2012-2013 AP CHEMISTRY SYLLABUS AND INFORMATION

Welcome to Advanced Placement Chemistry! Please take time to read this document entirely and keep it in your files for reference. The information is relevant and important. It is my sincere hope that your time spent in chemistry will be educational, rewarding, and enjoyable. Since this is a college level course taught in high school, it is very demanding, both in time and effort required. A strong foundation in mathematics is critical, and a good calculator and the ability to use it are essential to your success. Be prepared to spend about one hour per day on your studies and homework. A more detailed description may be found at the College Board AP web site: http://www.collegeboard.com/student/testing/ap/sub_chem.html?chem. The AP Chemistry exam is given in May; you should make every effort to take the exam.

The foundations of science are rooted in experimentation. The AP chemistry course meets seven times per week, with a double period two times per week. The double periods will be devoted as much as practical to laboratory experiments. Policies, procedures, and a list of labs can be found later in this document. Your other three days may include another AP class. On your "off" days you will have the resources of my classroom, your fellow classmates, and me. Consider these as recitation days should you need any remediation or clarification.

CLASSROOM REQUIREMENTS

1. The text is *Chemistry: The Molecular Nature of Matter and Change, 5/e* by Martin Silberberg. Further information and an online student edition may be found at: http://glencoe.mcgraw-hill.com/sites/0012041987/
2. A three-ring binder, where reference materials, labs, and notes will be kept.
3. Two notebooks dedicated only to this class, one for notes and the other for recording lab data, see p. 9 et seq.
4. A scientific calculator and your ability to use it.
5. A LAN and Internet access account through the school district.
6. A working knowledge of computer applications. (You will have access to a laptop while in the class.)
7. An optional 4 GB flash drive will allow you to store all of the lessons.
8. Pens or pencils for taking notes.

PREREQUISITES

1. Two years of algebra
2. One year of chemistry with previous experience in the following:
    - The scientific method and data collection
    - The SI system and dimensional analysis
    - Symbols, formulas, and simple inorganic equations
    - Atomic theory, including e^- configurations and quantum numbers
    - The Periodic Table
    - How to determine and use moles in quantitative calculations
    - The Ideal Gas Equation, simple gas laws, and some understanding of Kinetic Molecular Theory
    - Laboratory safety procedures and the use of some laboratory equipment
3. Recommendations by a previous science teacher and your counselor

SUPPLEMENTAL TEXTS

Brown, Theodore E., H. Eugene LeMay, and Bruce E. Bursten. *Chemistry: The Central Science*. Upper Saddle River, NJ: Prentice Hall.

Zumdahl, Steven, and Susan Zumdahl. *Chemistry*. Boston: Houghton Mifflin

OVERALL OBJECTIVES

(Specific objectives may be found in the text and lesson plans)

1. You will understand the scientific method, the SI system, variations on data collection, and convert units in calculations.
2. You will be able to explain the structure of matter and atomic theory, the formation of compounds and how those compounds are named.
3. You will determine a mole, write balanced formula equations, calculate amounts of reactants and products, and demonstrate an understanding of and application of stoichiometry.
4. You will classify reactions, balance redox reactions, and predict whether a reaction occurs.
5. You will correlate the Kinetic Molecular Theory with the behavior of gases, apply the gas laws to variable conditions, and explain deviations of gases from ideal behavior.
6. You will distinguish between systems and surroundings, enthalpy and endothermic and exothermic processes, calculate heat changes, and find unknown ΔH's.
7. You will evaluate the wave/particle duality of matter, explain the nature of light, and apply equations to the quantum-mechanical model of the atom.
8. You will describe the effects of e^- interactions in atoms, construct e^- configurations and orbital diagrams, and predict trends in the periodicity of elements' properties.
9. You will identify types of chemical bonds, develop models to explain these types, and determine bond type.
10. You will diagram the shapes of molecule using Lewis structures and use VSEPR theory to predict the three-dimensional shapes of molecules.
11. You will describe, compare and contrast valence bond theory and molecular orbital theory, postulate hybrid orbitals, and explain bond properties.
12. You will recognize intermolecular forces, predict the strength of intermolecular forces, construct and interpret phase diagrams, and describe the properties of liquids and solids.
13. You will understand solutions and solubilities, calculate concentrations, and predict the effects of colligative properties.
14. You will recognize organic functional groups and isomers, and apply a nomenclature to organic molecules.
15. You will express reaction rates in terms of temperature and concentration, determine the rate law for *n*-order reactions, and identify rate-determining steps.
16. You will determine reaction direction, calculate equilibrium concentrations and the equilibrium constant, and predict the effect of changes in concentration on equilibrium position.
17. You will compare and contrast Arrhenius, Brønsted-Lowry, and Lewis acids, identify conjugate acid-base pairs, calculate pH, find equilibrium concentrations and percent dissociations.
18. You will predict the effects of acid-base buffers, analyze acid-base titration curves, and determine solubility products.
19. You will apply the laws of thermodynamics to predict changes in systems, calculate free energies, and assess entropy change and the equilibrium state.
20. You will identify and write half-reactions for electrochemical cells, determine cell potentials, and determine oxidizing and reducing agents.

GRADING PROCEDURES

1. You will be graded in the following areas: tests, quizzes, special homework assignments, required homework assignments, projects, and lab reports.
2. Unless otherwise stated, all grading instruments will be assigned point values. Your grade will be a percentage of these total points, indexed to the school grading matrix. See your student manual for a copy of this matrix.

3. Extra credit is a sensitive issue and one that some students hope will save them from an unsatisfactory grade. In my experience the best remedy for poor performance is preparation and diligence, consequently, extra credit work will not be awarded.
4. Homework is due two days after it is assigned. Please refer to the schedule of required problems later in this document. Your homework will be reviewed and annotations may be added. Since homework is designed to be practice for quizzes and tests, it is of little value after the fact. Therefore, late homework will not be accepted. (Solutions to the problems will be posted on a flash file after our review and before the unit test.)
5. When you are absent it is your responsibility to arrange to make up work. If you are absent only the day of an exam, you will be expected to make up the exam the next day. Under few circumstances will you be permitted to make up any work after three school days. Two significant advantages to this policy are that subject material will still be fresh in your mind and subsequent work will not suffer any large interruption. Please make arrangements to complete your work promptly.

   Field trips and other special events require planning on your part. You are responsible for all material missed and must take any tests and submit any homework the day you return. No extra class time will be afforded to you: you must use a study hall (if you have one) or the class from which you took the field trip.
6. If you miss more than one lab each quarter, you will be given an “incomplete” until this deficiency is remedied. Lab reports that are submitted late will incur a 10% deduction in points for each school day that the report is late.

OBLIGATIONS

1. Please remember that you are expected to act as young adults in this class. A large portion of your work is of an individual nature and you must budget your time accordingly.
2. As upperclassmen it is assumed that you understand those behaviors that are acceptable in lab and classroom situations. Should you have questions about acceptable behavior see your student handbook or check with me about your concerns before you decide to act.
3. The academic penalties for plagiarism are severe. Copying a classmate’s homework or lab work is plagiarism, and you will not receive credit.
4. Keep a neat notebook, with all handouts and supplementary materials included. Probably the single biggest difference between success and failure is easy access to the information received in class.
5. You have every reason to expect me to grade your materials in a reasonable time and I have every reason to expect you to complete those materials on time.

SUMMARY

AP Chemistry is a challenging and exciting course. You have elected to take this subject because of your future plans or interests. Your successful completion of the course will prepare you well for an introductory college chemistry course.

The national AP Chemistry exam is offered in May. On a 5-point scale, a score of three or higher is considered passing, and you will receive college credit for the course when you enroll at most colleges and universities. You may alternately take freshman chemistry and should find the course an easy review. I think you will find that AP Chemistry is a wonderful addition to your education. You have proven your skills to this point: It is time to take the next step. Remember at all times that your goal is to gain an insight into the subject of chemistry and my job is to help you.

SYLLABUS

Chapter	Topics	Required Homework	Days
1 Topics in Chemistry	Fundamental Chemistry Definitions Chemical Problem Solving Measurements: Standard International System Uncertainty & Significant Digits Unit Test	2, 4, 5, 6, 8, 15, 19, 21, 26, 28, 30, 33, 35, 36, 37, 38, 40, 42, 46, 52, 55, 57, 59, 60, 62, 67, 70, 72, 77, 78, 82, 83	3 to 5
2 Components of Matter	Elements, Compounds & Mixtures Laws of Definite & Multiple Proportions Atomic Mass: Isotopes Naming Ionic & Covalent Compounds Separation Techniques Unit Test	1, 2, 5, 7, 8, 22, 24, 29, 39, 41, 44, 47, 49, 53, 54, 55, 56, 58, 60, 61, 63, 66, 70, 73, 74, 78, 79, 81, 82, 83, 84, 86, 87, 88, 90, 91, 92, 94, 96, 99, 100, 101, 102, 103, 104, 106, 108, 109, 110, 111, 112, 113, 116, 117, 136, 143, 152, 158	5 to 7
3 Stoichiometric Reactions	Mole Concept Determination of Empirical & Molecular formulas Writing & Balancing Equations Chemical Stoichiometry Limiting Reagents Chemical Solutions: Types of Concentrations Unit Test	2, 3, 7, 9, 12, 15, 17, 18, 22, 29, 33, 35, 37, 39, 41, 43, 47, 49, 51, 52, 55, 57, 63, 69, 73, 77, 81, 85, 92, 96, 98, 100, 102, 104, 109, 115, 116, 121, 124, 125, 129, 130, 131, 137, 139	10 to 11
4 Classes of Reactions	Reaction Types Role of Water – Solubility Writing Ionic Reactions Redox Reactions Unit Test	1, 3, 5, 6, 9, 10, 12, 14, 18, 20, 23, 25, 26, 28, 29, 30, 33, 35, 41, 43, 47, 53, 58, 65, 75, 78, 80, 82, 85, 87, 88, 91, 92, 93, 95, 99, 106, 112, 132, 135, 140	9 to 10
5 Gases & the Kinetic Molecular Theory	Gas Laws Ideal Gas Law Graham's Law Kinetic Molecular Theory Deviations From Ideal Behavior Unit Test	2, 6, 10, 11, 12, 13, 17, 19, 22, 24, 26, 28, 30, 37, 39, 43, 45, 52, 54, 56, 58, 65, 66, 69, 71, 78, 79, 80, 84, 91, 99, 113, 117, 122	10 to 11
6 Thermochemistry	1st Law of Thermodynamics/Energy Flow Enthalpy Calorimetry--Lab Measurements/Specific Heat Stoichiometry of Thermochemical Equations Standard Heats of Reaction Unit Test	1, 4, 6, 8, 10, 14, 17, 24, 26 ,28, 32, 35, 37, 41, 47, 50, 54, 62, 63, 65, 72, 75, 77, 81, 82, 99, 103, 108	8 to 10
7 Quantum Theory	Nature of Light Spectrum/Bohr Model Wave-Particle Duality Quantum Numbers Electronic Configuration Unit Test	2, 3, 7, 9, 11, 14, 20, 24, 26, 28, 30, 39, 42, 44, 48, 50, 51, 55, 58, 67, 68, 70	8 to 9
8 Electron Configuration & Periodicity	Development of the Periodic Table e^- Configuration--Relationship to Periodic Table The Aufbau Periodic Trends Relationship of Structure & Reactivity Unit Test	9, 11, 14, 16, 17, 20, 22, 23, 26, 27, 30, 31, 34, 35, 40, 42, 54, 55, 58, 60, 61, 64, 66, 67, 68, 71, 72, 75, 78, 80, 83, 87, 89, 91, 95, 104	8 to 9
9 Model of Chemical Bonding	Type Bonds/Lewis Dot Structures Lattice Energy: Born-Haber Cycle Relationship of Bond Length & Bond Strength Electronegativity Polarity & Ionic Character Resonance & Formal Charge Calculation of Bond Energies Metallic Bonding Unit Test	4, 6, 9, 10, 13, 15, 20, 22, 25, 30, 32, 33, 34, 35, 39, 41, 46, 47, 51, 54, 58, 61, 66, 73, 75	11 to 12

SYLLABUS

Chapter	Topics	Required Homework	Days
10/11 Molecular Shape & Covalent Bonding	Valence Shell Electron Pair Repulsion (VSEPR Theory) Orbital Hybridization Molecular Shape & Polarity Hybridization Molecular Orbital Theory Unit Test	1, 3, 4, 5, 8, 9, 13, 15, 17, 19, 22, 30, 34, 35, 38, 39, 48, 55, 58 1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 20, 21, 32, 34, 38	8 to 10
12/13 Intermolecular Forces in Liquids & Solids	Phase Changes/Diagrams Dipole Interactions & London Force Vapor Pressure Raoult's Law Crystal Lattice Types of Solutions Solution Concentration Colligative Properties Unit Test	1, 3, 4, 5, 7, 8, 9, 13, 15, 16, 18, 19, 21, 24, 28, 29, 30, 32, 34, 36, 37, 40, 43, 47, 49, 56, 67, 68, 84, 88, 121 7, 9, 11, 13, 51, 56, 64, 70, 82, 92, 94, 95, 98, 99, 104, 110, 112	4 to 5
15 Organic Compounds	Alkanes, Alkenes, Alkynes, Aromatic Hydrocarbons Isomerism IUPAC Nomenclature Functional Groups Organic Reactions Unit Test	4, 8, 9, 15, 19, 20, 21, 31, 41, 42, 44, 60, 61, 84, 85	5 to 6
16 Kinetics	Factors Affecting Reaction Rate Average, Instantaneous & Initial Rates of Reaction Rate Law & Its Components Effects of Conc. & Temperature: Collision Theory Reaction Mechanism/Rate Determining Step Unit Test	1, 2, 3, 4, 5, 6, 7, 11, 12, 14, 16, 19, 23, 27, 29, 34, 37, 38, 39, 41, 42, 49, 52, 53, 55, 65, 69, 72, 81, 84, 85, 95, 100, 105, 114	10 to 12
17 Equilibrium	Dynamic State Mass Action Expression Solving Simple Mass Action Expressions Solving for Concentration/Mass Action Expression LeChatelier's Principle/Prediction of Changes Unit Test	1, 6, 7, 13, 15, 17, 18, 23, 25, 26, 30, 33, 36, 41, 44, 47, 55, 58, 59, 64, 65, 69, 71, 90, 92	12 to 14
18 Acid-Base Equilibrium	Acid-Base Behavior Autoionization of Water Proton Transfer/Conjugate Acid-Base Pair Solving Weak Acid Equilibria Weak Base/Relationship to Weak Acid Acid-Base Properties of Salt Solutions Unit Test	1, 2, 4, 6, 8, 9, 12, 14, 16, 17, 18, 20, 21, 22, 24, 25, 27, 31, 35, 37, 38, 39, 40, 41, 44, 45, 48, 50, 51, 53, 55, 57, 59, 63, 65, 69, 72, 73, 88, 90, 100, 108, 116, 117, 119, 121, 123, 132, 133, 137, 140, 147, 165	10 to 12
19 Ionic Equilibrium	Buffer Solutions Acid-Base Titration Curves Unit Test	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 14, 17, 24, 31, 44, 49, 51, 55, 61, 66, 69, 70, 73, 74, 78, 79, 80, 82, 85, 86, 106, 107, 117	8 to 10
20 Thermodynamics	Second Law of Thermodynamics/Entropy Spontaneous Change Entropy, Equilibrium, Direction Unit Test	1, 2, 5, 7, 9, 10, 13, 14, 16, 18, 20, 23, 25, 26, 33, 35, 39, 47, 50, 54, 56, 68, 86	8 to 9
21 Electrochemistry	Half-Reactions & Electrochemical Cells Voltaic Cells Electrochemical Process in Batteries Unit Test	1, 3, 6, 9, 10, 11, 12, 14, 16, 22, 25, 26, 27, 29, 33, 36, 38, 40, 42, 44, 45, 46, 50, 51, 53, 56, 58, 60, 62, 64, 66, 70, 78, 79, 81	6 to 7

THE CHEMISTRY LAB SEQUENCE

(F = Flinn AP lab)

Chapter	Topics
1	Density of Solids and Liquids
1	Phase Changes and Heating Curve
1	Separation of Mixtures
2	Empirical Formula of Silver Oxide (F1)
2	Analysis of a Compound (F2)
2	Chromatography
2	Millikan's Experiment (Virtual)
2	Liquid Chromatography (F18)
3	Molar Mass of Carbon Dioxide
3	Determining the Stoichiometry of Chemical Reactions (F9)
3	Saponification
3	Preparing and Diluting Solutions
4	Gravimetric Analysis (F16)
4	Hydrogen Peroxide (Redox) Analysis (Titration) (F8)
4	Activity Series (F20)
4	Acid-Base Titrations (F6)
4	Selection and Use of Indicators (F11)
5	Determination of the Molar Volume of a Gas (F5)
5	Determining the Molar Mass of a Gas (F3)
5	Determining the Value of the Gas Constant
6	Hess's Law (F13)
7	Absorption Spectrum/Beer's Law (F0)
7	Spectral Analysis (F0)
7	Preparation and Calorimetry of Biodiesel Fuel (F0)
8	Periodic Table Simulation
9	Separation & Qualitative Determination of Cations & Anions (F14)
12	Phase Changes, Cooling Curve
13	Molar Mass by Freezing Point Depression (F4)
15	Synthesis, Isolation, and Purification of an Ester (F22)
16	Iodine Clock Reaction (Kinetics) (F12)
17	LeChatelier's Principle
17	Determination of K_{eq} for FCN^{2+} (F17)
18	Acid/Base (Weak vs. Strong) Titrations
18	Determination of K_A of Weak Acids (F10)
19	Qualitative Analysis
19	pH Properties of Buffer Solutions (F19)
21	Electrochemical Cells (F21)

SOME RECOMMENDED CHEMISTRY SIMULATION SITES

What follows is a list of URLs dedicated to chemistry that were viable at the beginning of the school year. You are encouraged to visit the sites and experiment with the simulations. I will use some of these simulations in class to demonstrate concepts. They are not replacements for the chemistry lab experience, but enrichment material that you may find interesting and helpful.

http://101science.com/Chemistry.htm
http://accad.osu.edu/~midori/GasLaw.html
http://antoine.frostburg.edu/chem/senese/101/index.shtml
http://chemistry.umeche.maine.edu/~amar/fall2004/Millikan.html
http://galileo.phys.virginia.edu/classes/109N/more_stuff/Applets/
http://intro.chem.okstate.edu/1314F00/Laboratory/GLP.htm
http://learningscience.org/
http://micro.magnet.fsu.edu/electromag/java/rutherford/index.html
http://phet.colorado.edu/new/index.php
http://projects.edtech.sandi.net/kroc/scimethod/
http://tre.ngfl.gov.uk/server.php?request=cmVzb3VyY2UuZnVsbHZpZXc=&resourceId=12811
http://www.baruch.cuny.edu/tutorials/weissman/chemlab/
http://www.cassiopeiaproject.com
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/animationsindex.htm
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/simDownload/index4.html
http://www.chem1.com/chemed/genchem.shtml
http://www.chemcollective.org/
http://www.chemtopics.com/index.html
http://www.chm.davidson.edu/ronutt/che115/Stoich/Stoich2.htm
http://www.colby.edu/chemistry/OChem/DEMOS/MassSpec.html
http://www.colorado.edu/physics/2000/index.pl
http://www.edinformatics.com/il/il_earth.htm
http://www.explorelearning.com/index.cfm?method=cResource.dspResourceCatalog
http://www.falstad.com/mathphysics.html
http://www.quia.com/shared/chem/
http://www.shambles.net/pages/students/simulation/
http://www.techtrekers.com/me.html
http://www.thinkquest.org/library/

THE CHEMISTRY LAB

Nowhere in the high school is the chance for personal injury greater than in the chemistry laboratory. With this in mind, it is imperative that you adhere to all safety procedures, know where all safety equipment is located and how to use the equipment, and follow all of the instructor's directions. Because of the inherent risks when dealing with chemicals, absolutely no misbehavior will be tolerated. Violations will result in expulsion from the lab and loss of credit for the work.

You will be given a tour of the lab facility and its safety equipment. When done, please make sure that you can locate and/or operate the following items:

- Eyewash
- Safety blanket
- Gas valves
- Emergency gas valve
- Shower
- Ground Fault Interrupter circuit
- Hoods and switches
- Goggles
- Lab coats

Some rules of the lab are:

1. Always wear goggles during an experiment.
2. Neither equipment nor chemicals leave the chemistry room.
3. No student should ever be in the stock room unless accompanied by the instructor.
4. Always turn off your gas valve at the end of the lab.
5. Put all equipment and materials back.
6. Put all safety equipment back.
7. Sponge and dry your lab station after use.
8. Report all injuries, no matter how slight.
9. Never taste any chemical!
10. Handle toxic and flammable substances under the hood.
11. Never insert glass tubing into rubber stoppers without the instructor's supervision.
12. When heating substances in a test tube always point the mouth of the tube away from other people.
13. Keep all solids out of the sink.
14. Do not use water jets for drawing water for casual use or cleaning up.
15. Return all stoppers or lids to chemical containers immediately after drawing the correct amount of chemical.
16. Never return unused portions of chemicals to their original containers.
17. Never add water to an acid.
18. Use clean equipment at all times.
19. When using a Bunsen burner or other equipment utilizing rubber tubing, ensure that there are no kinks in the tubing.
20. Keep all glassware and materials away from the edge of the lab table.
21. Clean up all spills promptly, using large quantities of water.
22. Avoid loose clothing in the lab. Roll up sleeves and tie back hair.
23. Keep combustible materials away from open flames.
24. Never take a reagent to your lab station.
25. Thoroughly read and prepare for a lab before the lab. Do not expect to walk into an experiment and be permitted to perform the experiment if you are not familiar with the objectives, procedures, and safety concerns.

A complete guide to lab safety can be found at http://www.cpsc.gov/CPSCPUB/PUBS/NIOSH2007107.pdf.

THE CHEMISTRY LAB REPORT

[Parts of these instructions are from Steve Marsden of Harvard-Westlake School and have been adapted to accommodate our lab, calendar, and classroom. Remember: The time to clarify any questions is before you submit your final report, for doing so will save us both time and anxiety.]

The laboratory report is first and foremost a record of one's work in the lab. Lab reports are as personal as the instructors that require them: Some are highly detailed, rigidly composed works while others are little more than anecdotes. Einstein might have said it best: “Make things as simple as possible, but no simpler.” If that seems an obvious statement, consider the fact that many students insist on recording experimental observations and data on their hands, scraps of paper towel, toilet tissue, etc. Of course these items are never turned in, and, therefore, instructors assume that at one point or another this data was transcribed.

A good scientist learns to "work" in a notebook just as surely as he or she learns to work in the lab. While an expert at lab note-taking may produce a notebook that is a work of art, the ultimate aesthetic appeal of a notebook is far less important than its logical sequence and clarity as a record of investigation. "Wanting it to look neat" is therefore not an acceptable excuse for not entering all data and observations directly in the notebook. Neatness comes with thought and lack of haste in recording. "Think first, then write" should be a motto.

So what exactly goes into a lab notebook? The requirements vary from situation to situation, but *for this course* you are responsible for the guidelines given below:

1) at the top of the first page of an experiment:
   - the complete experiment title
   - the date
   - you and your partners’ names
2) the abbreviated experiment title at the top of EACH succeeding page
3) the record of the lab:
   - the procedure you followed
   - the data, with UNITS
   - observations, in simple comment form, that are pertinent

Each experiment should begin with a *brief* statement of what is to be accomplished (the "purpose"). *Why are you doing it? What are you trying to find out? Rarely is the purpose simply "to measure..." or "to determine..."*. Generally we are trying to find out something or make something and test its properties. That is the immediate goal out front but behind it lies an exploration of important principles. This initial statement should indicate that you are not just doing the experiment because it is next on the syllabus.

The supplies and equipment or materials used for the lab should follow the purpose. Listing the materials allows another to replicate your lab or to visualize your setup. When necessary, make sure that units are attached to the materials. It is not sufficient to reference a solution without also stating the solution’s concentration and volume. Likewise, choosing the right containers insures accuracy and economy, so include volume or mass capacities where appropriate.

The next section might be called the "method" but it should be more than a list of steps you will follow to get out of the lab as quickly as possible. Explain how you intend to accomplish your task(s). Details such as "I will add 3 mL of HCl" are inappropriate. A statement such as "I will dissolve the metal sample in 12 M HCl", followed by a balanced equation, is entirely appropriate. *A "method" is NOT an entire procedure.* There is no expectation that another person could pick up your report and reproduce the entire experiment without any other information. That is not the point. *What is expected is that someone who knows something about chemistry would be able to follow the gist of what you did and understand the purpose behind what you did.*

This is an appropriate section for some preliminary literature references (e.g., "the free energy for...is... (CRC Handbook, 52nd ed., p.xxx) but no values are found for... which will be determined by ... ").

Your daily work will follow. Data should be recorded in neatly prepared and numbered tables. Numbering of the tables will facilitate discussion of results at the conclusion of the experiment. *Because many experiments* *extend over several days (or longer) it is important to get in the habit of dating entries in a table or on a page.* In general, record any pertinent observations. Non-numerical information may be written in simple comment form. Be sure to record primitive data--for example, initial and final buret readings, not the difference done in your head.

Finally you should indicate how the information you obtain in the lab will be used to achieve the purpose. This can take many forms. At the very least, lay out the calculations to be done with the numerical data. Any discussion of your calculated results is appropriate *whenever* you notice that things are going wrong or when you reach the end and need to compare with literature values, etc. Don't simply fill up a page with numbers. Be sure to include mention of error (be specific!) and touch on any other things listed in the conclusion section for the experiment.

At the end of an experiment, you will need to tie up all of the loose ends to make ONE END. You should begin by trying to show how your work addresses the goal you set out to accomplish. This can often be done neatly with a summary table comparing your calculated results with (referenced) literature values.

An error analysis of the type requested with the particular experiment is a MUST. Detecting error is generally simple since results will not agree with theory or handbook data. *Explaining* error is another matter. An acceptable error analysis is specific to your results and not general. Blaming instruments is NOT a legitimate recourse. Instead, you must go back through the experimental procedure and decide where an error could have been made that would result in the high/low or outrageous value. Then you must judge the likelihood of having made such an error and explain its impact on your results. Some experiments by their nature *cannot* yield accurate data. This is also a possible avenue for discussion but it must be backed up with theory.

Comments pertinent to your experience in the lab are fine. The style should be first person and relatively informal, but accurate. Don't be verbose, but try to discuss intelligently what you did and why it shows (or does not show) what you set out to show. If the experiment went wrong, what would you do differently if you had more time?

What follows are two abridged examples for an experiment in the course. This is not an invitation to copy but rather an attempt to clarify some of the general comments on the preceding pages. Compare the "bad" example with the "good" example. Try to avoid the former.

BAD
DATE: 11/11/09
EXP. NUMBER: 11
TITLE: Oxidation-Reduction Titrations
NAMES:

- James Madison
- James Monroe
- John Quincy Adams

PURPOSE:
To learn to titrate solutions.
METHOD:
First we assembled the equipment. Then we got the solutions and put them in beakers. After that, we titrated the solutions to get the concentrations. Finally, we cleaned up.
CALCULATIONS:
8.92 x 0.001 = 0.0892
0.02 moles/0.0892 = 0.2242153 M
ERRORS:
We read the buret wrong on the second trial.

GOOD
DATE: 11/11/09
EXP. NUMBER: 11
TITLE: Oxidation-Reduction Titrations
NAMES:

- George Washington
- John Adams
- Thomas Jefferson

PURPOSE:
To standardize a solution of potassium permanganate by redox titration with a solution of iron(II) ions, and to take a solution of oxalic acid titrated with permanganate solution to determine the concentration of oxalic acid.
MATERIALS:

- Buret, 50 mL
- Ring stand
- Erlenmeyer flasks, 250-mL, 3
- Buret clamp
- Hot plate
- Potassium permanganate, $KMnO_4$, ≈0.02 M, 100 mL
- Thermometer
- …

METHOD:
Part 1. Standardization of a Potassium Permanganate Solution
1. Take two 100-mL beakers and put about 80 mL of potassium permanganate into one beaker and 50 mL of the 0.100 M Fe^{2+} solution in the other 100-mL beaker.
2. Attach a buret clamp to a ring stand.
3. Add a clean 50-mL buret (Rinse the buret with 10 mL of deionized water and then with two 5 mL portions of MnO_4^- solution).
4. Make sure the stopcock is closed and fill the buret with MnO_4^- solution. The solution should be above the zero mark on the buret.
5. Get rid of any air bubbles from the tip of the buret by opening the stopcock. The liquid level should stay between the 0 and 10-mL marks.
6. Record the initial level of the MnO_4^- solution into the Part 1 Data Table.
7. With a 10-mL pipette, transfer 10 mL of the 0.100 M Fe^{2+} solution to a clean 250-mL Erlenmeyer flask. Record this volume in the Part 1 Data Table.
8. …

DATA:
Part 1:
Molarity of Fe^{2+}: 0.100 M

	Trial 1	**Trial 2**	**Trial 3**
Volume of Fe^{2+} solution titrated	10.00 mL	10.00 mL	10.00 mL
Initial Volume of MnO_4^- solution	0.65 mL	10.50 mL	20.30 mL
Final Volume of MnO_4^- solution	10.30 mL	20.30 mL	29.90 mL
Volume of MnO_4^- added	9.65 mL	9.80 mL	9.60 mL

…
CALCULATIONS & CONCLUSIONS:
Molarity of MnO_4^- = (1/5) Moles Fe^{2+}/L of MnO_4^- solution
Moles Fe^{2+}(aq) = $M_{Fe2+} \times V_{Fe2+}$ = (0.100 moles/L) × 0.01000 L
Moles Fe^{2+}(aq) = 0.00100 moles
Trial 1: Molarity MnO_4^-(aq) = (0.200 × 0.00100 moles)/0.00965 L= 0.0207 M
Trial 2: …
After completing this experiment, we calculated that the average concentration of the permanganate solution was .0198 M, which was only a 1% error from the expected value of .02 M.
ERRORS:

- The shades of pink that we detected may have been slightly beyond the equivalence point, which made the amount of solution added too high.
- Each person in the room was breathing CO_2 which may have affected the reaction inside the flasks.

…

Each group is responsible for one lab report, so choose your partner(s) wisely. The report will be submitted via Google Docs online and annotated by me. Don't forget to give me access to the report! If I cannot see the report it I will assume that it is not done by the deadline, whereupon points will be deducted.

Hopewell's Google Docs site is located at http://docs.google.com/a/hasd.hopewell.k12.pa.us where your login is the same as the school's server but your password has the first letter of your last name appended to it. In the spirit of collaboration, all partners must contribute equitably to the final report. Google Docs does track revision history and a record of all contributions is readily available to anyone that has editing access to the report.