

Grant crafting:

The on-ramp to fame and fortune in research

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Workshop Overview

Overall theme: “Crafting” and writing a proposal

Part 1: Content

What to write? How to write it?

Part 2: Structure - Formatting and Organizing

Think Visually

We'll also touch on:

Getting it done

Where to find funding

What is a grant?

A Grant is NOT:

A review article (*Forward looking and not all-encompassing.*) Avoid telling us everything you know and leaving no room for what you want to do.

Scholarship (*It doesn't live on in perpetuity.*)

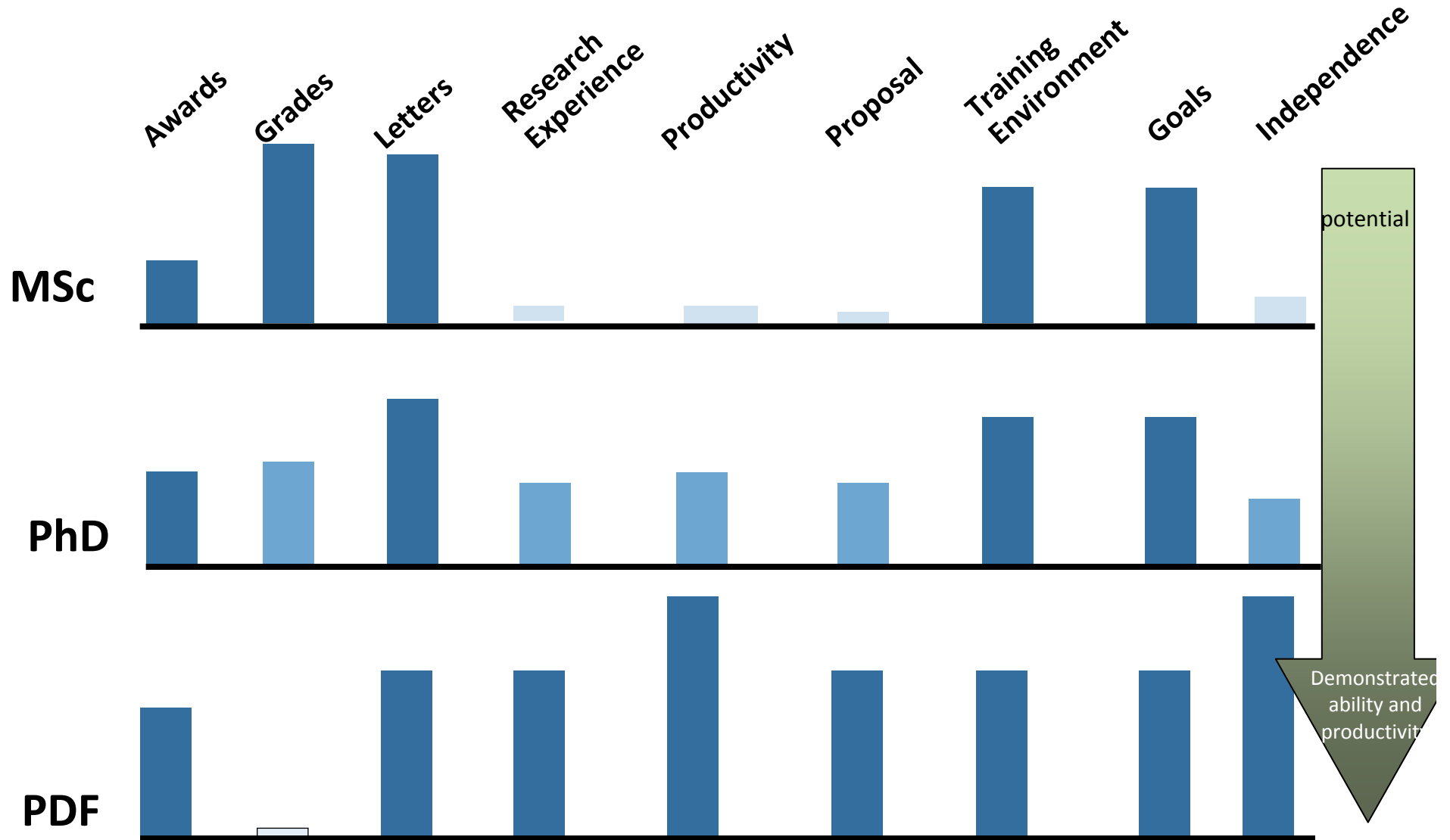
Literature (*Avoid flowery or highly descriptive language.*) This usually means writing your story in a chronological way instead of organizing the content.

A Grant IS... An elite sales pitch for money.

- you cannot lie and
- must provide solid evidence to back up claims.

As a whole, a scholarship application
tells your story – past, present, future.

And stories have characters and a plot...



Part 1: Content

Welcome to writing...

Anybody who likes writing a book is an idiot.

It's like having a homework assignment every stinking day until it's done.

*Writing is not fun. It's never been fun.
It is a brutal experience in many ways.*

Lewis Black, Comedian (Daily Show) and author

What to write? How to write it?

- (1)** Just get the words on the page.
- (2)** Connect all the dots & interlace sections
- (3)** Edit: grammar, spelling, logic, format

Sections to write & interconnection to criteria

Judging criteria	Discrete sections of application (vary with agency)
Research plans, experience, skill; Critical thinking	Proposal, Letters, CV
Goals	Proposal Training Environment Training Expectations
Environment	Training Environment Supervisor's CV
Productivity	CV (publications, abstracts, chapters) CV (Activities and contributions) Letters
Independence (or potential)	Proposal Training Expectations CV (publications, abstracts, chapters) Letters
Awards	CV (awards and distinctions) Letters
Grades	Significance/value backed up with Letters

A brief comment on grammar & spelling

Words & grammar are tools. Use them well.

Consequences of problems with language?

- can imply problems with project (or *you!*)
- more likely just lead to a poor argument

Brief Comment on Style

Good Writer

Suggestive
Exploratory
Surprising
Subtle
Creative



You put the pieces
together

vs.

Good Grant-writer

Predictable
Organized
Logical
Linear
Persuasive

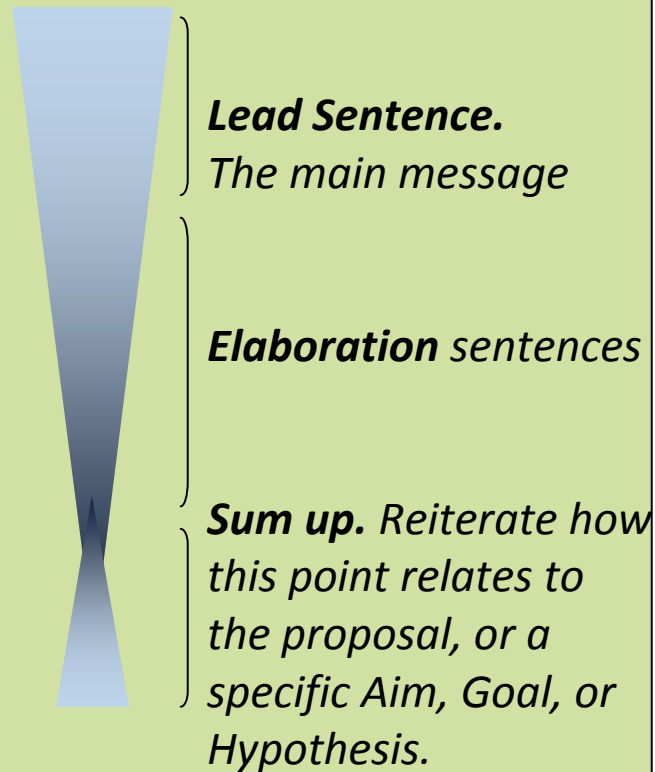


Leave little room for interpretation
Expository writing

Good expository writing

“To explain, describe, give information or inform.”

A paragraph in pictures



You should be able to grasp a grant by reading just the lead and summary sentences.

Common Error:

Rousing concluding sentence but no strong lead.

expository writing, cont...

Techniques for exposition	Cue Words
Description: Listing characteristics, features, examples	“for example”, “such as” Others?
Sequence: List items or events in numerical or chronological order. In <u>diagrams</u>:	1 st , 2 nd , 3 rd ; next; then; finally Arrows, directions, timelines.
Comparison Describing alike and/or different	in contrast; same as; as in; on the other hand; whereas
Cause & Effect	if...then...; as a result; therefore; because
Problem and Solution: Applies to both individual components AND the entire grant/proposal.	problem is; “knowledge gap”; “My goal is to...” Add “significance” to solidify the point

Elaboration sentences

segue

Sum-up

Phrase to Persuade

Convincing someone to give you money.

Persuasive language is:

Positive and Active, NOT passive.

For example, write,

"We will develop a cell line," not

"A cell line will be developed."

Short and sweet and direct and obvious

No long sentences with multiple parenthetical asides.

Be specific. Ensure reviewers make all the connections.

Be Specific.

- If your proposal is novel *EXPLICITLY* state so and explain why.
 - **Example:** Applying a technique to a field it's never been applied to.
- Is your skill set is unique? How? Explain relevance to research proposal.
- Are you bridging two fields (ex Engineering and occupational therapy?)
- Use the buzzwords. "Interdisciplinary", etc.
- Risky research? Shouldn't be, but if yes, own up to it and explain the value of doing the work.

HINT: Peruse dept/faculty/research centre communications propaganda for text. Pick the odd descriptive phrases to integrate.

Some applications require you show alignment with University or Faculty strategic plans.
Get help with that – there are resources.

Achieving Short & Direct sentences. Example:

Before edit: *This issue is ~~an important one~~, ~~bearing in mind how~~ common colon cancer is (2nd most common cause of cancer-related mortality in Canada) ~~and that~~ conventional measures are not always successful in achieving a cure.*

After edit: *Colon cancer is the 2nd most common cause of cancer-related mortality in Canada and conventional treatments do not always achieve a cure.*

The "after" sentence isn't elegant, but: *easy to read and absorb.*

Proposal

Overview: (20% of the page)

Set the general (biological/health/social) stage, and then set the research stage.

General Objective/Over-all Hypothesis and Specific Aims.

"The General Objective of our research is to identify critical regulators of..."

"To attain this objective, we have three Specific Aims." List them.

Proposed research (50-60% Page).

(1) State **what** you plan to do:

"To identify molecular regulators of axonal guidance, we will..." or

"To establish what family members think about genetic testing, we will..."

(2) Then, your specific strategy and **why** :

"Our approach will be to identify homologues of CUB domain proteins expressed in the developing brain, since proteins of this class have been shown to..."

Significance: A short paragraph, or even one sentence.

"This work will enhance our understanding of the biology of... and provide a foundation for elucidating [disease category or health issue]."

Breakdown of a Summary page overview

"The development of the brain is one of the most complex biological processes known. Each cell in the brain contacts about 1,000 other cells **but** the mechanisms that guide and regulate these connections are poorly understood. A number of inherited disorders have been shown to be associated with defective nerve cell connections. **Our goal is to determine...."**

Sets the stage

State the knowledge gap

Segue into the proposed research area

Rationale and Feasibility

Explain “Why” and “How” often.

Weave those points throughout the proposal.

Things to consider

- Have you conveyed the need for your research?
- Have you made it clear you can do the work?
- Will your approach answer the question? Defend your methods
- Is the research environment appropriate?
Resources – equipment, personnel
- Is the training environment appropriate?

Mentorship?

Professional development? Conferences attendance

Training Environment: The research location's resume.

Research Facilities and Equipment	<ul style="list-style-type: none">•List everything available. Is it “the best”? Tell us.•Include shared resources.•Connect equipment to research goals
Personnel:	<ul style="list-style-type: none">•Someone like me?•Statisticians? Techs? Clerical/coordinators?•Senior trainees who may mentor?
Operating funding:	<ul style="list-style-type: none">•How is your project funded?•How much, how long, from what source(s)?
Mentor:	<ul style="list-style-type: none">•Why is your supervisor THE person to work with?•Use phrases like, <i>Leading investigator in...</i>•Cross reference info in his/her CV
Researcher interactions:	<ul style="list-style-type: none">•Formal dept seminar series?•Interdisciplinary dept/center?•Continuing education opportunities.•Conferences?

Reviewers are a general audience. Remove jargon (except when listing the equipment).

Training expectations

Where are you and where do you want to go?

Common error – overly descriptive.

- It's not *“First I, and then I, which led me to learn, and so now I want to be a _____”*.
- Begin with end goal, then objectives that will get you there.

Research: Integrate what you know with what you'll learn.

“Soft” skills: leadership, teaching, supervision, communication, networking, publication plans.

The language is different for a Master's vs a PhD

“I wish to learn...”

VS

“I will continue to build my skills in...”

“Will apply my skills in X to Y-problem”

Example paragraph from Training Expectations

From a postdoctoral application – this is one of 5 objectives.

1. Fostering new skills for evaluating _____ and patient outcomes

During this training I expect to continue developing my ability to apply qualitative and quantitative methodologies to evaluate the continuum of trauma care in Canada. I have identified three core methodologies that I will become more proficient in during this training, including (1) the use of multivariate data analysis, (2) conducting online surveys to extract tacit information from stakeholders and policy advocates and (3) framing these studies using linked administrative health databases. These skills will improve my ability to analyze the clinical, social, and environmental factors that lead to _____ following _____. I have chosen to pursue these objectives under the mentorship of Drs. _____ and _____ as they complement each other in terms of their expertise in statistical techniques and building research capacity with stakeholders to transform research into policy. My graduate training administering online surveys to provincial medical health officers, prior use of logistic regression, principal component analysis, hierarchical linear models, and expertise in using _____ systems to explore _____ will strengthen this collaboration. Continuing to develop these skills is essential for conducting multi-disciplinary research evaluations of _____ performance that have a high level of scientific rigor.

The key “connecting” phrases:

- continue developing my ability to apply X to evaluate Y.
become more proficient
- improve my ability to
- pursue these objectives
- mentorship of Drs. _____ and _____ who complement each others expertise in
- My training in _____ will strengthen this collaboration.
- Continuing to develop
- conduct multi-disciplinary research

CV - major attachments

I. **Publication List** will be coded as the RFP dictates.

General categories:

Published Refereed Papers
Invited Talks and Workshops
Conference Presentations
Poster Presentations
Abstracts

If guidelines permit, include
“in preparation”.

Be quite descriptive RE your role and
significance of major papers.

Interesting approach – a key

PA – primary author (minimum 70% contribution)

MC – major contribution, contributed methodological expertise for study design, analysis, and interpretation (minimum 50% contribution)

CA – contributing author (literature review; interpreted research findings (minimum 10% contribution)

Masters – research conducted during master’s degree

PhD – research conducted during doctorate degree

CV - major attachments, cont

II. Activities

Include everything remotely relevant. Content will shift as you progress.

PROFESSIONAL DEVELOPMENT:

- Presentation / Communication skills
- Teaching / supervisory skills
- Project management

ACADEMIC SERVICE:

- Organized journal club
- Initiated and coordinated a lecture series
- Reviewer for ___

COMMUNITY/ VOLUNTEER:

- Charities, coach, kids school, certifications

RESEARCH Contributions:

MAJOR accomplishments to reiterate

Committee membership and service to community

- Editorial Boards (dates)
- Health Economics Journal Club
- Student Committees
- Judged science fair
- Volunteer in Extended Care Unit

Career development

- Developed Guidelines
- White papers
- Organized forums
- Conference activities that allow you to make key contacts

Evaluations of articles for scientific journals

Consulting

Research development

Teaching:

Coursework:

Invited presentations

Seminar/journal club

Readability: Write, Proof, Edit

“I didn't have time to write a short letter so I wrote a long one instead.”

Be ruthless.

CRITICAL colleague AND lay-person reviews.

Remove extraneous words. *“We found that...” “It has been demonstrated that...”*

Remove tentative language. *“Will”* instead of *“may”*. Also *“possible”, “might”, “could”*.

Read the grant out loud for your final copy-edit.

Submit a “perfect” application.

Is every section there? Typos, length, margins.


Take time away from it before proofing.

You'll avoid this – until yesterday, this was my title:

Grant grafting:

The on-ramp to fame and fortune in research

General Tips

- **READ A LOT OF GRANTS.**
 - **REVIEW** and critique your [junior] colleagues' applications
 - **START EARLY**
 - **Write RESEARCH PLAN first.** It informs content for other sections. E.g. **Environment** is tied to research plans.
 - Spell out the “match” between your project and competition goals.
 - Read a lot. Practice writing.
 - Look at the guidelines for reviewers
 - **A little repetition is a good thing.** Think about how people READ.
- 

Letters of support

How to get a good letter?

Tell them what you need, the format in which you need it, and process for submitting it.

Give them the guidelines.

Ask people who *know you and your accomplishments well*. **

Offer to draft it yourself or to give them bullet points. **

Content? What has impact? [More to come with Dr. Moritz.](#)

Part 2: Structure

Grant applications are built → Think VISUALLY

Ease of reading matters.

“..when presenting a factual statement, manipulations that make it easier to process - even totally nonsubstantive changes like:
writing in a cleaner font
making it rhyme, or
repeating it,
can alter people’s judgment of the truth of the statement, and the intelligence of the author.”

(from the Boston Globe, Jan 2010)

Make Life Easy for Reviewers

Make life easy for reviewers. Appearance matters. Write a grant they can “read without reading”. Create “chunks” of information. Use white space. No compressed fonts. Divide into sections using headings and subheadings. Headings must be informative: Bad: PI3K enzymes. Good: PI3K enzymes regulate a diverse range of cellular processes. Bold summary or intro sentences in important paragraphs. Guide reviewers with graphics. Timelines, charts, etc...Put a box around important text. Special case: Online forms that don't permit formatting. Same principles – but use all caps, asterisks, hyphens, and white space.

Assume you have 25 grants to review.
What's wrong here?

Make Life Easy for Reviewers, cont...

Appearance Matters.

Write a grant they can “*read without reading*”.

Create “chunks” of information:

- Use white space. No compressed fonts.
- Divide into sections using informative headings and subheadings.

Bad: *PI3K enzymes*

Good: *PI3K enzymes regulate a range of cellular processes*

Bold summary or intro sentences in important paragraphs

Guide reviewers with graphics. Timelines, charts, etc...

Put a box around important text.

Special case: Online forms that don't permit formatting. Same principles: but use ALL CAPS, asterisks, hyphens, and white space.

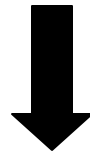
Formatting Example

Getting it Done

Done is better than perfect

Timelines – Staying in control

Panic is **inversely proportional** to **control**.



The closer to deadlines, the less control
over other people.



Choke and rush and miss details.

Key Timelines

I. Personal - Dates for completing sections:

Set specific, realistic goals. List ALL tasks.

Reminds you to do the “little” things. (CV module, anyone?)

Do easy task if stuck or sick of talking about yourself.

II. INTERNAL (institutional):

Signatures: Institutional, Faculty, Department, Supervisor

Supervisor: Explain what you need & the submission process

If submitted by the institution: Notify them of intent to apply.

III. EXTERNAL:

Transcripts, and other externally-supplied documents

Letters of support. HUGELY important – lots of notice.

Finding money

Who offers scholarships?

Schools (and departments/faculties therein)

Charities

Governments****

- i) National, provincial, regional
- ii) Government Agencies (Ex. Worksafe BC, NRC)

Professional Societies

Private/Public foundations – ex CIFAR

Industry

Search early, search often, apply broadly (This may not be the lottery but you still have a far greater chance of NOT being funded, than funded. So increase the odds with more agencies.)

Where to find opportunities?

The obvious:

- Web search (keywords)
- Ask around
- Return early and often to relevant agencies
- Set up alerts or RSS feeds
- Twitterfeeds?
- OTHERS?

*** **Community of Science Database.**

Science and more! www.cos.com

COS.com

- set up a profile. Do it on a ubc network as the UBC subscription is inherently recognized.
- Set up a “work bench” (profile)
- Click “search for opportunities”.
- Basically play around.
- You can set up alerts. Search for experts in the field.

COS Funding Opportunities™

Funding Opportunities Home About Instructions Subscribe Help Desk

We have improved how you search and share funding opportunities in COS Pivot.

Try the new look

Switch to Classic View

Search

Clear Fields

Search by Abstract, Title, Sponsor and Other Fields

Match all of the below fields Match any of the below fields

Number of results to view: 25

All Fields () or () or ()
and All Fields () or () or ()
and All Fields () or () or ()
Add Row

More Search Fields

Deadline - Limited Submission / Other Internal Coordination - Amount - Keywords - Activity Location - Requirements - Citizenship or Residency - Funding Type - Sponsor Type

Exclude Opportunities that match

not All Fields () or () or ()
Add Row

More Exclude Fields

Deadline - Limited Submission / Other Internal Coordination - Activity Location - Requirements - Citizenship or Residency - Funding Type - Sponsor Type

Clear Fields

Search

and Deadline:
on or after mm/dd/yyyy
on or before mm/dd/yyyy
Deadline within: 7 days 30 days 90 days select from calendar
Include: Optional Deadlines
Include: Continuous or undefined deadlines

and Limited Submission / Other Internal Coordination:
 Limited Submission Other Internal Coordination Required

and Amount:
Include: Unspecified

and Keywords:
browse | clear

and Activity Location:
(Select from the List)
more locations | clear

and Requirements:
PhD or MD or Other Professional
Graduate Student
Undergraduate Student
Academic Institution

and Citizenship or Residency:
United States
Canada
United Kingdom
Australia
Include: Unrestricted Unspecified

and Funding Type:
Research
Program or Curriculum Development or Provision
Training or Scholarship or Fellowship
Prize or Award

and Sponsor Type:
Federal, U.S.
National Government, Non-U.S.
Private Foundation
Academic Institution

More Search Fields

Sample COS output:

COS Unique Id: 120181		Date Last Revised: Nov 14 2011 7:00PM		<input checked="" type="checkbox"/> Send this record to a colleague!		<input type="checkbox"/> Track this record on my Workbench.	
Title	Mentored Research Award (MRA) Program			URL for more info	http://www.htrs.org/		
Sponsor	Hemophilia and Thrombophilia Research Society			Sponsor Type	Other Nonprofit		
Upper Amount	\$150,000			Amount Note	The maximum award is \$150,000 (\$75,000 per year for two years). Second-year funding is contingent upon a satisfactory progress report submitted to HTRS after the completion of the first year of research. Funds may be used for full or partial salary support for the recipient or other key personnel, direct research costs, expenses related to training programs, and travel to scientific meetings. Funded applicants are required to present a report on their research at NHF during the second year of their grant program. Applicants are required to report additional sources of salary and research support in their applications. Institutional overhead must be included in the budget and is limited to eight percent of the total direct cost of the project (total two-year project budgets may not exceed U.S. \$150,000).		
Activity Location	United States Canada			Citizenship or Residency	Unrestricted		
Upcoming Deadlines	Date	Certainty	Type	Mandatory	Invite Only?	Note	
	Sep 01, 2012	Anticipated	Letter of Intent	Yes	No		
	Nov 14, 2012	Anticipated	Application	Yes	Yes		
Requirements	Graduate Student Ph.D./M.D./Other Professional						
	The HTRS Mentored Research Award (MRA) Program was established in 2007 to provide research support to fellows and junior faculty within five years of completing core clinical hematology training in hemostasis and thrombosis.						
Abstracts	The goal of the HTRS MRA Program is to attract talented young clinicians and investigators into the field of hemostasis and thrombosis and to provide career guidance, research support, and educational opportunities for upcoming physician researchers.						
	It is expected that the principal focus of the successful candidate will be to further his or her experience in performing basic, clinical, and/or epidemiologic research. Candidates must spend a minimum of 50 percent time on research related activities.						
Eligibility	Candidates must hold an M.D. or equivalent degree and be within five years of completing core clinical rotations for hematology subspecialty training. Fellows must be enrolled in accredited Hematology, Hematology-Oncology, or Pediatric Hematology-Oncology fellowship training programs in the U.S. or Canada. Faculty applicants must hold a faculty position in a U.S. or Canadian academic institution. Only investigators associated with non-commercial institutions are eligible. U.S. or Canadian citizenship is not required. Applicants may be enrolled in a higher degree program during the tenure of the Mentored Research Award as long as they demonstrate that they have sufficient time to conduct the research program proposed in their application.						
COS Keywords	Hemophilia Thrombosis Blood Diseases						
Funding Type	Meeting or Conference or Seminar Training, Scholarship, or Fellowship						
Sponsor Contact Info	Lynyn Jacobsen-Freys, Grant Development Coordinator Hemostasis & Thrombosis Research Society PO Box 2178 53201 United States Phone: +1 (414) 937-8562						

Resources

NSERC videos:

http://www.nserc-crsng.gc.ca/Students-Etudiants/Videos-Videos/Index_eng.asp

Resource Videos



NSERC undergraduate programs summary

August 25, 2011

This video provides an overview of NSERC funding available to undergraduate students.



NSERC USRA program application tutorial

September 12, 2011

This video guides students through the process of applying to the NSERC Undergraduate Student Research Awards Program.



NSERC postgraduate programs summary

August 25, 2011

This video summarizes NSERC's postgraduate programs.



NSERC PGS/CGS application tutorial

September 19, 2011

This video guides students through the process of applying for a Canada Graduate Scholarship or Postgraduate Scholarship from NSERC.



NSERC postdoctoral programs summary

August 25, 2011

This video summarizes NSERC funding opportunities for postdoctoral fellows.



NSERC PDF program application tutorial

September 19, 2011

This video guides students through the process of applying to the NSERC Postdoctoral Fellowships Program.



Tips on applying for an NSERC scholarship or fellowship

May 25, 2011

This video provides practical tips to help applicants write a better proposal for an NSERC Postgraduate Scholarship, Canada Graduate Scholarship or NSERC Postdoctoral Fellowship. It features interviews with members of the selection committees that evaluate applications.

NOTE: Some of the interviews were conducted in French. To see the English subtitles, turn on the closed captioning feature.



Demystifying the review process for NSERC scholarships and fellowships

May 25, 2011

This video describes the various steps of the peer review process for each application for an NSERC Postgraduate Scholarship, Canada Graduate Scholarship or NSERC Postdoctoral Fellowship.

NIH – annotated grants

- These are operating grants beyond the scope of this workshop, but these sections could be useful:
- “Equipment, Facilities and other resources”, “Bio Sketch”, and “Research Strategy” will give general ideas.
- The “strategy” section is annotated with comments to point out key concepts.

The screenshot displays a software interface for a grant application. On the left, a 'Bookmarks' sidebar lists various sections of the application, including 'Introduction', 'Cover Page', 'SF 424', 'Table of Contents', 'Project / Performance Site', 'Other Project Information', 'Facilities and Other Resources', 'Equipment', 'Senior / Key Person Profile', 'Biographical Sketch 01', 'Cover Page Supplement', 'Modular Budget, Periods 1 and 2', 'Modular Budget, Periods 3 and 4', 'Modular Budget, Periods 5 and Cumulative', 'Personnel Justification', 'Research Plan Forms', 'Specific Aims', 'Research Strategy', 'List of Publications', 'References Cited', 'Letters of Support', and 'Checklist'. The 'Research Strategy' section is highlighted in blue. On the right, the main content area shows the text of the 'Research Strategy' section, starting with 'Principal Investigator/Program Director (Last, first, middle): Striepen, Boris'. The text discusses the maintenance of the apicoplast genome and the identification of genes for a suite of proteins. It is divided into sections: (B) Innovation, (C) Approach, and Specific Aim 1. The 'Specific Aim 1' section is annotated with yellow speech bubble comments. The page number 'Page 28' is visible at the bottom right.

Principal Investigator/Program Director (Last, first, middle): Striepen, Boris

and segregation, a mutant in Tic22 showing that this protein is required for apicoplast import across the innermost membrane, and a mutant in the HU protein demonstrating that this protein is required for the maintenance of the apicoplast genome. We also have identified the genes for a suite of proteins with a likely role in apicoplast genome replication and we have tagged and successfully localized their protein products (PolA/Helicase/Primase, DNA-Helicase, Gyrase A and B). The space limitations of the new format preclude us from showing this extensive (yet still unpublished) data.

(B) Innovation

We would like to argue that our project has been highly innovative and we expect it to continue to be innovative. Innovation in this project is evident in the topic of the research, the concepts and hypotheses to be tested, and the approaches to be used. The apicoplast as a research topic has produced a truly new way to think about Apicomplexa that now permeates our view of their metabolism, development and cell biology. Studying the apicoplast has brought together biologist focused on different organisms that previously had little contact. This cross-fertilization has let parasitologists to consider pathways initially studied in plants and algae to explain parasite metabolism, drug sensitivity, gene expression control, and signaling and hormone action. Over the last year I have been invited to present our research on the apicoplast at Gordon Research Conferences in three different fields (parasite biology, chloroplast biology, and protein transport) and we view that as a testament to the fact that our specific questions and hypotheses have been innovative and are at the cutting edge of multiple fields. I am particularly excited about the potential role of ubiquitination in the apicoplast. This is a new concept that will lead us to discover new biology and might have strong potential for drug development. Lastly, as a research group and within this project we have invested considerable effort into the development of new experimental tools and approaches. This is particularly true for parasite genetics and cell biological analysis and the current proposal represents an extension of these efforts. We feel that overall this investment has paid off (at times in unexpected ways) and that taking the risk to develop new approaches in the future will keep our experiments fresh and will allow us to ask deeper and deeper mechanistic questions.

(C) Approach

Specific Aim 1: Dissect the mechanism of apicoplast protein import.

The apicoplast maintains its own genome, however the bulk of the estimated 400-500 apicoplast proteins are nuclear encoded and imported into the organelle (46). Nuclear encoded apicoplast proteins are synthesized with a bipartite leader and initially routed through the secretory pathway (47, 48). Vesicle fusion with the outermost membrane is believed to deliver proteins to the organelle. How they then cross the remaining three membranes to reach the lumen has been the topic of many spirited discussions and countless review articles, yet until very recently little experimental evidence was available to test these various hypotheses. This has changed dramatically and a model is emerging that proposes three consecutive protein translocons that enable transport over consecutive membranes. Work performed under this proposal has made significant contributions to this progress. We have identified, cloned and localized several members of two candidate translocons in *T. gondii* ((29, 36, 37), van Dooren & Striepen unpubl., and this proposal). This work described a translocon related to the Tic (translocon of the inner chloroplast membrane) in the innermost apicoplast membrane and a translocon of the second or periplastid membrane derived from an endoplasmic reticulum associated mechanism of the algal endosymbiont. We have adapted a split GFP assay to define the various subcompartments of the apicoplast (37) that has subsequently also been used in other complex plastid systems (49, 50). We also have developed three biochemical assays to quantify apicoplast protein import and most importantly we have used these assays in combination with knock out studies to provide rigorous genetic support for a direct role of two translocons in protein import (36, 37). A recent publication from an algal model organism suggests that a Toc (translocon of the outer chloroplast membrane) derived mechanism might be responsible for the transport across the middle membrane (50).

The apicoplast ERAD system

The initial focus of our mechanistic studies will be the system that is now believed to be responsible for protein import across the second outermost apicoplast membrane. This membrane is of particular interest as it is thought to be homologous to the plasma membrane of the algal endosymbiont. Key to the discovery of the

Research Strategy Page 28

Resources

Community of Science: www.cos.com

NSERC videos: http://www.nserc-crsng.gc.ca/Students-Etudiants/Videos-Videos/Index_eng.asp

Annotated NIH grants – click on “Full application”. General ideas in Equipment, Bio Sketch, Research Strategy. (The strategy is annotated with comments to point out key concepts.)

<http://www.niaid.nih.gov/researchfunding/grant/pages/appsamples.aspx>

A talk to the incoming international students at the Columbia Graduate School of Journalism, by William Zinsser (A bit over the top in places but some good points on keeping it simple.) <http://theamericanscholar.org/writing-english-as-a-second-language/>

The great god Google!