Cumming School of Medicine– Graduate Science Education

Written communication

Rebekah DeVinney
Assistant Dean – Graduate Science Education
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Written communication

- How to keep good research notes
- Proposal writing
  - Research proposals
  - Scholarship proposals
- Electronic communication

Research notes: Purpose

- Record what you plan to do
- Record what you have done
- Document your results
- Research notes are a form of communication
  - Between you and your lab mates
  - Between you and your supervisor
- Research notes also a history
  - Future trainees can refer to your notebook
  - What worked, what did not

Thanks to Dr. Tara Beattie

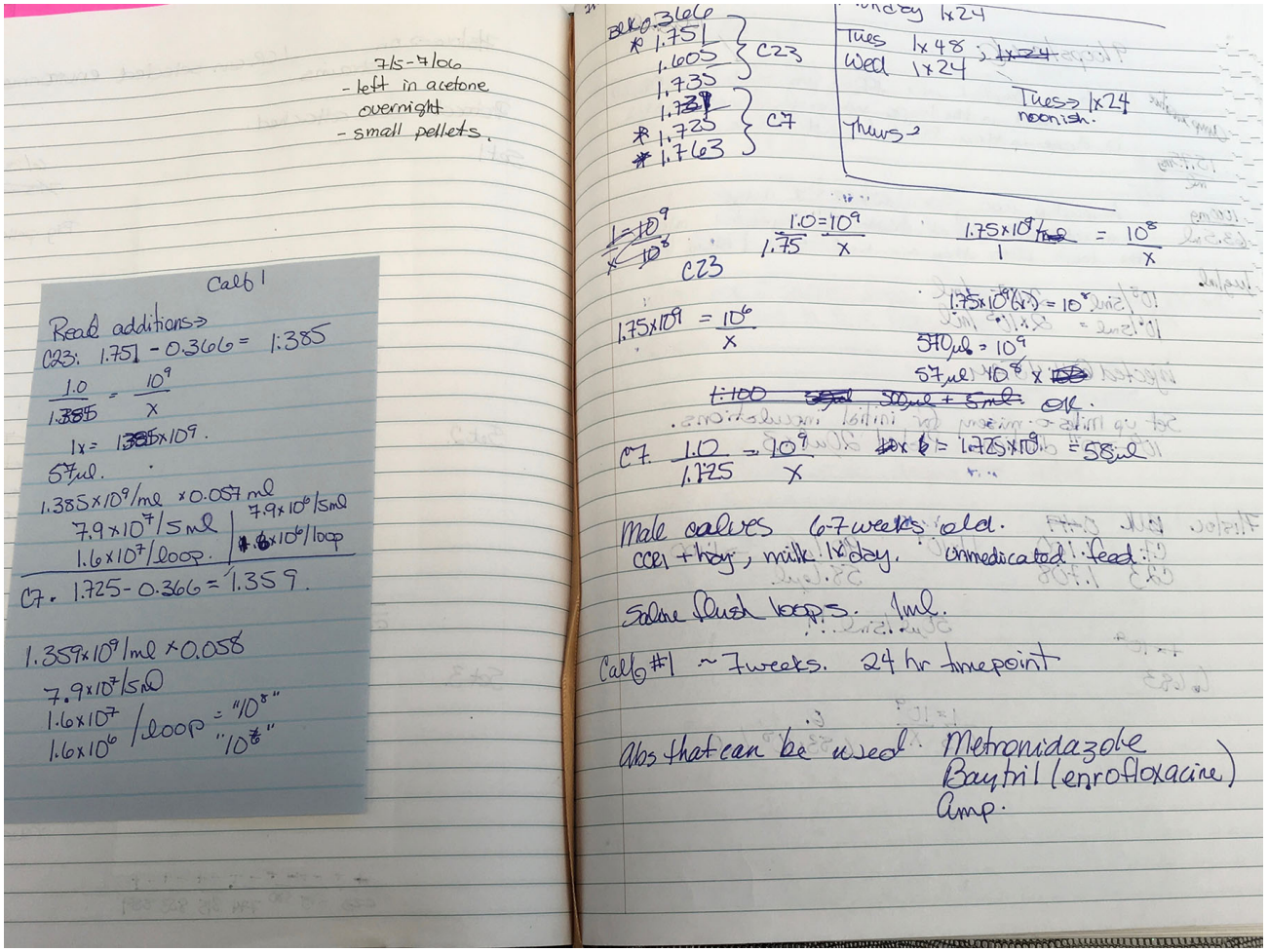
Research notes

- Notes should be understandable by
  - You
  - Your supervisor
  - Your lab mates, present and future
- You will need to go back to your notes later
  - Publications
  - Data reanalysis
  - Lab resource

Research notes

- Start with the date, including year
  - Chronological order of notes most logical
- Why are you doing the experiment?
- Record your methods
  - Any changes, write them down
  - Show your calculations
- Write down any errors or concerns
  - This will allow you to troubleshoot if things do not work
- Document all relevant information, even if you are unsure of its importance in the short term
- You should be able to recreate the experiment years down the road!

All clear in 2010, but maybe not so clear in 2018



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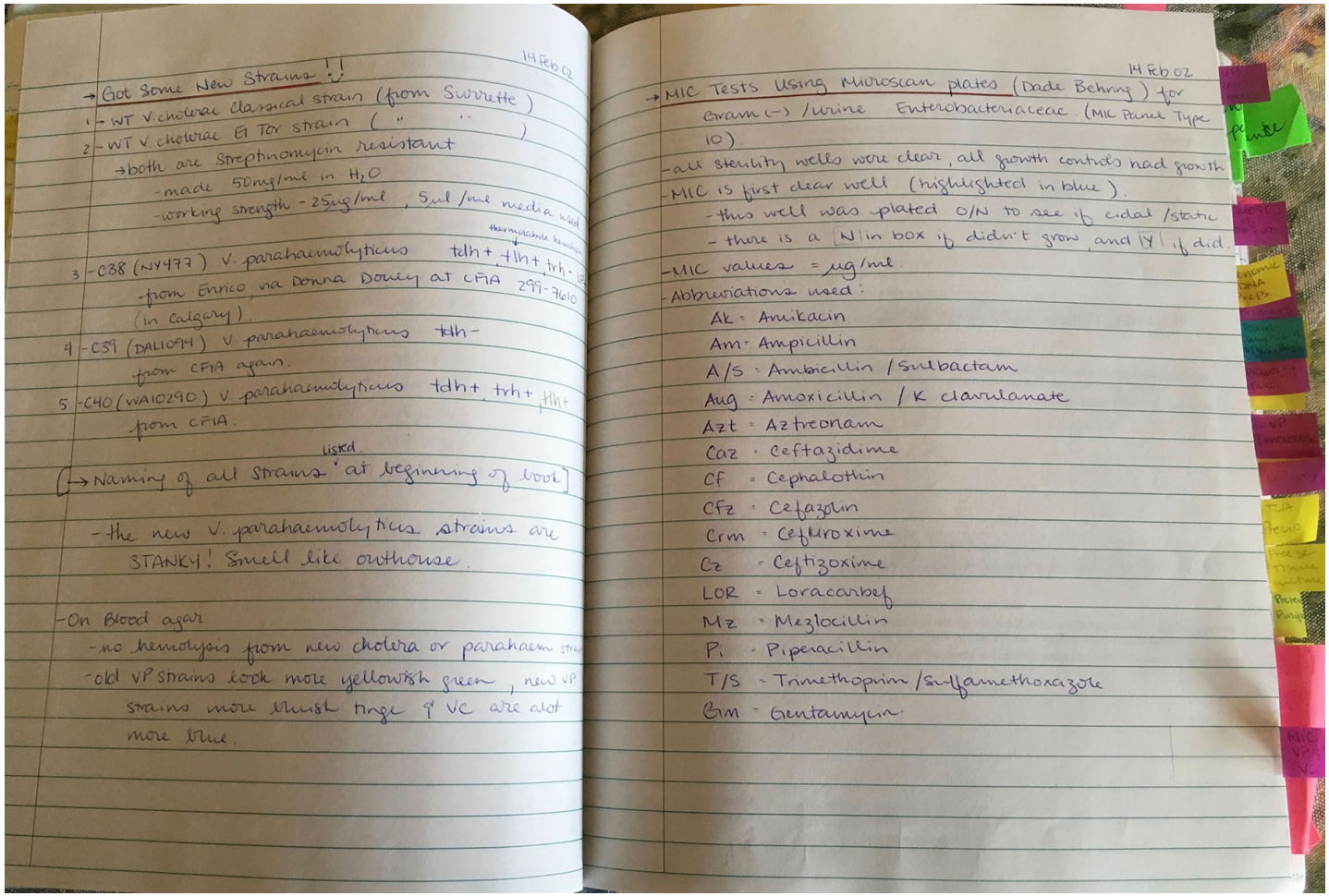
Much better!!!



14 Feb 02

→ Got some New Strains !!

1 - WT V. cholerae classical strain (from Surrette)
2 - WT V. cholerae El Tor strain (" ")
→ both are Streptinomycin resistant
- made 50mg/ml in H_2O
- working strength - 25ug/ml, 5ul/ml media used

3 - C38 (NY477) V. parahaemolyticus tdh+, tlh+, trh- (thermostable hemolysin)
- from Enrico, via Donna Dorey at CFIA 299-7610 (in Calgary).

4 - C39 (DALI094) V. parahaemolyticus tdh-
- from CFIA again.

5 - C40 (WA10290) V. parahaemolyticus tdh+, trh+, tlh+
- from CFIA.

→ Naming of all Strains listed at beginning of book

- the new V. parahaemolyticus strains are STANKY! Smell like outhouse.

- On Blood agar
- no hemolysis from new cholera or parahaem strains
- old VP strains look more yellowish green, new VP strains more bluish tinge & VC are alot more blue.

14 Feb 02

→ MIC Tests Using Microscan plates (Dade Behring) for Gram (-) / Urine Enterobacteriaceae (MIC Panel Type 10).

- all sterility wells were clear, all growth controls had growth
- MIC is first clear well (highlighted in blue).
- this well was plated O/N to see if cidal / static
- there is a [N] in box if didn't grow and [Y] if did.
- MIC values = ug/ml
- Abbreviations used:
  - Ak = Amikacin
  - Am = Ampicillin
  - A/S = Ambicillin / Sulbactam
  - Aug = Amoxicillin / K clavulanate
  - Azt = Aztreonam
  - Caz = Ceftazidime
  - Cf = Cephalothin
  - Cfz = Cefazolin
  - Crm = Cefuroxime
  - Cz = Ceftizoxime
  - LOR = Loracarbef
  - Mz = Mezlocillin
  - Pi = Piperacillin
  - T/S = Trimethoprim / Sulfamethoxazole
  - Gm = Gentamycin

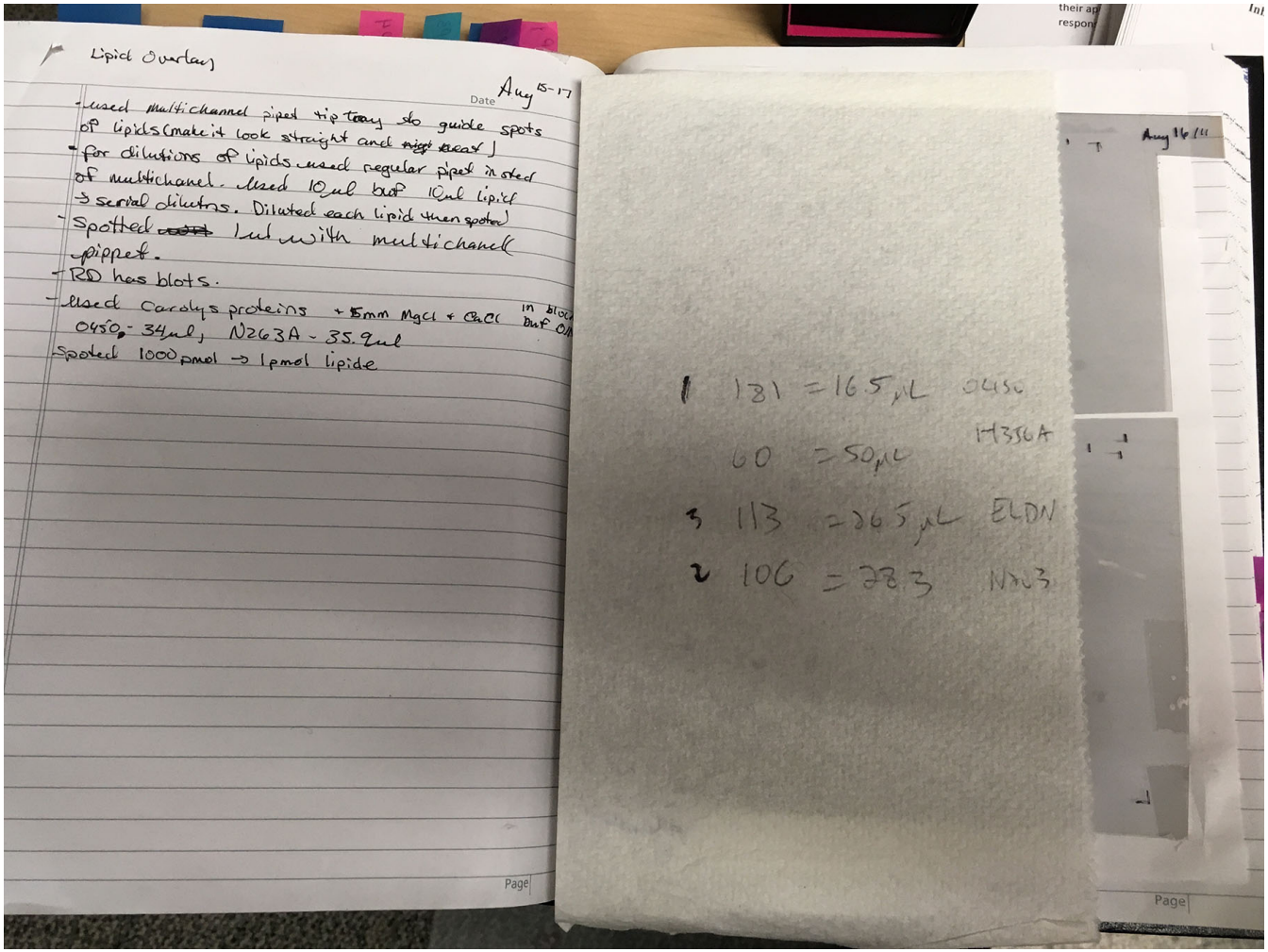
Research notes

- When the experiment is done
  - Promptly write up your results
  - Summarize what you did
  - Indicate any observations or conclusions
  - Is there any other relevant information you can get from the results? What worked? What did not?
- For repeated procedures
  - Please talk to your supervisor about expectations in this regard.
  - Do they want you to record all aspects of the procedure again, or can you refer back to a previous entry in your lab book and only indicate any changes that are being made.

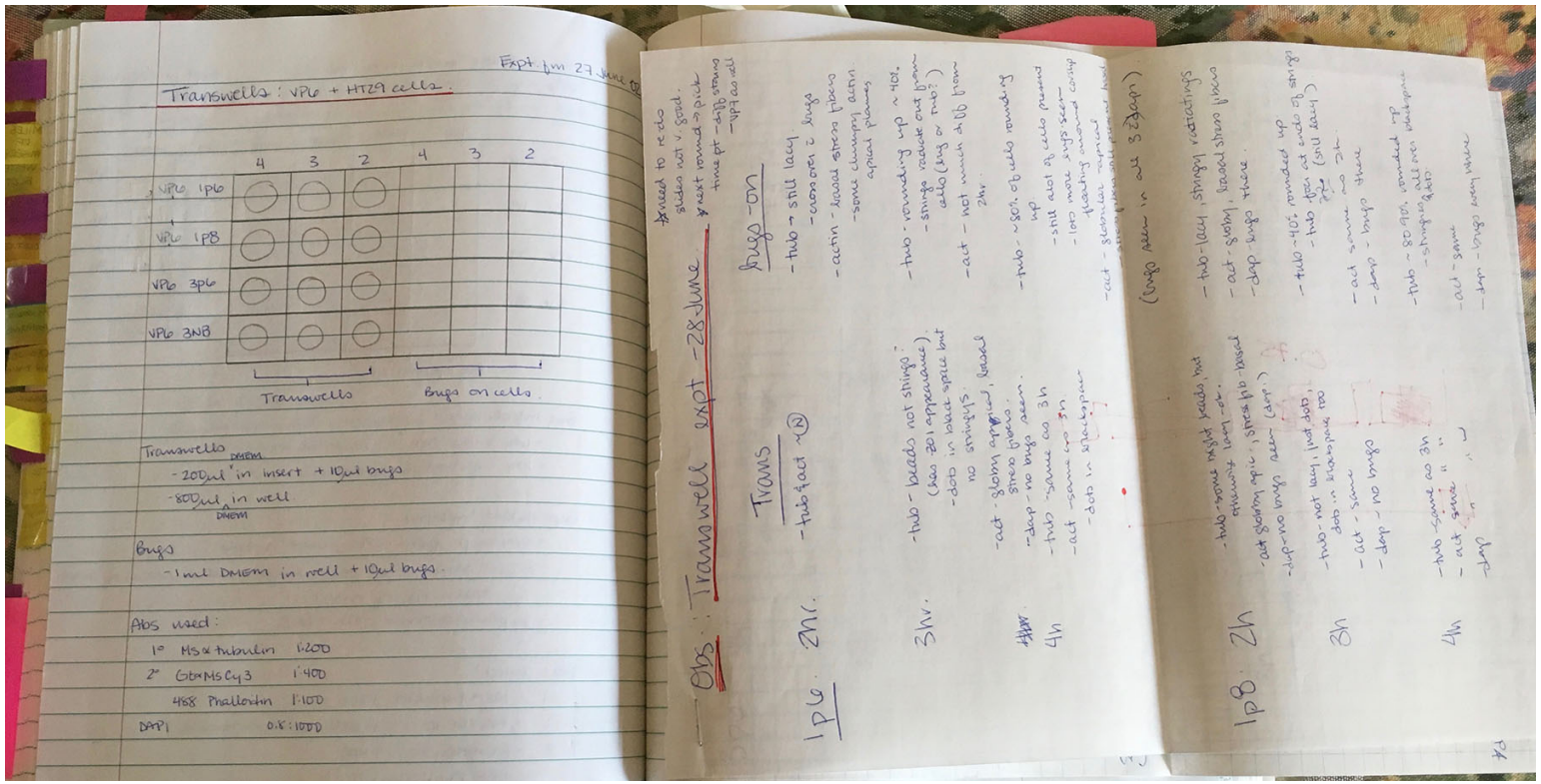
Research notes best practices

- Use your notebook for all of your notes
  - Paper towels, gloves, back of hand not an acceptable substitute
- Do not erase entries or tear out pages
- Don’t add anything you do not want others to see
  - Not a diary
  - Not a “slam book”
- Write up your notes promptly to ensure you do not forget important information

The dreaded paper towel



More appropriate



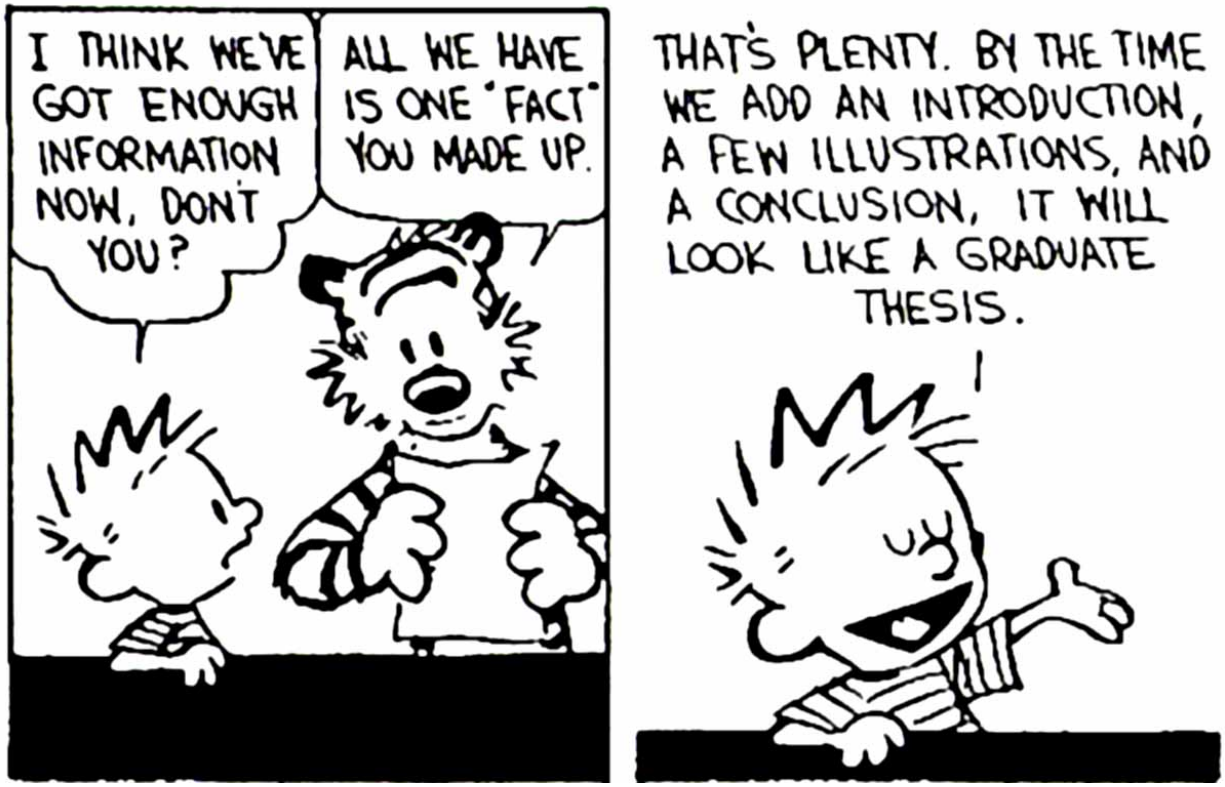
Electronic Notes or Data Files

- Talk to your supervisor about their views on electronic lab notes
- For electronic data, please ensure that your supervisor would know where to find it. What computer, folder, document name. Best to work out that details of this with your supervisor
- Should NOT be kept (only) on a personal laptop.
- Always back up your data!!!!!

Keeping Good Research Notes

- Key to remember. Lab notes belong to the supervisor/university.
- Your supervisor should have access to lab notes at all times.
- When you leave the lab, the lab notes remain behind with the supervisor.

Research proposal writing



Calvin and Hobbes by Bill Watterson

Thanks to Dr. Sarah Childs

Why write a good research proposal?

- Because it's a graduate school requirement
- Because it's a requirement of my course
- Because I want to apply for scholarships

Because it will help focus my thinking, and direct experiments to make effective use of my time as a graduate student

Research proposal goals

- Defines a fundamental question or hypothesis that the project will address
- Provides compelling rationale for the significance of the work
- Outlines the approach in specific experiments
- Shows that you know the limitations of your study

In short:

What do you intend to do?
Why is the work important?
What has already been done?
How are you going to do the work?

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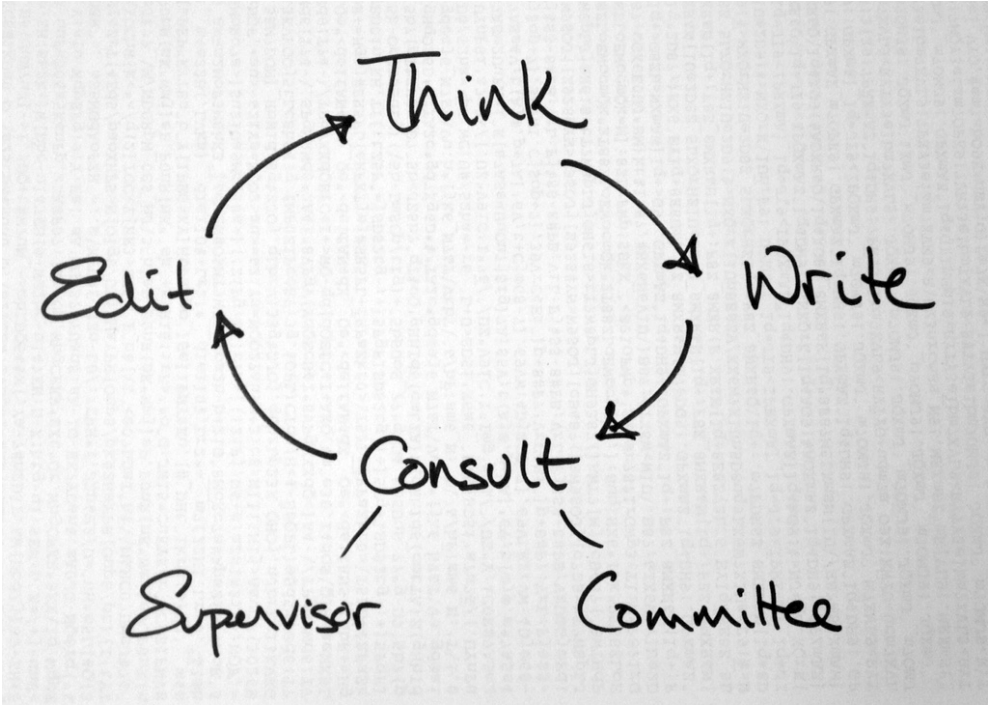
Topics covered in this session:

1. Research proposals
2. Scholarships and abstracts
3. Approaches to writing

The importance of starting early



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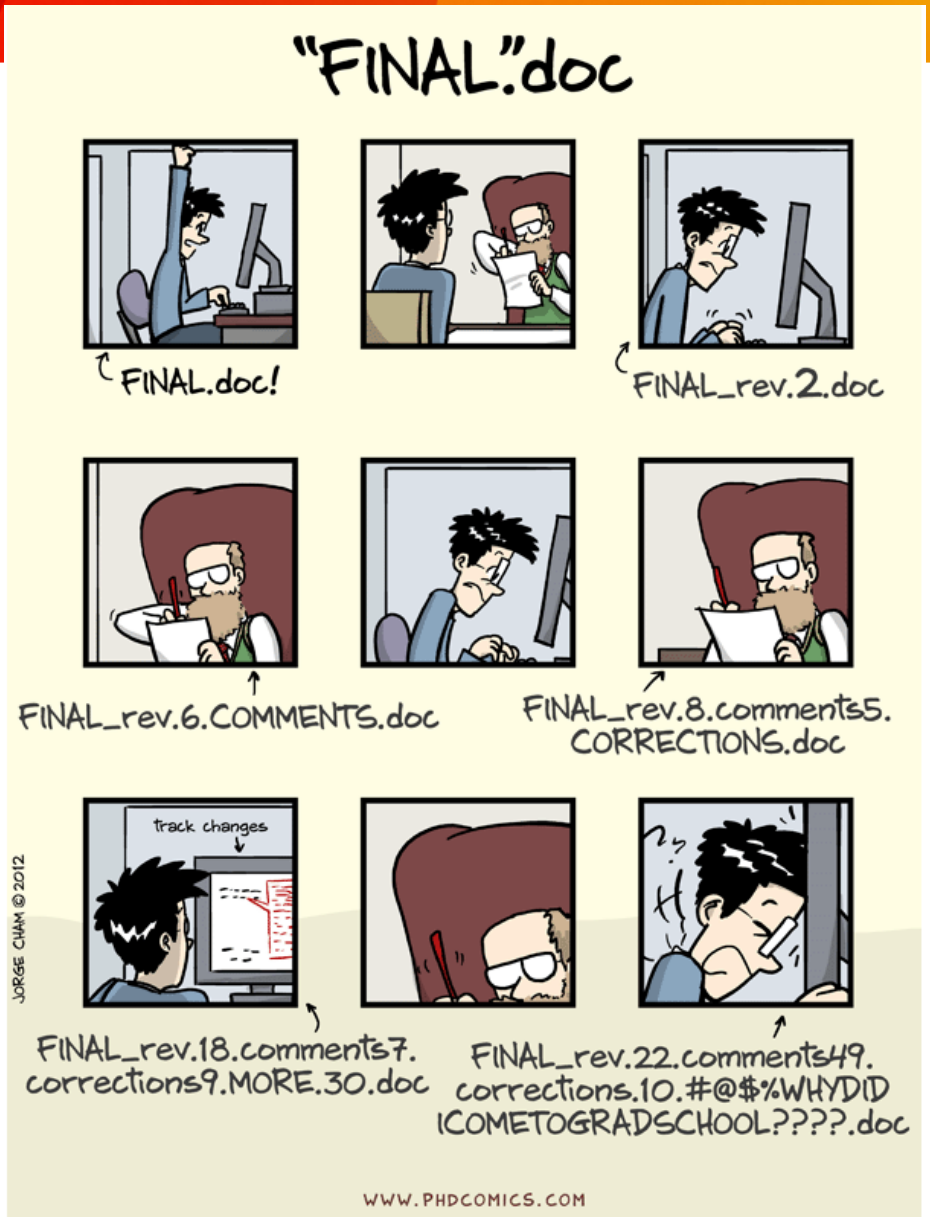
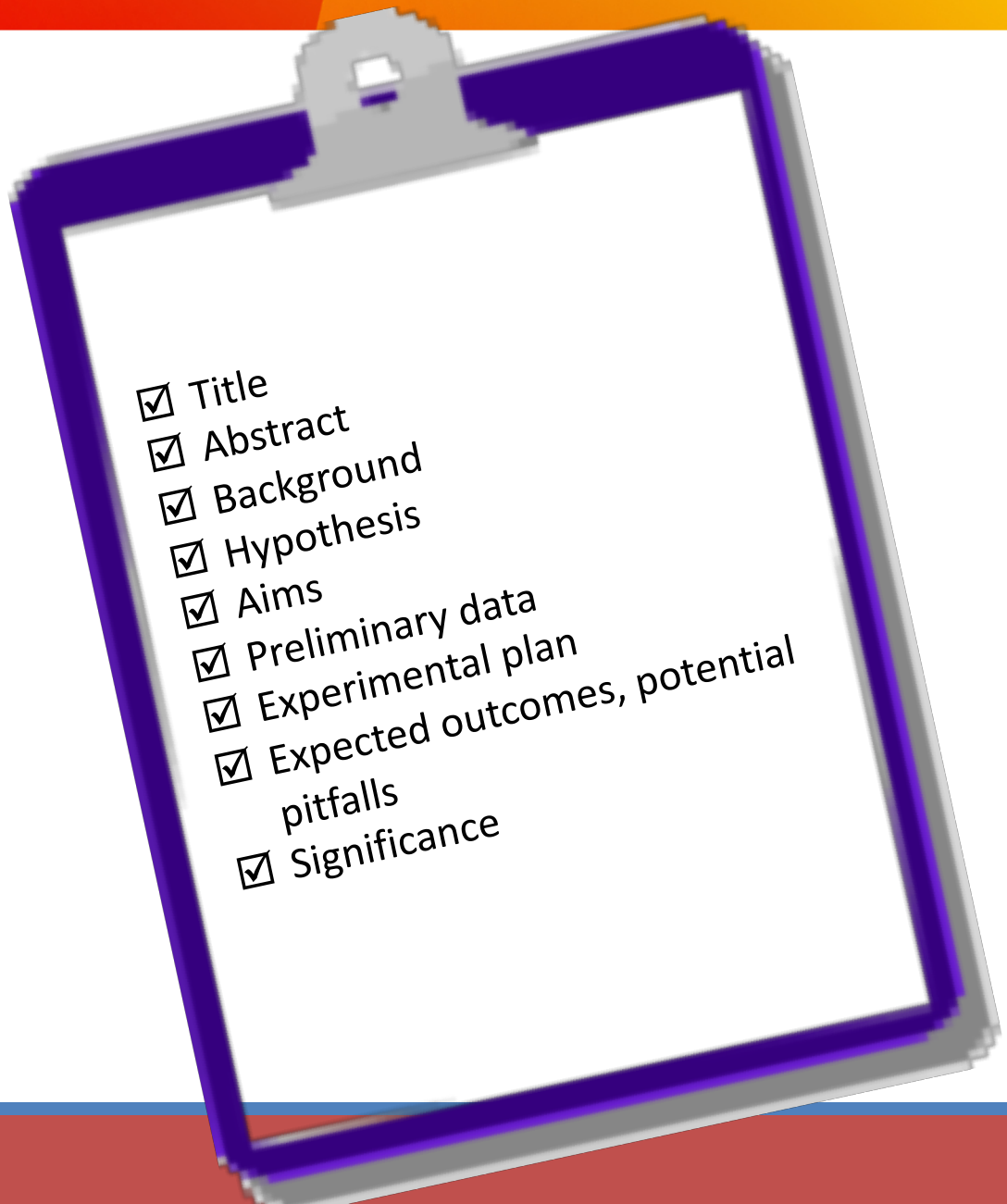


Basic outline of a research proposal



☑Background

- Rationale for choosing this research area

  - Historical background to the problem
  - Introduce the knowledge needed to understand the proposal

    - Highlight the problem under study and the unknowns
    - Highlight how your approach will address the unknowns

The introduction is an argument as to why the work your propose is necessary

It is not a comprehensive review of the topic: Focus your intro on the research you plan to do

☑ Hypothesis or research objective

- One sentence hypothesis (**Bold** or <u>underline</u> to make it stand out)
  - should be testable, not a vague description
  - be definitive!
- For example: *The E. coli* toxin hemolysin A targets tight junctions
  - **Not**
- The *E. coli* toxin hemolysin A might target tight junctions
- Some projects better served by research objective or question
  - The objective of this project is to determine the prevalence of antibiotic resistant *E coli* in treated waste water

☑ Aims (overview)

- Directly after the hypothesis have a simple list of 2-3 aims (one line each) that address your hypothesis
- Start aims with dynamic words
  - “Determine the role of …
  - “Characterize…
  - “Test whether.

☑ Preliminary Data

- When you submit your research proposal, chances are that you've done a considerable amount of work already.
  - Either have a separate preliminary data section to describe the data or embed relevant data within each of the aims.
  - Support your data with figures and tables.

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☑ Experimental Plan

- Define the experiments to test your hypothesis as listed in your aims.
- It is sometimes convenient to divide each aim into sub-sections:
  - Rationale: brief 1-2 sentences on why this is an important experiment
  - Experimental Plan (could be subdivided into a, b, c etc.)
    - What are you going to do?
    - How are you going to do it?
    - Controls!!
    - N's?
    - Statistical tests?

Potential pitfalls & Alternative Approaches

- Potential pitfalls
  - Show that you know what might go wrong and that you know how to overcome and solve problems.
  - Address all questions readers may have about your experiments.
  - Identify potential weaknesses in your protocols and research design.
- Alternative approaches
  - Offer alternative methods, in case your primary method fails.
  - Show that you are capable of adapting future experiments depending upon the results generated.

☑ Expected outcomes & Significance

- Expected outcomes/ Key Deliverables:
  - What will we learn from your research?
  - Stress novelty, innovation, advances to field
  - Future directions
    - Follow up studies, knowledge translation
- Significance
  - What is important about your work

Scholarship proposals & abstracts

- Short; often only one page
- Used to describe research and to address research potential, communication and critical thinking skills
- Only one part of your application
- Includes
  - Introduction
  - Hypothesis/objective
  - Aims and methodology
  - Significance

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Scholarship Proposal

- Your reviewers will likely not be experts in your field
- Introduction: High level, explain motivation/rationale for your study. Should be about 1/3 of your proposal
- Reviewers look for a **clearly stated, testable** hypothesis/research objective
- Include enough methodological detail so the reviewers know you can perform the work
  - Methods also used to assess research environment. Are the facilities/equipment/expertise available to support the proposed research
  - Address potential pitfalls/mitigation strategies

Scholarship Proposal

- **Expected outcomes/ Key Deliverables:**
  - What defines success in your project
- **Significance**
  - Be realistic. You don't need to cure cancer!
  - Tie into agency or institutional priority areas
  - "This work is aligned with a larger national network grant funded by CIHR…which will ensure resources and expertise is available for successful completion"

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Approaches to writing

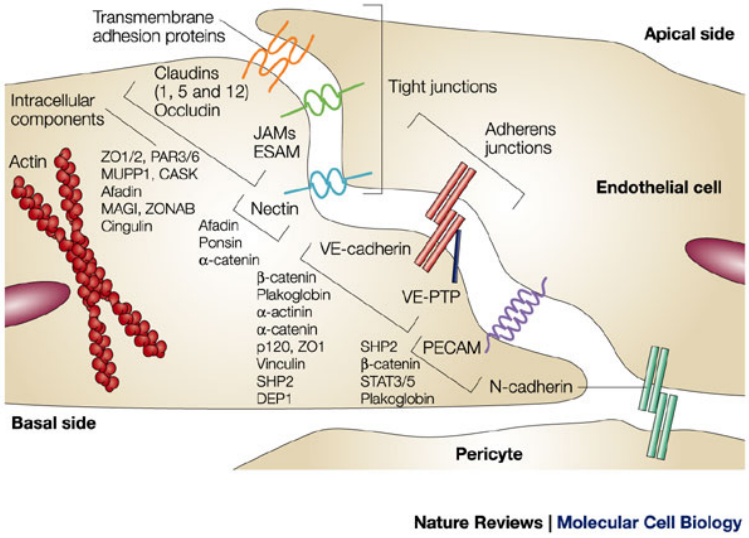
Make your ideas accessible

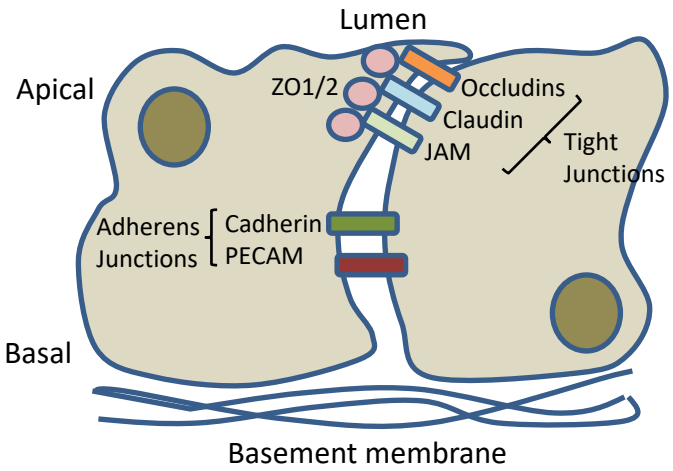
- Realize your readers have diverse backgrounds.
  - Essential for scholarships
  - Your committee will have different levels of expertise on your project
- Write so that all your readers can understand your proposal. Include basic, obvious information throughout.
- Explain your logic (“In order to determine X, I will first test Y”)
- Keep it concise and avoid convoluted arguments. Guide your reader through every sentence and idea.
- Minimize jargon and define abbreviations and acronyms

Figures are your friend

- Figures help your reader follow your argument
  - Schematics/cartoons to illustrate concepts
  - Preliminary data
- Draw your own schematics if possible, but figures can be adapted from other people or references as long as you cite it
- Include all relevant preliminary data
- Too many figures will distract, so choose carefully
  - Don’t use figures to extend the page limit

Simpler is often better





Nature Reviews Molecular Cell Biology **5**, 261-270 (April 2004)

References

- A research proposal is scholarly
  - 20-70 references
- Cite the primary literature (not just reviews)
- Show that you know the literature surrounding your project
- Read the references you cite
  - Understand methods, arguments
  - Should be relevant to topic and of good quality
- Using Endnote or Reference Manager is a must

Style: Active vs Passive Voice

- Use the active voice as much as possible
  - More powerful and straightforward
  - Uses fewer words
- **Active Voice:** "I measured protein X levels by western blot"
- **Passive Voice:** "a western blot was performed to examine the levels of protein X"
- Pick a verb tense and stick with it
  - Past tense conventional
  - Present tense now more common for emphasis and universality

Style: When to use “I” vs. “we”

- A research proposal is about the work that YOU are going to do
- “I will perform PCR…” tells the reader that you will personally do the experiment (*active)
- “We will perform PCR…” tells the reader that someone else in addition to you will do the experiment (*active)
- “PCR will be performed” gives no idea of who will to the work (* passive)

Formatting: Aesthetics

- Don’t cram as much text as possible into the document
- Consider using some of the following (but don’t over use):
  - Space between paragraphs
  - Indentation
  - Headings
  - Bullets
  - Bold text
  - Colour

Aplastic Anemia (AA) is a bone marrow failure disease where in approximately 20% of patients, the AA evolves into a myelodysplastic syndrome (MDS) or acute myeloid leukemia (AML), clonal disorders of hematopoietic cells. Studies have shown there is an association between shortened telomeres, advanced AA and increased risk of progression to MDS and AML. However, the mechanism on how shortened telomeres impact disease progression and response to treatment is not well understood. Progressive telomere shortening triggers cellular senescence but in a small proportion of cells, this is bypassed by activating the enzyme telomerase. Preservation of telomere length requires the activation of the telomerase complex, consisting of telomerase reverse transcriptase (hTERT) and an intrinsic RNA template (hTR). In the case of AA, telomerase activation and shortened telomeres may lead to an accumulation of chromosomal aberrations, evading senescence and apoptosis, providing a proliferative advantage of leukemic clones. Heterozygous mutations in the gene encoding the telomerase protein component hTERT are seen in approximately 10-15% of AA patients and result in short telomeres. We will investigate how mutations lead to telomere shortening and telomere dysfunction in cells in order to improve our understanding of the role telomerase plays in the pathogenesis of these disorders. Hypothesis: Aberrant telomerase activity from naturally occurring hTERT mutations in AA and AML, results in telomere shortening and genomic instability, contributing to bone marrow failure and disease progression. We will test this under the following aims: Aim 1. Biochemical characterization of hTERT mutants associated with AA and AML. Telomerase regulates telomere length at several levels. First, hTERT and hTR are transcribed, processed, and in the case of hTERT, translated. Second, telomerase localizes in the nucleus and assembles into an active complex. Third, the enzyme recognizes and is recruited to the telomere. Telomerase then catalyzes de novo addition of the telomeric sequence. Since each of these steps is indispensable, disruption of any one would decrease the efficiency of telomerase function. To understand the biochemical properties of these naturally occurring mutants, we have generated expression constructs bearing hTERT mutations found in patients with AA and AML and will test each biochemical activity in vitro. Catalytic activity will be measured using the telomeric repeat amplification protocol (TRAP), processivity measured using the conventional telomerase assay and the ability to interact with telomeric DNA measured with a primer binding assay. Aim 2. Generation of cell lines as surrogate models of human disease state. To better understand the effect of hTERT mutations in a cell culture model, we will utilize various cell models to create human cell lines that over-express the naturally occurring hTERT proteins. 2a. Hematological Cell Line: For initial characterization, we will stably express our mutants in a leukemic cell line, THP-1. 2b. Senescent Cell Line: We will also examine the effects of expressing our mutant hTERT proteins in BJ fibroblast cell, a telomerase negative cell line. These cells do not express telomerase and telomeres shorten with each division. This allows us to address whether expression of hTERT mutants are able to elongate telomeres and bypass senescence. 2c. Hematological Stem Cells: To address the function of mutant telomerase in hematopoiesis we will utilize a long term culture method using CD34+ hematopoietic stem cells. CD34+ cells will be collected from apheresis bone marrow transplant products and transfected with either a control vector or specific hTERT variants. In all 3 models, we will examine the effects of mutant hTERT on telomerase activity (TRAP assay), telomere length (Terminal Restriction fragment analysis), senescence (growth curves and B-galactosidase activity), chromosomal instability (cytogenetics and telomere induced foci assays), apoptosis (Annexin V staining) and the DNA damage response (DDR, clonogenic survival assays, and activation of the DDR via phosphorylation of ATM, Chk2, and p53)Aim 3. Affect of therapeutics on mutant telomerase. In addition to examining the contribution of hTERT mutations on disease progression, our cell model systems can be used to assess therapeutic responses. Each of our stable cell lines expressing either wt or mutant hTERT proteins will be treated with a selective chemotherapeutic panel from MDS and AML treatment protocols to determine how expression of mutant telomerase and difference in telomere lengths affects the viability of the cells via alamar blue viability assay. Outcomes such as cellular differentiation, telomerase activity and apoptosis will also be measured. By considering the role telomeres, telomerase and genomic stability play in the hematopoietic system, we can determine the replicative capacity of hematopoietic stem cells during tumour progression. This will provide insight in predicting response to therapeutics, determining most suitable treatment plan and a mechanism to monitor disease progression. Our studies will advance our understanding of bone marrow failure and AML disease progression in patients with hTERT mutations as well as lead to novel therapeutics for bone marrow failure syndromes.

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Aim 1. Biochemical characterization of hTERT mutants associated with AA and AML. Telomerase regulates telomere length at several levels. First, hTERT and hTR are transcribed, processed, and in the case of hTERT, translated. Second, telomerase localizes in the nucleus and assembles into an active complex. Third, the enzyme recognizes and is recruited to the telomere. Telomerase then catalyzes de novo addition of the telomeric sequence. Since each of these steps is indispensable, disruption of any one would decrease the efficiency of telomerase function. To understand the biochemical properties of these naturally occurring mutants, we have generated expression constructs bearing hTERT mutations found in patients with AA and AML and will test each biochemical activity in vitro. Catalytic activity will be measured using the telomeric repeat amplification protocol (TRAP), processivity measured using the conventional telomerase assay and the ability to interact with telomeric DNA measured with a primer binding assay.

Aim 2. Generation of cell lines as surrogate models of human disease state. To better understand the effect of hTERT mutations in a cell culture model, we will utilize various cell models to create human cell lines that over-express the naturally occurring hTERT proteins. 2a. Hematological Cell Line: For initial characterization, we will stably express our mutants in a leukemic cell line, THP-1. 2b. Senescent Cell Line: We will also examine the effects of expressing our mutant hTERT proteins in BJ fibroblast cell, a telomerase negative cell line. These cells do not express telomerase and telomeres shorten with each division. This allows us to address whether expression of hTERT mutants are able to elongate telomeres and bypass senescence. 2c. Hematological Stem Cells: To address the function of mutant telomerase in hematopoiesis we will utilize a long term culture method using CD34+ hematopoietic stem cells. CD34+ cells will be collected from apheresis bone marrow transplant products and transfected with either a control vector or specific hTERT variants. In all 3 models, we will examine the effects of mutant hTERT on telomerase activity (TRAP assay), telomere length (Terminal Restriction fragment analysis), senescence (growth curves and B-galactosidase activity), chromosomal instability (cytogenetics and telomere induced foci assays), apoptosis (Annexin V staining) and the DNA damage response (DDR, clonogenic survival assays, and activation of the DDR via phosphorylation of ATM, Chk2, and p53)

Aim 3. Affect of therapeutics on mutant telomerase. In addition to examining the contribution of hTERT mutations on disease progression, our cell model systems can be used to assess therapeutic responses. Each of our stable cell lines expressing either wt or mutant hTERT proteins will be treated with a selective chemotherapeutic panel from MDS and AML treatment protocols to determine how expression of mutant telomerase and difference in telomere lengths affects the viability of the cells via alamar blue viability assay. Outcomes such as cellular differentiation, telomerase activity and apoptosis will also be measured. By considering the role telomeres, telomerase and genomic stability play in the hematopoietic system, we can determine the replicative capacity of hematopoietic stem cells during tumour progression. This will provide insight in predicting response to therapeutics, determining most suitable treatment plan and a mechanism to monitor disease progression. **Our studies will advance our understanding of bone marrow failure and AML disease progression in patients with hTERT mutations as well as lead to novel therapeutics for bone marrow failure syndromes**

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Aim 1. Biochemical characterization of hTERT mutants associated with AA and AML.
Aim 2. Generation of cell lines as surrogate models of human disease state.
Aim 3. Affect of therapeutics on mutant telomerase

Telomerase regulates telomere length at several levels. First, hTERT and hTR are transcribed, processed, and in the case of hTERT, translated. Second, telomerase localizes in the nucleus and assembles into an active complex. Third, the enzyme recognizes and is recruited to the telomere. Telomerase then catalyzes de novo addition of the telomeric sequence. Since each of these steps is indispensable, disruption of any one would decrease the efficiency of telomerase function. To understand the biochemical properties of these naturally occurring mutants **(Aim 1)**, we have generated expression constructs bearing hTERT mutations found in patients with AA and AML and will test each biochemical activity in vitro. Catalytic activity will be measured using the telomeric repeat amplification protocol (TRAP), processivity measured using the conventional telomerase assay and the ability to interact with telomeric DNA measured with a primer binding assay**.**

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In addition to examining the contribution of hTERT mutations on disease progression, our cell model systems can be used to assess therapeutic responses **(Aim 3)**. Each of our stable cell lines expressing either wt or mutant hTERT proteins will be treated with a selective chemotherapeutic panel from MDS and AML treatment protocols to determine how expression of mutant telomerase and difference in telomere lengths affects the viability of the cells via alamar blue viability assay. Outcomes such as cellular differentiation, telomerase activity and apoptosis will also be measured. By considering the role telomeres, telomerase and genomic stability play in the hematopoietic system, we can determine the replicative capacity of hematopoietic stem cells during tumour progression. This will provide insight in predicting response to therapeutics, determining most suitable treatment plan and a mechanism to monitor disease progression. ***Our studies will advance our understanding of bone marrow failure and AML disease progression in patients with hTERT mutations as well as lead to novel therapeutics for bone marrow failure syndromes.***

Style: Checking over the final document

- ✓ Acronyms are defined at first use.
- ✓ The verb tense agrees through the whole document.
- ✓ Gene names use standard convention
- ✓ All statements that are not common knowledge are referenced
- ✓ When methods are referred to another paper, make sure it was the original method, and not one that refers to a third paper.
- ✓ Simplify: Never use a long word when a short one will do
- ✓ Edit: Cut unnecessary words and sentences

Editing

- A research proposal should be purely your own work.
- Enlist spelling/grammar assistance if you are a non-English speaker.
- In the case of candidacy, someone reading your proposal to edit your ideas is **not** acceptable.
- Computer spelling and grammar checks won't find all mistakes- read it yourself.
- Know the rules on plagiarism

Feedback

- Absolutely critical to get feedback from others prior to submission
  - You want to find flaws in the proposal before submitting, not at your candidacy exam!
- Reviewers include
  - Supervisor
  - Supervisory committee members, lab members, other students/postdocs
  - Scholarships: Internal peer reviewers
- Review etiquette
  - Don’t wait until the last minute
  - Critiques of your work is not personal and should be constructive

Electronic Communication

- Be clear in your subject line.
- If you don’t know the recipient use titles
  - Hello Dr. DeVinney
  - Hey RD!!!
  - Once you know each other you may then be on first name basis
- Avoid emojis and texting abbreviations
- Proofread before sending
- Avoid ALL CAPS
- Respond promptly

Electronic communication

- Know your recipient's preferences
  - Email
  - Text
- Be careful with attachments
  - Make sure you know the size limits
  - Make sure they are in a format the recipient can open
- Sign off professionally
  - Signature line

Resources

- CSM Graduate Writing Community
  - Friday Nov 23. 1-4 pm HS Library 1459
- Faculty of Graduate Studies My Grad Skills Workshops
- University of Calgary Student Success Centre
  - Writing support
- “Elements of Style” by Strunk & White
- ”On Writing Well” by Zissner
- “Writing readable prose” (2006) Bredan AS, van Roy F. *EMBO Reports*, 7, 846