

Science-1A Lecture: Week-1, Monday, August 10, 2020

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.

I use lots of written handouts to explain specific topics. 184 pages of handouts (2 in color) for the physics half of the course have been printed by the school and are available for pickup. Pickup details have been sent in an e-mail on August 6 and are posted at <http://yosemitefoothills.com/Science-1A/PrintedHandoutsAvailable.pdf> so you will not need to print them from the school Canvas server or view them on a small screen. Half-way through the course, another batch of handouts covering chemistry and nuclear physics, many in color, will be available for pickup. The lecture and lab notes, however, will be written as the semester progresses. They will be posted on my website at <http://yosemitefoothills.com/Science-1A/#onlineNotes> as they become ready. I expect them to be largely collections of links to handouts and video clips.

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@sccd.edu with any questions. If I cannot explain it well in a reply, we can set up a Zoom meeting or I can prepare a video explanation to post on Canvas.

I plan to make use of the PBS Crash Course in Physics at <https://www.youtube.com/user/crashcourse>. Those 46 10-minute video clips are excellent, but 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 (75 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.

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.

I run a computer server <http://yosemitefoothills.com> from my house that will be your primary source of course information. For example, the course syllabus is at <http://yosemitefoothills.com/Science-1A/Syllabus-81175-81176.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 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 parallelepiped is lwh .

The 10 unit prefixes (unit multipliers) you must memorized are discussed in

<http://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

<http://yosemitefoothills.com/Science-1A/Handouts/Week-01/PracticeWithUnitPrefixes.pdf>.

(Both of these pdf files are also in the Week-01 section of your printed handouts packet.)

You will be graded on how well you correctly arrange the calculation problems. This is shown in the handout at

<http://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. In the past, I have not required students to write a numeric answer for calculation questions, just the correct units. Starting this semester, however, putting the correct numeric answer in front of the correct units will be worth 1 point. Most students chose to do this in the past, but this semester it is required. That answer should have 2 or 3 significant digits. For example 1.253 m, 1.23 m, and 1.3 m are ok, but just 1 is not. If the answer were just a single digit, like 5 m, I would expect it to be written as 5.0 m.

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 is in your handouts packet at page 122. It must be 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 81175 and 81176. Each section has an entry on the school Canvas system, but I will make sure that they both have the identical course content and are treated identically.

Most course information, however, will be on my website at

<http://yosemitefoothills.com/Science-1A>

which I can more easily update. There, you will find the following sections:

Online Class Lesson and Communication News

This is where I post announcements about handouts, quizzes, tests, etc., 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.

Links to other goodies

Some links to other 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 links to additional information and animated gifs.

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.

Quiz and Test Preparation

I am a big believer that people learn from seeing examples. Quiz and test preparation consists of studying examples 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. All of these are included at the end of your printed packet of handouts.

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

Online Lecture and Lab Notes

The lecture and lab notes will be posted here as they are prepared.

Molecular Animations

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.

Week-1 Handouts

All these are in your packet of printed handouts, but are also at

<http://yosemitefoothills.com/Science-1A/Handouts/Week-01/>

Algebra Refresher

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

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 - by 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.

Areas and Volumes

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

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

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.

Equation Sheet For Quizzes and Tests

These 6 pages contain the physics and chemistry formulas and unit notes needed when doing quizzes and tests for this course. You should mark this copy up as you work the practice quiz questions. A clean copy of these 6 pages is on page 122 of your printed handouts. That copy must not be marked up since it is the one you are allowed to use when taking quizzes and tests.

Analyzing Video Data of a Falling Rock

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.

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.

Practice with Unit Prefixes - Fill in the Blanks

Use the table of prefixes in section 5 of the Algebra Refresher (page 10 of the printed handouts) to answer these problems. The correct answers are on the second page.

Rules for Teachers - 1915

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

Calculations Using Scientific Notation

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.

Signal Averaging

This describes a biology experiment where the data is extremely "noisy"; a single measurement does not reveal the data, but averaging thousands of repeated measurements can let the signal grow faster than the random noise. Watch the animated gif at

<http://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.

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.

Using Units

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.

Partial Vocabulary List for Science-1A

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.

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