1915

The teaching profession as changed a bit from 100 years ago!

Equation Sheet For Quizzes and Tests ** Used for every quiz and test ******

These 6 pages contain the physics and chemistry formulas and unit notes needed when doing quizzes and tests for this course. You should mark up this copy up as you work the practice quiz questions. An additional clean copy of these 6 pages that is not marked up is the one you are allowed to use when taking quizzes and tests.

Preparing for Quiz 1

This is a special note to introduce you to what is expected in quizzes. Normally, a Monday lecture note a week or two before a Quiz will give information specific to each quiz.

The following additional notes are linked in
https://yosemitefoothills.com/Science-1A/LabNotesAndLinks/MeasurementsAndFallingObjects .

Signal Averaging

A biology experiment where the data is extremely "noisy" is described in the note at *https://yosemitefoothills.com/Science-1A/Handouts/Week-01/SignalAveraging.pdf* .
A single measurement does not reveal a trend in the data, but averaging thousands of repeated measurements can let the signal grow faster than the random noise. Watch the animated gif at *https://yosemitefoothills.com/Science-1A/Handouts/Week-01/ConstantSignalPlot.gif* to see how the averaging helps.

If you are hiking and you hear a very faint call that you think might be "help!", you stop and listen again to see if you will hear it repeated. This is a simple example of how we signal average when we need to improve the "signal-to-noise" ratio of something.

In the experiment described here, it is found that our brain makes a decision about 0.3 seconds before we become conscious of that decision. We then have about 0.2 seconds to cancel it if we realize that it is a bad decision.

Hubble Ultra Deep Field in 3D

The video linked here is another example of signal averaging. 10 days of averaging of light from what seemed to be a dark portion of the universe revealed about 3000 galaxies.

Interpolation and Extrapolation

Often data is not yet available or lost and a guess must be made. This note is in the context of data about the melting Arctic Ice coverage. Interpolation is usually pretty reliable, but extrapolation is considered specially unreliable.

Measurement Worksheet

This is for a lab exercise that teaches about metric measurements. More about this during our lab session.

Dropping Marbles

This worksheet and blank graph grids are to be used when determining the local acceleration of gravity, *g*, by measuring the fall time of marbles. It is not very accurate, but easy to do when a good timer is available such as found on smart phones. More about this in the lab exercises.

Analyzing Video Data of a Falling Rock ** Shows how to do dropping more carefully ******

You are not going to be tested on this material, but I hope you will glance over it and find it interesting. It is here to give you an idea of how the marble dropping might be improved. This could keep your bored top students busy while you help others.

Partial Vocabulary List for Science-1A

Finally, I also pass out the following science vocabulary list at *https://yosemitefoothills.com/Science-1A/Handouts/Week-01/VocabularyList.pdf* .

As I teach physics and chemistry, I sometimes feel that most of learning science is a matter of learning and understanding the specialized vocabulary. This list should help. Refer to it as you proceed through the course.