Intermediate Physics Laboratory (PHY 3802L-0001)

Class held in MSB 333A, Tuesday and Thursday 12:00-2:50 PM

Instructor: Dr. Chris J. Bennett
Office: PSB308
Email: Christopher.Bennett@ucf.edu

Lecture 2 – Scientific Writing

Grading Criteria

Grading:

Introductory quizzes/homework	15%
Laboratory interviews	10%
Laboratory notebook and execution of experiments	10%
Laboratory write-ups	50%
Final oral presentation	15%

Grading Scale:

Your final letter grade will be determined by your total score according to the following scale:

100% ≥ **A** ≥ 90% 90% > **A-** ≥ 85%

85% > **B+** ≥ 80% 80% > **B** ≥ 75% 75% > **B-** ≥ 70%

70% > **C+** ≥ 65% 65% > **C** ≥ 60% 60% > **C-** ≥ 55%

55% > **D** 40 % > **F**

Laboratory Notebook & Execution (10%)

Each week, you will also be graded on how well you perform the tasks and set about solving problems (asking the instructor for help at ***every stage*** of the experiment, for example, doesn't show a lot of initiative in this area, but you are encouraged to ask for help when needed)

This grade will be provided each week in addition to the Laboratory Grade on your returned Lab report.

- **5 pts:** Evidence of well-executed experiment, or documentation of sufficient attempts to recover the experiment if something went wrong.

- **5 pts:** Clear presentation of the original data (photo image of the hand-written data page from your note book, must be your own version, even if several students conduct an experiment together, each must have his/her own copy of the original data).

The Lab Report

Lab reports for this course should consist of the following sections:

1) Title & Abstract. Include Authors, as well as the week the experiment is performed and the experiment number.
2) Introduction & Background.
3) Methods. A description of the apparatus used (usually including a schematic or photograph of the instrument)
4) Results. Tabulated and/or graphed data of results.
5) Analysis (can be combined with presentation of results)
6) Summary, Applications & Discussion
7) References
8) Supplemental Information (photographs of your lab book)

Criteria for Lab Report Grading (50% of total grade)

Lab report are always due before midnight of the following Thursday. For example, if an experiment is conducted during the week of Sept 3rd-7th, then its report is due by webcourses to the instructor ***by*** Sept 13th, the next Thursday night (12 am). Late submission of a lab report will suffer a **2pt penalty for every 24 hrs** behind the due date, or **10pts** per week past the due date. *This rule applies to the homeworks as well.*

- **5 pts (10%):** **professional presentation** of the word document (not sure what this means? Go to www.aps.org, find any paper to take a look). Write data in tables where appropriate. Use equation editor in word and number your equations for reference throughout the report, and preferably use a graphing program such as Excel (Origin, Python, R, Matlab, IDL, etc. also acceptable). Tables and Figures should be numbered and labeled. References well formated and cited throughout. Correct title, authors, etc.
- **10 pts (20%):** **Introduction** covers sufficient background, including a concise **literature review** and sufficient theory required to understand how the experiment works, and underlying physics principles. Typically includes a demonstrated **understanding of the underlying phyiscs** behind how the apparatus and/or experiment works.
- **10 pts (20%):** **Description of the apparatus** (usually with annotated photograph and/or schematics). Model number, manufacturer, chemical suppliers, etc. as well as an **overview of the procedure**.
- **15 pts (30%):** clear **presentation and derivation of your results** and analysis of the data (see No. 5 *Analysis* in format specification above). The **error/uncertainty analysis** typically constitutes a significant fraction of the grading criteria for this section (up to 50%).
- **10 pts (20%):** **discussion of the results**, as well as relevant example/application/phenomena based on this experiment. I am expecting different contents from each member in the same group, which means you need to complete this part independently.

Resources for writing scientific articles

(will be uploaded to WebCourses and Website Later Today!

1. Google Scholar: *https://scholar.google.com/*

2. Good, general guide (brief):

https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously

3. Hasselbach et al. (2012):

https://www.liebertpub.com/doi/abs/10.1089/zeb.2012.0743

4. Good, general guide (long!):

http://spie.org/samples/9781510619142.pdf

5. Tenses:
https://services.unimelb.edu.au/__data/assets/pdf_file/0009/471294/Using_tenses_in_scientific_writing_Update_051112.pdf

Present Perfect Tense…

- Examples:

- I **have seen** that movie twenty times.
- I think I **have met** him once before.
- There **have been** many earthquakes in California.
- People **have traveled** to the Moon.
- People **have not traveled** to Mars.
- **Have** you **read** the book yet?
- Nobody **has** ever **climbed** that mountain.
- A: **Has** there ever **been** a war in the United States?
  B: Yes, there **has been** a war in the United States.

Resources for writing scientific articles

(will be uploaded to WebCourses and Website Later Today!

6. Writing an Abstract: https://www.easterbrook.ca/steve/2010/01/how-to-write-a-scientific-abstract-in-six-easy-steps/

7. Writing an Introduction:

https://writing.wisc.edu/wac/writing-an-introduction-for-a-scientific-paper/

& https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4548565/

8. Writing a Methods Section:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4548564/

9. Writing a Discussion:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4548568/

& http://www.biosciencewriters.com/How-to-Write-a-Strong-Discussion-in-Scientific-Manuscripts.aspx

Title, Authors & Abstract (1st page)

Abstract MadLibs!!

This paper presents a _____ method for _____
(synonym for *new*) (sciencey verb)
the _____. Using _____, the
(noun few people have heard of) (something you didn't invent)
_____ was measured to be _____ +/- _____
(property) (number) (number)
_____. Results show _____ agreement with
(units) (sexy adjective)
theoretical predictions and significant improvement over
previous efforts by _____, et al. The work presented
(Loser)
here has profound implications for future studies of
_____ and may one day help solve the problem of
(buzzword)
_____.
(supreme sociological concern)

Keywords: _____, _____, _____
(buzzword) (buzzword) (buzzword)

WWW.PHDCOMICS.COM

Please keep this on a separate front page

Title: please provide the experiment number (1-10) as well as the Title of the experiment.

Authors: **Primary Author First**, Secondary Authors second and third… underline your name!. Affiliations are typically given here too (optional).

Abstract: Usually word limited (e.g., 100-250 words). The abstract is part of the title page of the report, but it is a good idea to write it last. It should be a succinct summary of what the reader will find in the report. Typically 1-2 sentences providing background, 1-2 sentences on the aims of this paper, 1-2 sentences on the methods, 1-2 methods on the results, and 1-2 on the conclusions and/or significance of the work.

Example of a 'Structured' Abstract

A&A 604, L8 (2017)
DOI: 10.1051/0004-6361/201731492

Astronomy & Astrophysics

LETTER TO THE EDITOR

The [Y/Mg] clock works for evolved solar metallicity stars*

D. Slumstrup[1], F. Grundahl[1], K. Brogaard[1,2], A. O. Thygesen[3], P. E. Nissen[1], J. Jessen-Hansen[1], V. Van Eylen[4], and M. G. Pedersen[5]

ABSTRACT

Aims. Previously [Y/Mg] has been proven to be an age indicator for solar twins. Here, we investigate if this relation also holds for helium-core-burning stars of solar metallicity.
Methods. High resolution and high signal-to-noise ratio (S/N) spectroscopic data of stars in the helium-core-burning phase have been obtained with the FIES spectrograph on the NOT 2.56 m telescope and the HIRES spectrograph on the Keck I 10 m telescope. They have been analyzed to determine the chemical abundances of four open clusters with close to solar metallicity; NGC 6811, NGC 6819, M 67 and NGC 188. The abundances are derived from equivalent widths of spectral lines using ATLAS9 model atmospheres with parameters determined from the excitation and ionization balance of Fe lines. Results from asteroseismology and binary studies were used as priors on the atmospheric parameters, where especially the $\log g$ is determined to much higher precision than what is possible with spectroscopy.
Results. It is confirmed that the four open clusters are close to solar metallicity and they follow the [Y/Mg] vs. age trend previously found for solar twins.
Conclusions. The [Y/Mg] vs. age clock also works for giant stars in the helium-core burning phase, which vastly increases the possibilities to estimate the age of stars not only in the solar neighborhood, but in large parts of the Galaxy, due to the brighter nature of evolved stars compared to dwarfs.

Key words. stars: abundances – stars: fundamental parameters – stars: late-type – Galaxy: evolution – open clusters and associations: general

Introduction (& Background)

see also: http://www.wikihow.com/Write-a-Research-Introduction

Often the most difficult parts (Writer's block). Often tackled second to last (just before the abstract), when you know what the rest of the paper consists of.

Introduce the topic of the paper or research area and how it 'fits' into a more broader research area. A good introduction successfully hooks the reader into being interested in the paper.

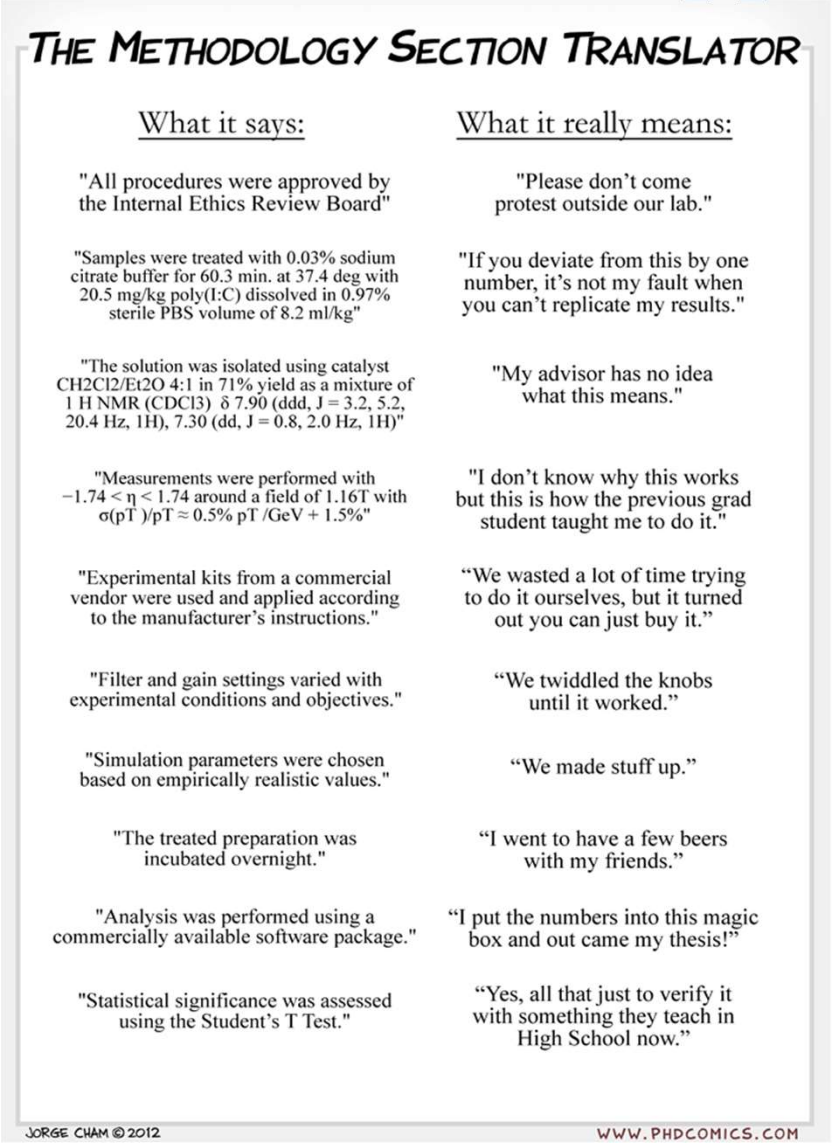
Often requires a brief or extensive coverage of the relevant **literature (review** - citations to previous efforts and relevant areas to the field, are there other notable papers that have made a similar effort to contribute to the field?).

State the specific aims and approaches that will be used in this paper. Compare and contrast to other possible approaches where possible. In general this typically requires **explaining the relevant theoretical background** and is often a place where governing equations are provided (with citations and references where they were obtained if not derived).

Ideally, a **testable hypothesis** is outlined in the introduction that will be covered by the experiment at hand. A ***thesis statement*** is often outlined.

Sometimes how the paper is structured is additionally included in the introduction section (outlining the sections and/or overall approach).

Methods (Apparatus and Procedure)



Explain **what** measurements were made, **how** they were made, and **what they were made with**.

Describe the apparatus and how it works (if not also part of the introduction). It is generally a good idea to include a labeled photograph of a set-up or a schematic of the important parts (**required for this lab**).

Be detailed. **Include instrument model # and manufacturer, chemicals used along with the concentrations, purity and manufacturer. What settings were used? (duration, numbers of scans? Was there a background?)**

There should be sufficient details that a reader can:

i) assess whether your data are sufficient to derive at your conclusions, and

ii) repeat the experiment if necessary (or desired).

If you are following a procedure, summarize it and be specific if any changes made to the apparatus or procedure stating what was different and why the changes were made.

Example of a good (honest) methods section

The Meteoritical Society

Meteoritics & Planetary Science 49, Nr 11, 2017–2026 (2014)
doi: 10.1111/maps.12269

Mid-infrared study of stones from the Sutter's Mill meteorite

Michel NUEVO[1,2], Scott A. SANDFORD[1*], George J. FLYNN[3], and Susan WIRICK[4]

[1]NASA Ames Research Center, MS 245-6, Moffett Field, California 94035, USA

SAMPLE SELECTION, PREPARATION, AND ANALYSIS

Sample Selection and Preparation

The samples analyzed in this work are small fragments from four stones of the Sutter's Mill meteorite (Table 1). SM2 was found in a parking lot and was the only sample studied in this work that was collected before the rainstorm, although it had unmistakably been run over by a car while in the parking lot. We received only a small amount of this fragment, and much of this material subsequently proved to contain fusion crust, although some nonfusion crust material could be analyzed. SM12, SM20, and SM30 fragments were collected after the rainstorm, so that they were probably exposed to water and terrestrial biological contamination. We had enough material from SM12 to select among available

technique biases against large crystals and disperses small particles, generally less than a few μm in size, on the TEM substrate.

Infrared Analyses of the Samples

Stand-alone FTIR Microscope

Infrared spectra of fragments from the SM2 and SM12 samples were recorded with a Nicolet iN10 MX FTIR microscope in the mid-infrared range (4000–650 cm^{-1}, 2.5–15.4 μm), referred to as the molecular fingerprint region because many mineral and organic functional groups exhibit characteristic absorption features in that range. This microscope uses a convention globar light source and a liquid N_2-cooled MCT detector, and is capable of analyzing samples down to about 10 μm in size. IR spectra were collected by averaging 128 scans at a 4-cm^{-1} resolution in "reflection mode" using the spectrometer's OMNIC

Example of a good (honest) methods section

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Abstract–The Sutter's Mill meteorite fell in northern California on April 22, 2012. Several fragments of the meteorite were recovered, some of them shortly after the fall, others several days later after a heavy rainstorm. In this work, we analyzed several samples of four fragments—SM2, SM12, SM20, and SM30—from the Sutter's Mill meteorite with two infrared (IR) microscopes operating in the 4000–650 cm^{-1} (2.5–15.4 μm) range. Spectra show absorption features associated with minerals such as olivines, phyllosilicates, carbonates, and possibly pyroxenes, as well as organics. Spectra of specific minerals vary from one particle to another within a given stone, and even within a single particle, indicating a nonuniform mineral composition. Infrared features associated with aliphatic CH_2 and CH_3 groups associated with organics are also seen in several spectra. However, the presence of organics in the samples studied is not clear because these features overlap with carbonate overtone bands. Finally, other samples collected within days after the rainstorm show evidence for bacterial terrestrial contamination, which indicates how quickly meteorites can be contaminated on such small scales.

Results (or Data)

Explain what the Data is relating back to the experimental procedure followed (short narrative to guide the reader)

Present the pertinent data in easy to visualize formats such as Tables and Graphs. (It is not necessary to put these on a separate page as listed in one of the manuals)

When is it appropriate to use a Table?

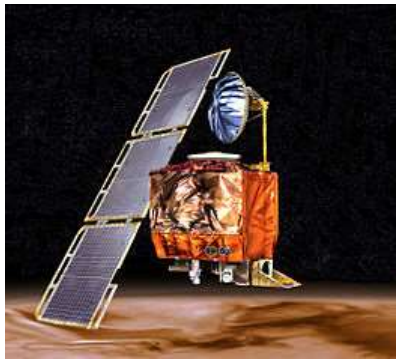
When is it appropriate to use a graph?

What kind of graph is best to visualize the data you are trying to present?

Should the raw data be combined with your analysis of the data?

Use Excel, Origin (recommended), Matlab, Python, etc.

Make sure the Tables and Graphs have appropriate axes labels and units. **Do not use non-SI units!** If non-SI units were originally presented, convert to SI units, but also provide the original non-SI information originally provided.



R. I. P.
Mars Climate Orbiter
1999. ($330M)

Data Analysis & Error Analysis

(Lecture on this next Thursday!)

Note that the Analysis can be a separate section, or combined with the results, or combined with the discussion sections. This is somewhat up to the author how they want to paper to flow.

It is expected to perform an analysis of the confidence limits, derivation of errors and error propagation).

Error Analysis alone can count for up to 15% of the grading of your lab reports.

Where possible, compare your results to standard values from the literature (include citations for your source). The rationale for observed deviations from these literature values (including levels of accuracy) can form part of the discussion, where better methods can be compared and/or suggested.

Use Excel (recommended), Origin, Matlab, Python, etc. to perform data analysis and error analysis. **Let me know if you need help with Excel, Matlab, Origin, Word or Python!**

Be careful with errors and significant figures…

Summary, Applications & Discussion

There should consist of a summary/conclusions either at the start or end of this section; if at the start the summary consists of a short summary of what has been learnt so far.

The summary/conclusion is often the most important part of the paper :

- Summarize the main purpose of the experiment and the most important results
- Compare values to literature where possible and explain why there may be deviations (systematic error?)

Explain how these results are significant (or for our purpose how the original experiment was significant; which may be explained in the introduction – for the purpose of these labs, you may chose to provide historical details up to the time of the experiment and what problems were yet to be solved at the time in the introduction, and the historical consequences and/or applications/implications in the discussion?)

What are the potential applications of this result to science or industry? Did it allow any further groundbreaking discoveries or permit technology that is now used in everyday life, for example? Again, another opportunity to do a literature search to determine how widespread and influential this discovery/experiment has been (or could potentially be).

What was learnt, what are the implications, and what could be improved or investigated in the future now we know the results of this experiment? This could be an opportunity to suggest or discuss improvements to the experiment that could lead to increased precision or accuracy.

It may feel like you are repeating previous parts of the paper, but bear in mind a lot of scientists read only the abstract, or only the discussion section of papers…

This section should be distinct from that of your lab partner.

References (e.g., AIP style)

http://physics.gac.edu/~huber/misc/aiprefs.htm

"The first experimental search of muonium-antimuonium conversion, in 1968, placed a 95% confidence upper limit[1] of $G<5800G_F$ on the four-fermion coupling constant.[2] A number of experiments [3,4] have placed more stringent limits on this conversion. The first run of the current TRIUMF experiment published the limit[5] $G<0.88G_F$ (90% confidence). A preliminary upper limit of $G<0.5G_F$ has been quoted by a LAMPF experiment.[6] Using a longer run than our previous result,[5] we report the final results of the TRIUMF experiment of $G<0.29G_F$ (90% confidence) on the conversion of muonium to antimuonium. "

REFERENCES **(As a separate section, AFTER the discussion)**

[1] J.J. Amato *et al.*, Phys. Rev. Lett. **21**, 1709 (1968).
[2] G_F is the Fermi coupling constant $1.16637(2)\times10^{-5}$ $GeV^{-2}(hbar\ c)^3$, from *Review of Particle Properties*, Phys. Lett. B **204**, 51 (1988).
[3] W.C. Barber *et al.*, Phys. Rev. Lett. **22**, 902 (1969); G.M. Marshall *et al.*, Phys. Rev. D **25**, 1174 (1982); B. Ni *et al.*, Phys. Rev. Lett. **59**, 2716 (1987); Nucl. Phys. **A478**, 757c (1988).
[4] G.A. Beer *et al.*, Phys. Rev. Lett. **57**, 671 (1986).
[5] T.M. Huber *et al.*, Phys. Rev. Lett. **61**, 2189 (1988).
[6] H.J. Mundinger *et al.*, in *Rare Decay Symposium*, edited by D. Bryman, J. Ng, T. Numao, and J.-M. Poutissou (World Scientific, Singapore, 1989).

For websites, put the address and the date accessed.

For Webscourse details, put the file name/location and any dates relevant.

Alternative style (Smith et al. 1996) and then list the references alphabetically. This is generally preferred amongst both readers and authors, but takes up more space…

Supplementary Information

Provide all relevant pages from your Laboratory Notebook. This should have **dates and page numbers**, and a record of all pertinent information.

If you make a mistake, you should cross out the information with ***a single line*** so it is still legible.

Use only black or blue ink. (won't be penalized here unless this is not legible).

ScannerforMe $4.99 from the App store does a fairly decent job, but it should be fine if you want to just use your phone to take a picture. **Please try to make sure it is legible, however; points will be deducted if not.**

If you generate some code (e.g., Python?) you can put it in the supplementary section. Also, if there was data collected that you ended up not using you can place it here.

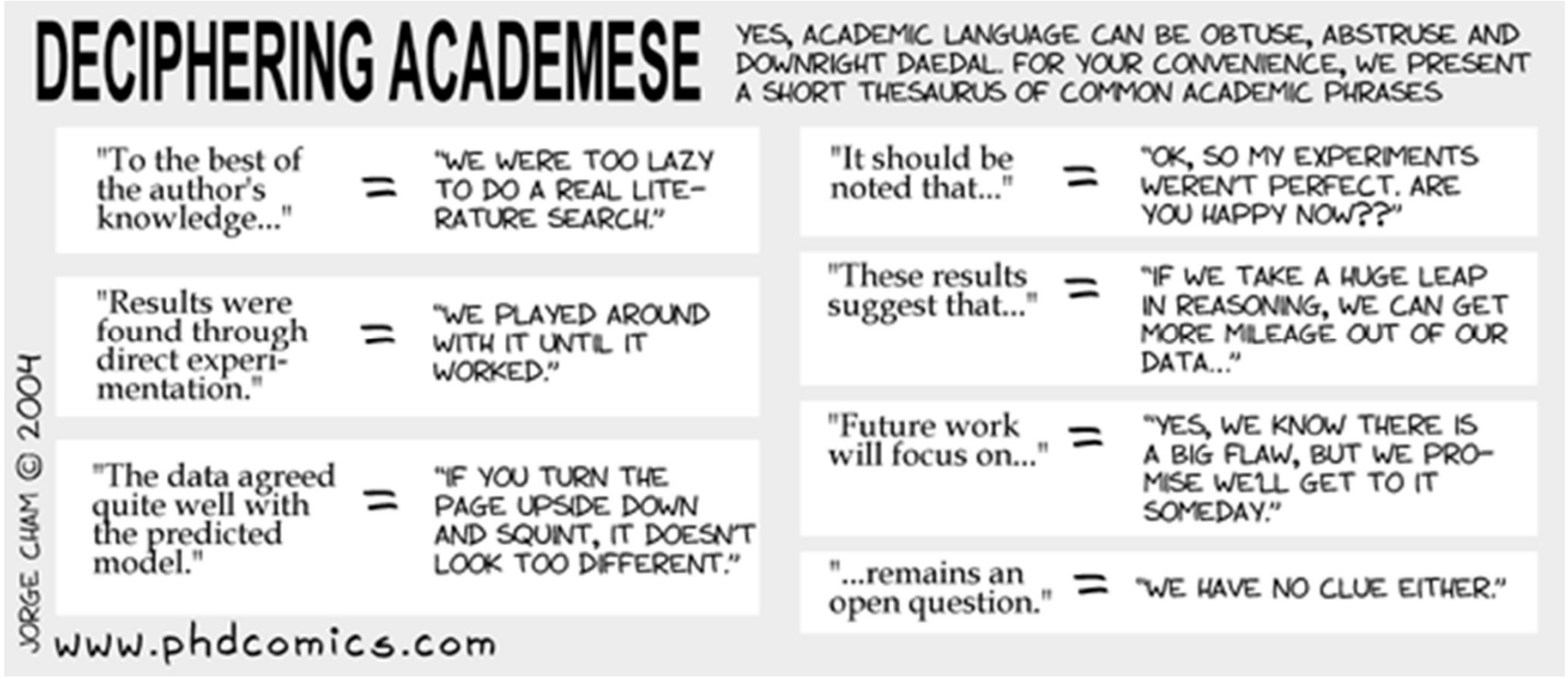
Laboratory Reports – What to Hand in…

(lab reports are due on the Thursday following the week you performed the experiment)

1. Pages of original notes from your lab note book, handwritten in blue/black pen. Different members in the same group can photo copy (for example with your smart phone) the original lab notes and attach the duplicate copy at the end of their own submission, a word document as specified in 2, please place this information at the end of the Word document, titled as *Supplementary Information*.

2. A word document. The name of the word document should be: **ExpNumber_ExpName_LastNameFirstLetterofFirstName**. For example, if John Smith conducted his first experiment on the Franck-Hertz experiment, then his word document should be: ***01_FranckHertEXP_SmithJ***.*doc*. In the document, figures must be plotted by software such as excel, origin, or anything you have on your computer so long as it is legible. The original data from your lab note book must be present in table format in the word document. In the document, figures must be plotted using softwares such as Excel, Origin, Matlab, Python, etc. The original data from your lab notebook must be presented in table format in the document. **All lab reports may be screened by UCF turnitin system to detect potential plagiarism.** ***If confirmed by the system, the student will get an F for the course and will be reported to UCF Office of Student Conduct.***

At the end of the course, you are expected to be an expert in how to write (and translate) scientific articles…



The best ways to get better at writing scientific articles are:

i) Read as many scientific articles as you can

ii) Practice writing scientific articles (e.g., this course)

Some Further Resources

Will be made available through links on webcourses and my website under 3802L teaching page.

- English-Research-Article-Writing-Guide.pdf
- http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtoc.html
- https://www.liebertpub.com/media/pdf/English-Research-Article-Writing-Guide.pdf
- https://www.nature.com/scitable/ebooks/english-communication-for-scientists-14053993/118519636#bookContentViewAreaDivID