Writing Your Honors Thesis

Your thesis should be in the common scientific paper format using FIVE separate sections

- Abstract
- Introduction
- Materials and Methods
- Results
- Discussion

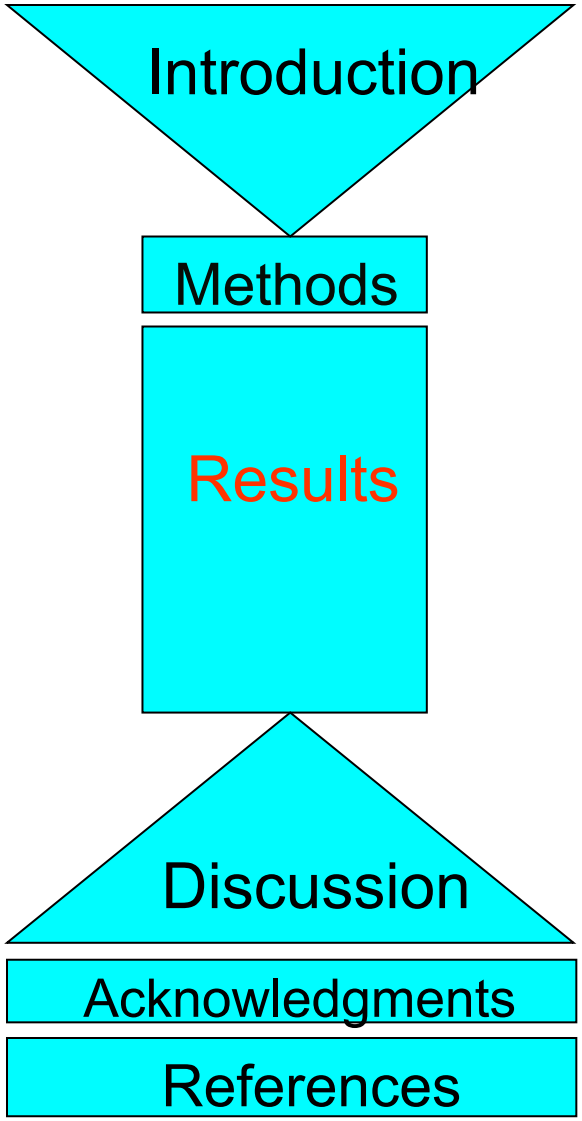
Keep in mind----Your thesis is basically a scientific paper.

You are writing the thesis for fellow scientists in your field.

There are different types of papers (= different types of theses)

- Method
- Descriptive
- Hypothesis

But any thesis needs a solid structure and has a main point



Part	Answers	Goal
Introduction	Why?	What led to this experimental questions
Methods	How?	Enable replication
Results	What?	Share data
Discussion	Significance	Suggest interpretation
Acknowledgments	Who helped?	Give thanks
References	Papers cited	Give credit

General questions

How long should the thesis be?

- Hard to define a specific length (same as for all scientific publications). Longer is not always better.
- Cover the topic, include all **relevant** data. (Not all data!)
- Usually 15-40 double-spaced pages of text.
  - Extra pages for figures and references

Where to begin with the "writing"?

- Should be putting your data into figures now.
- Start writing whatever section is easiest for you.
- Presented data and text can be a starting point.

General Questions

Where should figures go?

- Most journals request that figures are at the end of the manuscript (after references)
- However, for your honors thesis you can include in body of the text or at the end.

How to format text?

- Use 12 pt font. No reason to go smaller.
- Use easy to read font. Standard are Arial, Times, Geneva
- Use double-spaced or single-spaced
- Use single column format not double column
- For ALL of these issues it might be good to ask your PI

General Questions

Deciding what data to use

Which data do you include?

--only data that pertains to your results.

-- only data you generated unless required for story.

Problems with data

--Negative data to demonstrate what did not work.

--Need to distinguish between lack of technique working (including controls) versus issues with obtaining RNA versus variability in the experiments.

(do you have data is a different issue)

General Questions

Types of figures

1) Figures are a pictorial summary

- Graph → Data in connected series
- Chart → Data in separate series
- Picture → Must be seen (Photos)
- Diagram → Model to show concepts

All have figure Legend

2) Tables → Data in an array

All figures MUST have figure legends

Four parts to figure legends

1. Title
   - One sentence to identify the main point of the figure.

2. Brief experimental details
   - Enough details so that the reader can understand the type of assay and explain the data shown in the figure.

3. Definitions
   - Symbols or bar patterns that are not explained in figure.

4. Statistical information
   - Number of samples, p-values, etc.

Table format

- Columns and rows
  - Organize a table so that the similar items read down, not across
- Table has title above and no figure legend but can have footnotes.
- Footnotes are BRIEF explanations about data including: Exceptions, Abbreviations, Statistics
  - Do not write out information that belongs in the results!

Common errors in making figures

small amount of data should not be graphed

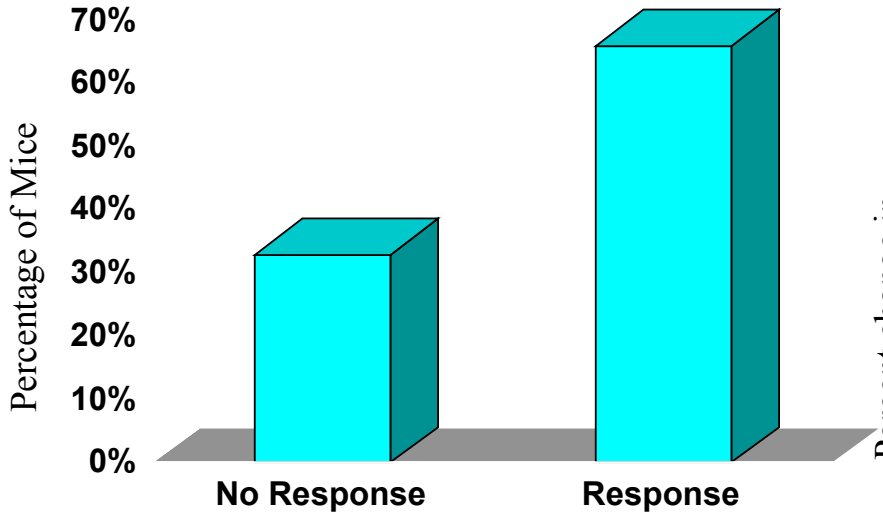


Figure 1. Percentage of mice that responded to amoxicillin treatment. Three mice were treated with 0.5 mg/ml amoxicillin for 7 days.

ANSWER: Include data in text.

Low number of replicates Hard to justify error bars and statistics

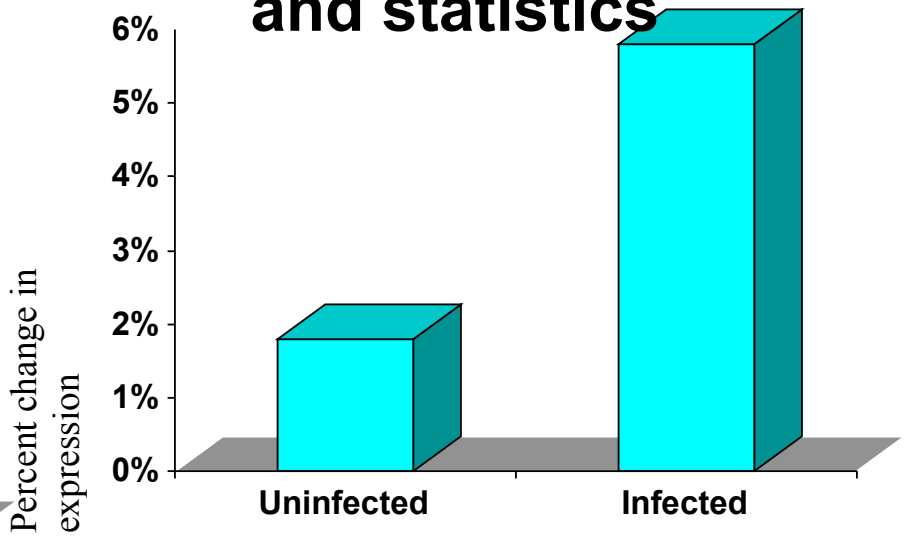


Figure 2. Infected and uninfected cells were tested two times for the change in expression of NF-kB. The average of the two experiments is shown. Infected cells had a greater percent change in expression.

ANSWER: state number of times done. Maybe do not put in fig

How to display the data?

Data from past honors thesis

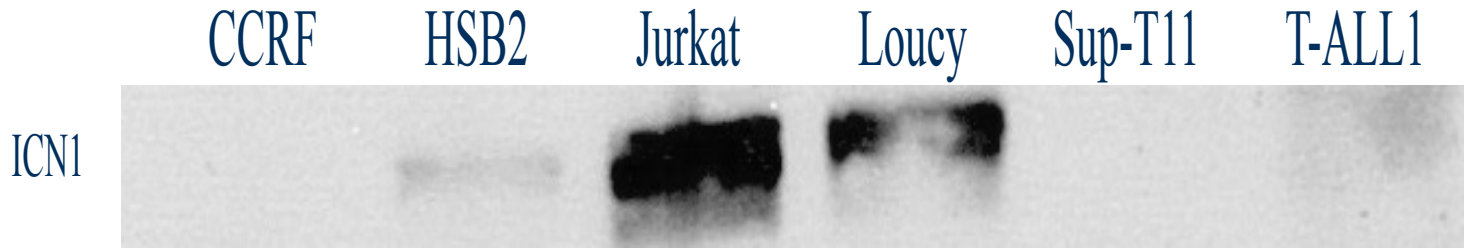


Figure 2A: Intracellular-Notch1 (ICN1) Levels in T-ALL cell lines: Protein was harvested from CCRF, HSB2, Jurkat, Loucy, Sup-T11, and T-ALL1 cell lines in the logarithmic growth phase. The protein was analyzed by Western Blot using an anti-ICN1 antibody.

Do you think this figure is helpful? Needed? Required?

What do you think of this figure legend?

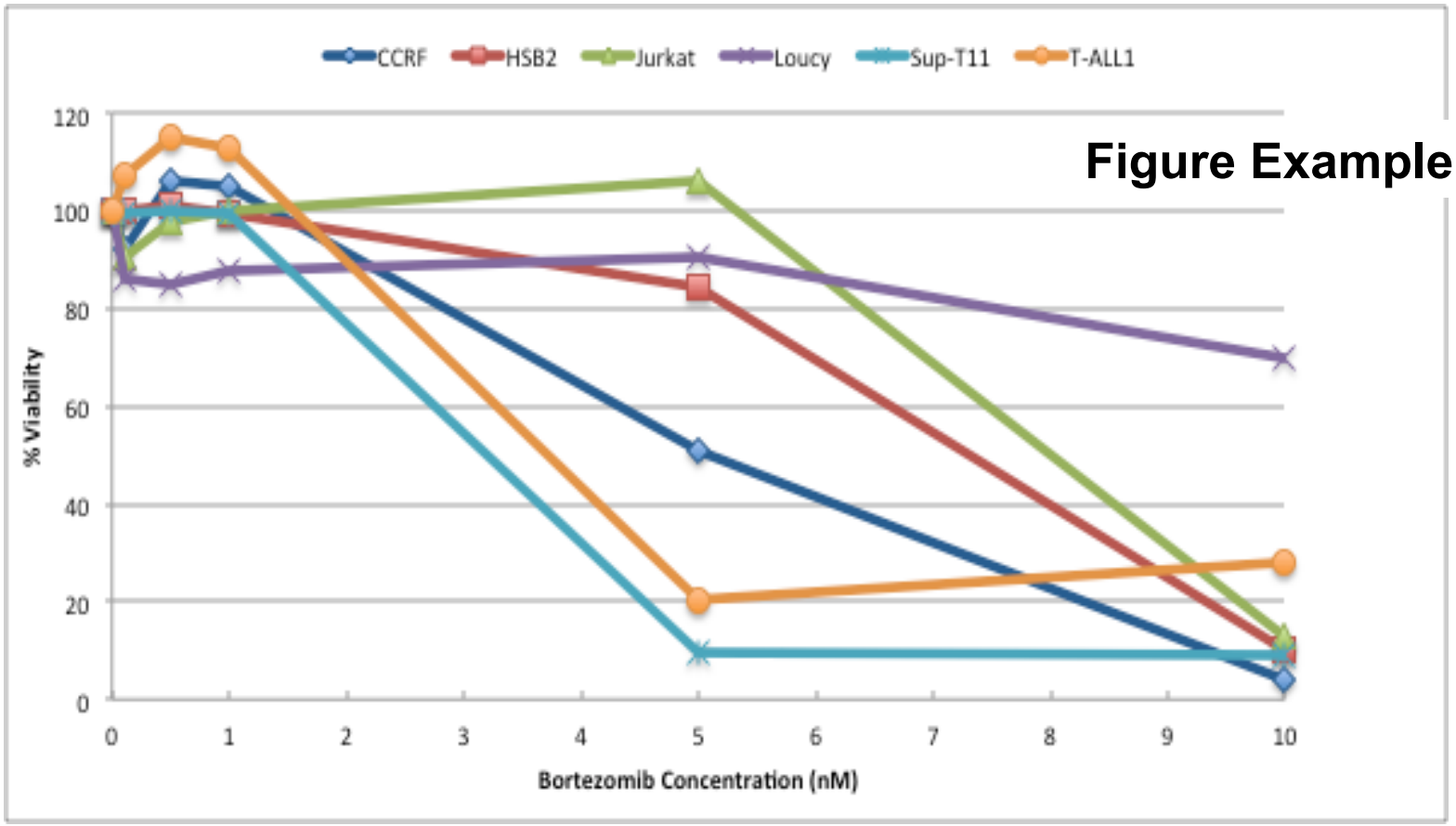


Figure Example

Figure 3: T-ALL Cell lines are variably sensitive to Bortezomib: CCRF, HSB2, Jurkat, Loucy, Sup-T11, and T-ALL1 cell lines were incubated for 24 hours with Bortezomib at .1, .5, 1, 5, and 10 nM concentrations. Cells were stained with Propidium Iodide and viability was analyzed by flow cytometry. Percent viability of each sample was normalized to the viability of untreated cells with a vehicle control..

What do you think of this figure legend?
Can you tell what type of assay was done?

Writing style recommendations

- Science writing is often best with short succinct sentences.
- Use past tense for most sections.
  - Important to use past tense for your data
  - Only present tense for known facts
- Place emphasis deliberately
  - Emphasize important information in power positions
  - Condense or omit less important information
  - Do not start out a paragraph with the problems or what did not work.

Writing style recommendations

- Using first person for descriptions of results.
- This is controversial and many scientists do not feel it is correct to say “I” or “We”

- Active versus passive voice. Whenever possible it is always great to use active voice. But challenging in methods section and describing results. Best papers use combination of active voice with passive voice.

Link Ideas:
Use Transition words

Transition Words
Therefore, / Thus, /In conclusion
First, Second, Finally
For example
However, / In Contrast, / Instead
In addition, / Similarly, / Furthermore, / Also,
Although / Despite / Nonetheless

The language of science writing is more direct than creative writing

Word or Phrase	Preferred for papers
Looked at	Examined
Prior to	Before
Due to the fact that	Because
The vast majority of	Most
Utilize	Use
At this point in time	Now
It has long been known that	USE A REFERENCE!!!

Writing the Thesis

Materials and Methods are often easiest thing to write first. Many times it means taking an existing protocol and converting it to narrative format.

Always include description of samples, strains

For each experiment you should include

- Reaction conditions
- Reagents
- Instruments
- Name and location of suppliers

Level of Detail in Methods

- Important to explain what you did so the experiment could be repeated by another scientist.
  - Not the same as a protocol but similar.
- Specifics of how YOU did the flow cytometry, not how to do flow cytometry.

Reagents

- What was in the reagents?
  - Tris buffer (5 mM NaCl, 5% TRIS, pH 7.6)
  - TE (10 mM Tris-HCl [pH 8.0], 1 mM EDTA)

- Need chemical concentrations in moles or micrograms/milliliters (ug/ml) most of the time.

- Occasionally will only state dilution used.
  - Such as with detergents (0.05% Tween) OR sera (diluted 1:1000 in PBS).

Suppliers

In general in publications, you need to

- List the NAME of a reagent and where you bought it.
  Example: Reverse transcriptase (Amersham Corp., Arlington Heights, IL).

- The Name and LOCATION of the supplier of an instrument.
  Example: Cetus 480 thermocycler (Perkin Elmer, Norwalk, CT)

This is probably less critical in an undergraduate honors thesis.

Abbreviations

- Define all abbreviations once

  TE, TBE, SSC, DTT

- Abbreviations for common techniques or buffers do not need to be defined. (such as RNA, ELISA or PCR)
- But this can vary between fields.

Detail in Methods------ Example

Flow cytometric analysis of spleen cells from infected mice.
After harvest, spleens were disrupted between the frosted ends of two glass slides in complete RPMI medium, which consists of RPMI 1640 (Invitrogen, Carlsbad, CA) supplemented with 10% fetal calf serum (FCS) (Hyclone, Logan, UT), 10 mM Hepes, 200 mM L−glutamine, 10,000 U/ml penicillin and streptomycin, 50 mM 2-mercaptoethanol, 1% non-essential amino acids, and 1% sodium pyruvate. Single-cell suspensions were prepared in flow buffer (PBS/5%FCS/10 mM Hepes/5 mM EDTA/0.05%NaN_3), blocked with anti-mouse CD16 (clone 24G2) hybridoma supernatant, and stained with directly-conjugated monoclonal antibodies (mAbs) against mouse cell surface markers as previously reported (Wu et al 2005).

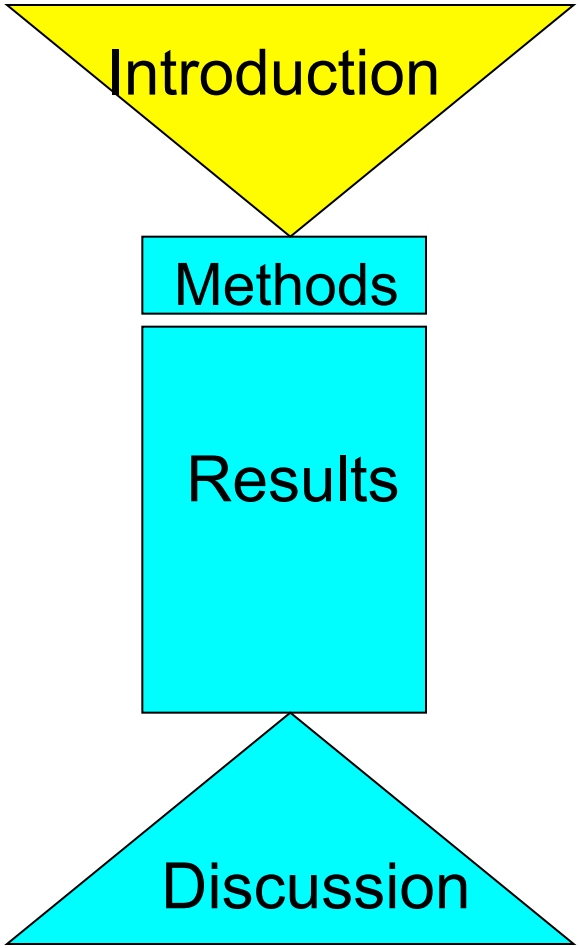
References in Methods

- Can refer to previous paper for methods your lab developed. But be specific.

  Example: NOT CLEAR

  "cells were lysed as previously described (9)"
  BETTER: "cells were lysed by ultrasonic treatment as previously described (9)“

- If referring to other publication often good to briefly review the protocol.
  Example:
  “..as previously described (9). Briefly, cells were lysed by ultrasonic treatment and then...”



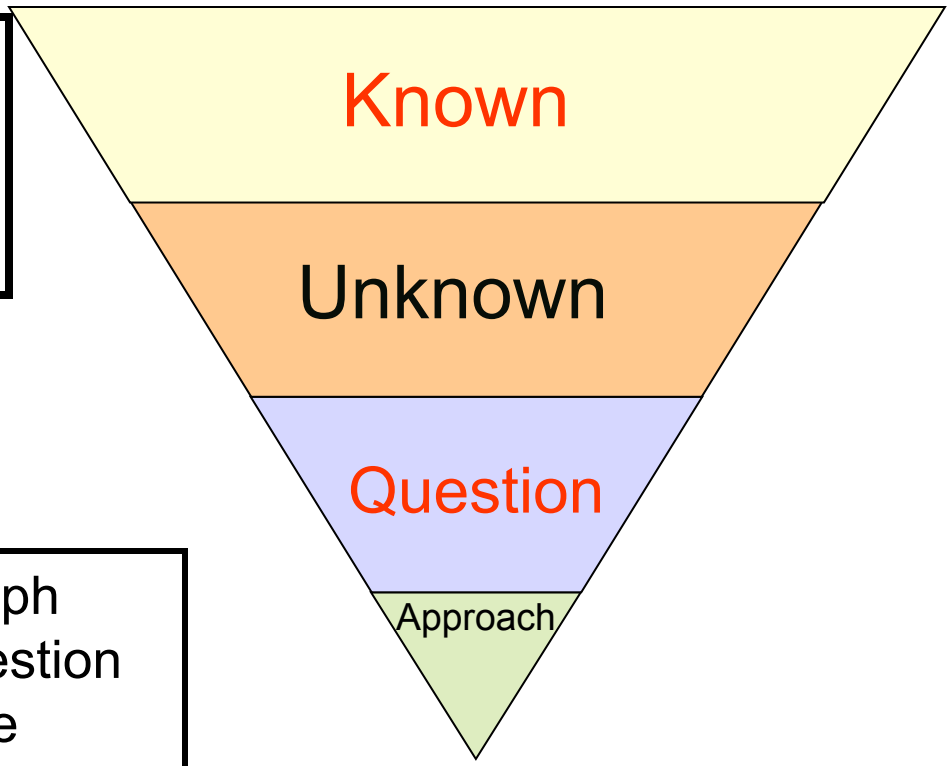
The function of the Introduction is to explain why this study was planned and demonstrate that you understand the purpose of the study.

Should answer:

- Why did you do this study?
- How does it compare to previous work?
- How are you going to do the study?

Flow of Introduction

Describing previous data is the main body of the Introduction



General

Specific

The last paragraph presents the question and how it will be answered. Might include conclusion or results.

References

The Introduction is NOT a review

- You need to present the broad information about WHY this topic is important with references
- BUT you should only provide references that are directly relevant to your topic
- Avoid just referencing review articles of the topic

- How may references do you need? Depends on the topic
- When do you need a reference? Whenever you state a fact or want support for your statements

The Discussion

The discussion is your creative opportunity to:

- Put your data into perspective
  - How does it fit into the field?
- Contrast your results with previous work.

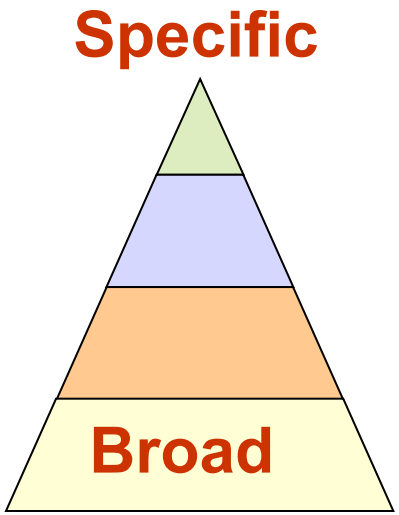
Did your findings agree or disagree with others

- Propose new experiments
- Explain negative data but do not dwell on it

Style

Introduction was
broad → specific

Discussion is the opposite
specific findings → broad implications



Content of Discussion

1) Conclusions
2) Implications/Significance
3) Limitations
4) Future directions

Clearly distinguish between what you have shown vs. what you imagine