The Journal of Undergraduate Neuroscience Education (*JUNE*), Spring 2013, 11(2):A178-A186
Using Chick Forebrain Neurons to Model Neurodegeneration and Protection in an Undergraduate Neuroscience Laboratory Course
By Joseph R Burdo

SUPPLEMENTARY MATERIAL 2

Laboratory Notebooks

BI485
Research in Neuroscience
Dr. Joseph Burdo

Adapted from:
Dr. Brett Couch
Biology Program
University of Minnesota

Lab Notebooks Grading Rubric

"A" Grade

Lab notebook has all or most of the following features:

- θ Title, Date and TA signatures for each entry
- θ Very neat and well organized
- θ Titles are always descriptive enough to understand the objectives of the experiment or entries always contain a summary of the objectives or hypotheses being tested in the experiment
- θ Records are always very thorough (including all steps performed by other group members).
- θ All records (including all steps performed by other group members) have enough detail that an experienced outsider could understand and repeat all experimental steps, understand data tables, calculations etc. without aid.
- θ Raw data and calculations included for all observations (e.g. cell counts, individual A_{600} measurements)
- θ Results and conclusions of experiment are always included following completion of the experiment.

"B" Grade

Lab notebook has all or most of the following features:

- θ Title, Date and TA signatures for each entry
- θ Generally Neat and organized
- θ Title is usually descriptive enough to understand the objectives of the experiment or entries usually contain a summary of the objectives or hypotheses being tested in the experiment
- θ Records are usually thorough (including all steps performed by other group members).
- θ Records (including steps performed by other group members) usually have enough detail that an experienced outsider could understand and repeat all experimental steps, understand data tables, calculations etc. without aid.
- θ Raw data and calculations usually included for all observations (e.g. cell counts, individual A600 measurements)
- θ Results or conclusions of experiment are usually included following completion of the experiment

"C" Grade

Lab notebook has all or most of the following features:

- θ Title, Date and TA signatures for most entries
- θ Adequate Neatness and Organization
- θ Title is usually present but not generally descriptive enough to understand the objectives of the experiment or entries don't always contain an informative or precise summary or the objectives or hypotheses being tested in the experiment
- θ Records are present (including steps performed by other group members) but lack detail.

θ Records (including steps performed by other group members) lack detail making it difficult for an outsider to, repeat all experimental steps, understand data tables, calculations etc. without aid.

θ Raw data and calculations not always included; results of calculations are presented without inclusion of raw data (e.g. calculated cell concentration without raw cell counts)

θ Results or conclusions of experiment are included following completion of the experiment but are not very informative

"D" Grade

Lab notebook has all or most of the following features:

θ Title, Date and TA signatures absent from most entries

θ Notebook messy and unorganized

θ Titles not usually present or are uninformative or entries don't contain a summary of the objectives or hypotheses being tested in the experiment

θ Records are incomplete (steps performed by other group members are not included or are incomplete).

θ Records (including steps performed by other group members) lack detail making it difficult for the instructor to, repeat all experimental steps, understand data tables, calculations etc. without aid.

θ Raw data and calculations are not included

θ Results or conclusions of experiment are not included or are uninformative.

"F" Grade

Lab notebook has all of most of the following features

θ Title, Date and TA signatures absent from entries

θ Notebook illegible and unorganized

θ No descriptions of purpose of experiment

θ Documentation of experiments is cursory, incomplete or incorrect; the lack of detail suggests the student did not have a clear idea of what was done during the course of the experiment or did not participate in lab work

θ Raw data and calculations not included.

θ Results or conclusions of experiment are not included or are totally uninformative or blatantly incorrect.

Laboratory Notebooks: Learning Objectives

Ethical Conduct in Research

Your laboratory notes provide a permanent record of your experiments. This document should reflect the high ethical standards expected of you by your peers, the university and your community. For more information please refer to the BC Research Integrity and Misconduct webpage (http://www.bc.edu/research/oric/compliance/integmisconduct.html)

Effective Communication and Note Taking:

Document experiments with enough detail that you are able to refer back to your notes at a later date and understand the objectives, methods and outcomes of an experiment.

Document experiments with enough detail that technically skilled outsiders can understand them without consulting you for clarification.

Master the Scientific Mode of Inquiry

Develop the self-discipline to keep an accurate, complete laboratory notebook

Document the thought process and ideas for executing experiments, making observations and problem solving during the course of a project.

What is the purpose of a lab notebook?

A lab notebook is

1) A **permanent**, chronological record of experiments. For example, Charles Darwin's notebooks are available online http://darwin-online.org.uk/. These notebooks have lasted over 175 years!

2) A record of ideas and approaches taken during the course of a project.

3) Legal documentation of the timing and outcome of experiments.

Lab Notebook Format

The exact format of lab notebooks varies tremendously among researchers. Most universities and academic departments have common standards or guidelines for maintaining laboratory notebooks. Some researchers keep notes entirely on computer while others use pen and paper recording experiments with varying levels of detail.

While the medium used to keep a notebook may change over the course of your career as a scientist, an important skill you will need to develop is the self-discipline to maintain an accurate, clear record of your experiments by maintaining your laboratory notebook. **The laboratory notebook you use in BI485 will be one of the tangible products that you will produce during this course.** When you are looking for jobs in research labs or interviewing for grad/med school, your lab notebook can serve as a resource demonstrating your organizational skills and ability to keep accurate, clear records of experiments. **SO DO NOT THROW AWAY YOUR LAB NOTEBOOK WHEN THE COURSE IS FINISHED.**

Guidelines and Checklists for Laboratory Notebooks

General Guidelines for Lab Notebooks

1) Records should be thorough and complete with the objective of providing enough detail that an outsider, with background in your field of study, could understand what was done without your aid.

2) Record what you did. Include as much information as possible this includes: observations that may seem trivial, mistakes and deviations from the protocol you are using.

For example,

"I dropped the PCR tube before placing it in the Thermal Cycler".

"DNA extraction was performed from an overnight liquid culture of *Saccharomyces cerevisiae* using the MasterPure Yeast DNA Purification Kit from Epicenter following the manufacturers instructions except that the optional RNase treatment was omitted.

3) Record why the experiment was done. What were the objectives and goals of the experiment that you performed?

4) Include notes on who suggested the experiment, your TA or supervisor, a classmate, or was it your novel idea?

5) Who actually performed the experiment? Since you will be working in groups, one of your partners may have been the one to actually perform the experiment.

Checklist for Formatting Notebooks

θ 1) Use a bound notebook with sequentially numbered pages and carbonless page sets. **NEVER** remove original pages from your notebook. Remove the carbon copies and store them in a safe place, or photocopy the original if there are no carbon copies.

θ 2) Page 1 should consist of a Title Page with:
- θ Your Name
- θ Address
- θ Phone number
- θ Course number
- θ Project description or Title

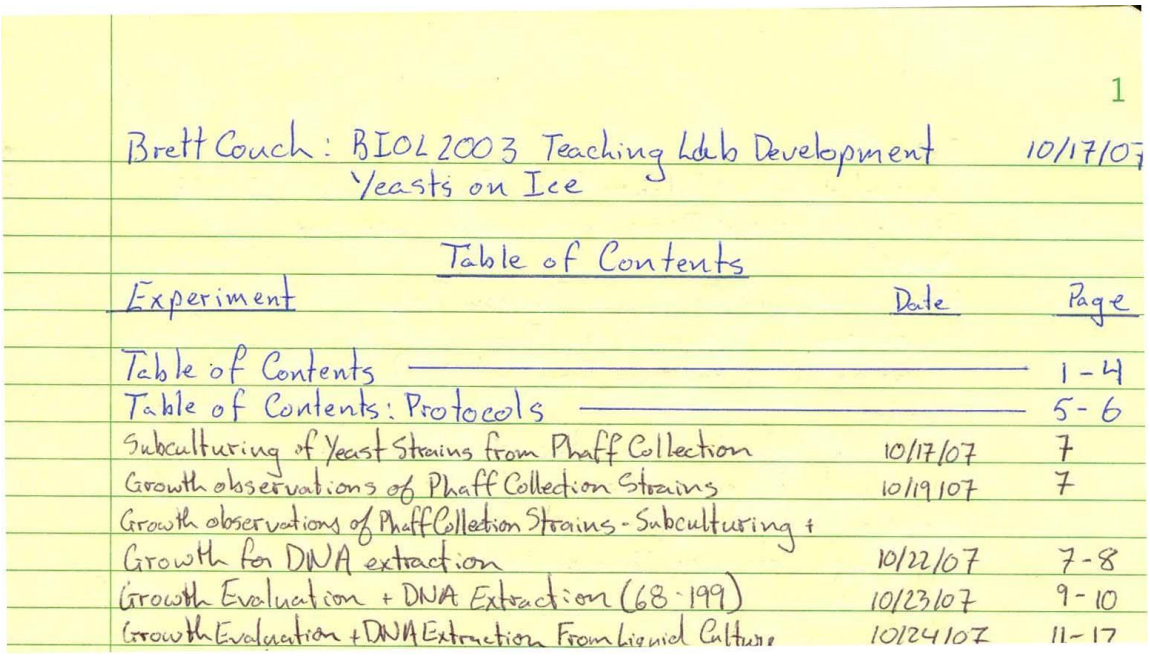
θ 3) Include a General Table of Contents (2-3 pages) with four columns. Please refer to the example table of contents Table 1 and Figure 1 showing the table of contents from an example lab notebook.

The table of contents should include:
- θ The date the experiment was performed
- θ A short (1-2 line) descriptive title
- θ Page number of the experiment
- θ A space for instructor signatures

Table 1 Example table of contents.

Experiment	**Date**	**Page Num.**	**Instructor's Signature**
Table Of Contents		1-4	
Table of Contents: Protocols		5-6	
Subculturing of yeast strains from the Phaff Collection	10/17/07	7	

Figure 1 Table of contents from an example lab notebook.



1

Brett Couch: BIOL 2003 Teaching Lab Development 10/17/07
Yeasts on Ice

Table of Contents

Experiment	Date	Page
Table of Contents		1-4
Table of Contents: Protocols		5-6
Subculturing of Yeast Strains from Phaff Collection	10/17/07	7
Growth observations of Phaff Collection Strains	10/19/07	7
Growth observations of Phaff Collection Strains - Subculturing + Growth for DNA extraction	10/22/07	7-8
Growth Evaluation + DNA Extraction (68-199)	10/23/07	9-10
Growth Evaluation + DNA Extraction From Liquid Culture	10/24/07	11-17

θ 4) Include a Table of Contents for Protocols (2 pages)

Table 2 Example table of contents for protocols.

Protocol	**Date**	**Page Num.**	**Instructor's Signature**
YPD recipe	10/17/07	7	

θ 5) Include a Glossary (1-2 pages) at end of notebook with abbreviations, chemical names, common lab terminology and any terms that an outsider reading your lab notebook may need to understand the material in your notebook.

Table 3 Example glossary

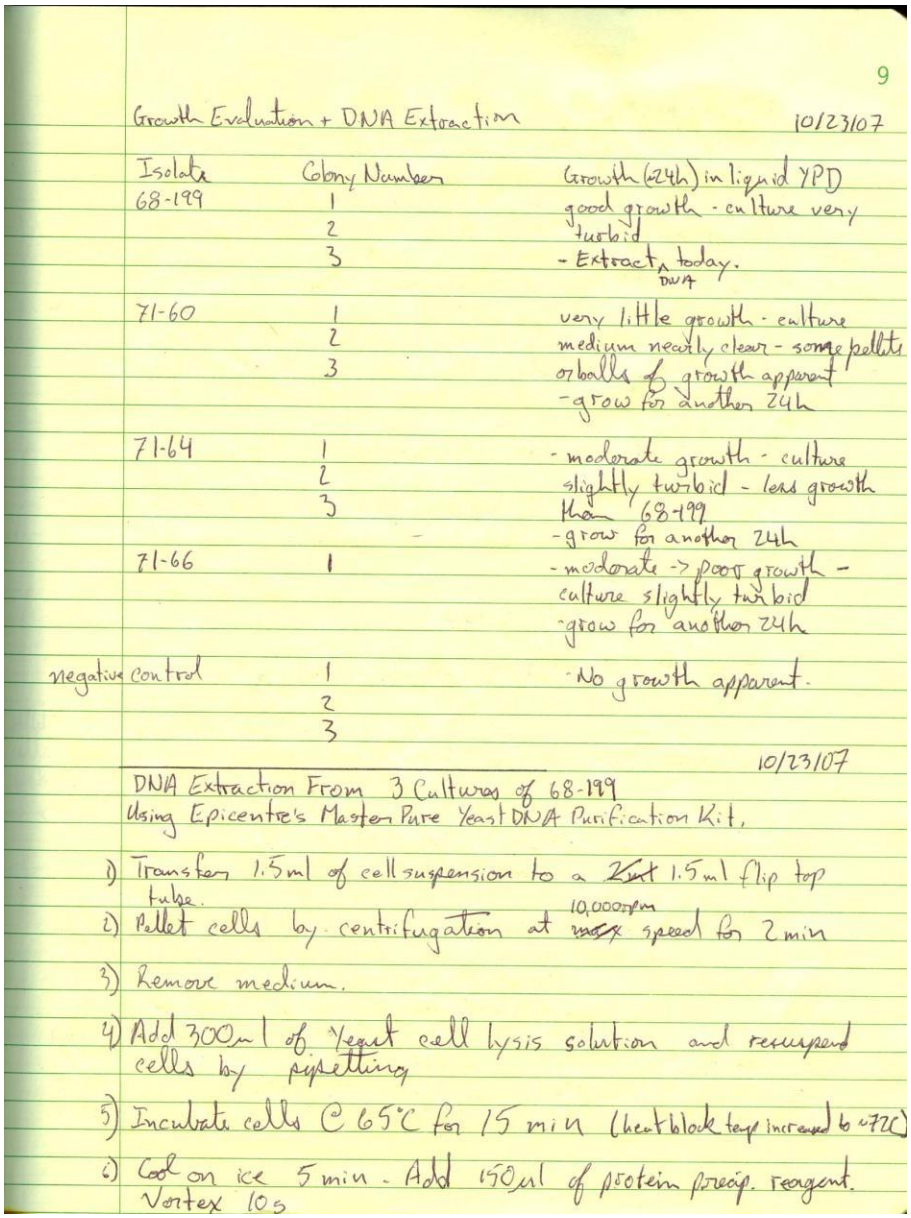
Term / Abbreviation / Chemical Name	Definition / Notes
EDTA	Chemical Name: Ethylenediaminetetraacetic acid A common component of buffers used in molecular biology. Chelates divalent cations such as Mg^{2+}.

θ 6) Entries made consecutively with no skipped pages or spaces. Skipped spaces or pages should be **NEATLY** crossed out with an X (Figure 2, Figure 3).

Do not leave space in your notebook where you will attach pages, notes and protocols after you have finished your lab work. Adding information or notes after an experiment has been performed miss-represents the order of ideas or experiments.

Do not "finish up" lab notes after leaving lab. New entries made outside the lab should be distinct from lab entries and be clearly marked with a new Date and Title (**pg. 11**)

Figure 2 A page from an example lab notebook, Yeasts on Ice, showing consecutive, dated entries on the same page. Separate observations and experiments performed on the same date (10/23/07) have a new title and date to indicate the uniqueness of the new entry.



9

Growth Evaluation + DNA Extraction 10/23/07

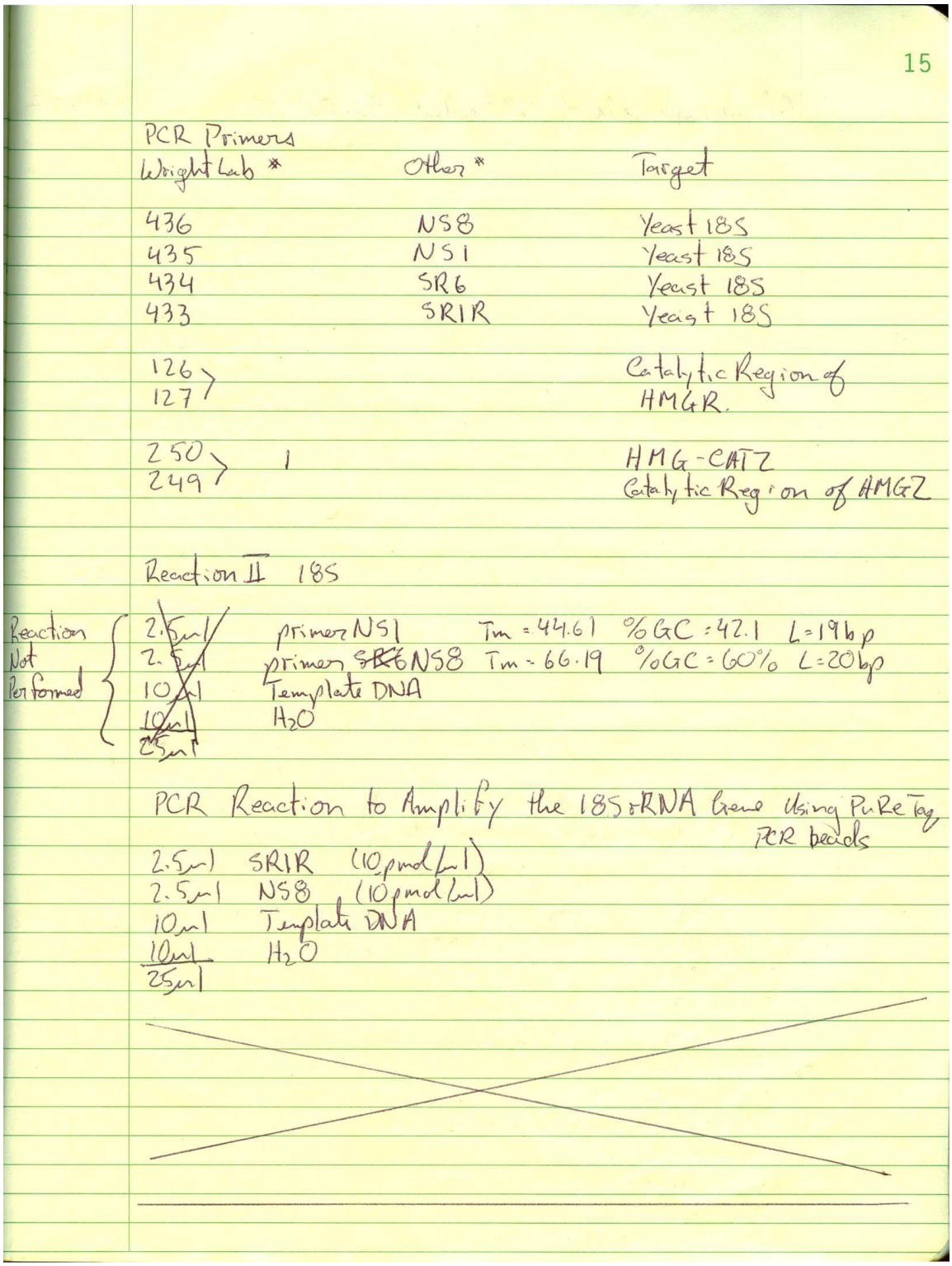
Isolate	Colony Number	Growth (24h) in liquid YPD
68-199	1	good growth - culture very turbid
	2	
	3	- Extract DNA today.
71-60	1	very little growth - culture
	2	medium nearly clear - some pellets
	3	or balls of growth apparent - grow for another 24h
71-64	1	- moderate growth - culture
	2	slightly turbid - less growth
	3	than 68-199 - grow for another 24h
71-66	1	- moderate -> poor growth - culture slightly turbid - grow for another 24h
negative control	1	- No growth apparent.
	2	
	3	

10/23/07

DNA Extraction From 3 Cultures of 68-199
Using Epicentre's Master Pure Yeast DNA Purification Kit.

1) Transfer 1.5ml of cell suspension to a ~~2ml~~ 1.5ml flip top tube.
2) Pellet cells by centrifugation at ~~max~~ 10,000rpm speed for 2 min
3) Remove medium.
4) Add 300ul of Yeast cell lysis solution and resuspend cells by pipetting
5) Incubate cells @ 65°C for 15 min (heat block temp increased to 72C)
6) Cool on ice 5 min - Add 150ul of protein precip. reagent. Vortex 10s

Figure 3 An example where skipped spaces are crossed out neatly with an X.



15

PCR Primers

Wright Lab *	Other *	Target
436	NS8	Yeast 18S
435	NS1	Yeast 18S
434	SR6	Yeast 18S
433	SRIR	Yeast 18S
126 > 127		Catalytic Region of HMGR.
250 > 249	1	HMG-CAT2 Catalytic Region of HMG2

Reaction II 18S

Reaction Not Performed

~~2.5 µl~~	primer NS1	Tm = 44.61	%GC = 42.1 L = 19bp
2.5 µl	primer ~~SR6~~ NS8	Tm = 66.19	%GC = 60% L = 20bp
~~10 µl~~	Template DNA		
~~10 µl~~	H_2O		
~~25 µl~~			

PCR Reaction to Amplify the 18S rRNA Gene Using PuReTaq PCR beads

2.5 µl	SRIR	(10 pmol/µl)
2.5 µl	NS8	(10 pmol/µl)
10 µl	Template DNA	
10 µl	H_2O	
25 µl		

θ 7) Entries must be made in permanent ink. **ENTRIES IN PENCIL CAN BE ALTERED AND WILL NOT BE GRADED!**

θ 8) Entries should be legible (to both yourself and others). Neatness and organization are critically important! Your notes need to be legible and easily read by your instructor.

When making entries ask yourself two questions:

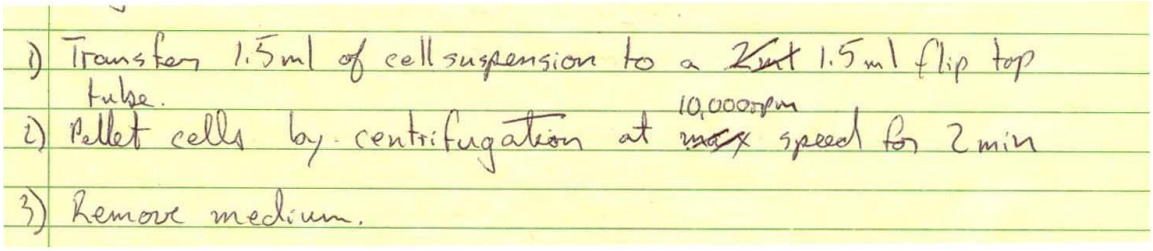
i) Would I show this lab notebook to a potential employer, a Medical School Admissions Board or a jury?

ii) Would anyone else understand what I have done and be able to replicate my experiment?

θ 9) Mistakes should be crossed out with a single or double line and initialed so that the information is still legible (Figure 4)

Do not erase mistakes. Any evidence that mistakes have been erased or entries altered without evidence of the content of the original entry calls into question the validity and truthfulness of all entries made in your lab manual.

Figure 4 An example of a mistake crossed out in a lab notebook. Notice that it is still possible to read the text that has been crossed out.



θ 10) No loose pages.

LOOSE PAGES WILL BE REMOVED BY THE INSTRUCTOR AND DISCARDED

θ 11) If it's necessary to attach external materials such as graphs or photos, do so securely (staple if possible) and write date and identifying info directly on the attachment in case it gets separated.

θ 12) Have your instructor sign and date all of your notebook pages and the table of contents. Please refer to the "**Instructor Signatures Checklist**" (**pg. 12**).

Checklist for Experiment Records

θ 1) Title

θ 2) Date

θ 3) Notes, Reflections and Literature References (if necessary)

θ 4) Objectives

For example:

Why are you doing this experiment?
Are you testing some hypothesis from a previous experiment?
Are you repeating an old experiment?
Who proposed this experiment?

θ 5) Hypothesis (optional – not all experiments testing a hypothesis)

θ 6) Protocol details i.e. materials used, chemical manufacturer, equipment used.
Photos, drawings etc. of experimental setup

θ 7) Results, raw data and observations from the experiment

θ 8) Discussion, interpretation and conclusions

θ 9) Notes and reflections on the outcome of the experiment

θ 10) Given what you discovered from this experiment, what do you plan to do next?

θ 11) Record your experiment in your table of contents.

θ 12) Have your instructor sign and date all of your notebook pages and the table of contents. Please refer to the "**Instructor Signatures Checklist**" (**pg. 12**).

Checklists for Journal Records and Transcribed Notes

You will be using your laboratory notebook as a journal documenting your ideas, discussions with your lab group and teaching assistants as well as pertinent notes from papers you may have read. You will also need to record data and experiments performed by your group members in your lab notes. If group members perform separate tasks, you may not be present for every experimental step in the project. It is important, however, that you have a clear understanding and a permanent record of experiments performed by other group members and the results of these experiments.

Checklist for Transcribing Data From Other Group Members

θ 1) Date (the date you are actually transcribing your notes)

θ 2) Title

θ 3) Make sure the data, protocol etc. is complete and you have enough detail to replicate the experiment if necessary.

θ 4) Indicate the person who actually performed the experiment.

θ 5) Record the date the actual experiment was performed. This date may be different from the date you are transcribing the notes.

θ 6) Record all of the information required for a normal experimental record (**pg. 11**).

θ 7) Record journal entry in your table of contents.

θ 8) Have your instructor sign and date your notebook pages and table of contents when you return to the lab. Please refer to the "**Instructor Signatures Checklist**" (**pg. 12**).

Checklist for Journal Entries

θ 1) Date

θ 2) Participants – if applicable (if it is a discussion i.e. TA name, classmates, lab group members)

θ 3) References – if applicable (if notes on a specific paper or from a specific resource)

θ 4) Record journal entry in table of contents.

θ 5) Have your instructor sign and date your notebook pages and table of contents when you return to the lab. Please refer to the "**Instructor Signatures Checklist**" (**pg. 12**).

Instructor Signatures Checklist

As in many research labs and in industry, every page of your lab notebook will require a signature. The policy on signatures is to ensure that notebook entries are truly chronological and provide proof of participation in lab work. In some labs, such as industrial research and development labs, your supervisor will review all the notes for the

day making sure that they can understand the experimental protocols, notes, methods results and conclusions before signing off on the day's work.

- θ 1) Before beginning lab work for the day, have your instructor sign and date all lab notebook pages filled out before lab, if any.

- θ 2) **ALL** notebook pages need to be dated. This includes the notebook pages containing attached protocols.

- θ 3) **ALL** notebook pages need to be **signed** and **dated** by an instructor. This includes notes and protocols that are made outside of lab. Signatures on the protocol itself are not sufficient.

- θ 4) Instructors will delimit the day's notes with a line below their last signature.

- θ 5) **ALL** table of contents entries need to be **signed** and **dated** by an instructor. This includes entries for notes and protocols that are made outside of lab.

- θ 6) **ALL** notebooks need a permanent table of contents (TOC) in the notebook not on a removable page.

- θ 7) Notebook pages lacking signatures **will not be graded**. It is **YOUR** responsibility to make sure all pages are signed.

Lab Notebooks – Further Reading

Barker, K. "At the bench: A laboratory navigator" Chapter 5 Laboratory Notebooks 2005 Cold Spring Harbor Laboratory Press