08: **Proposals (part II)**

March 16, 2012

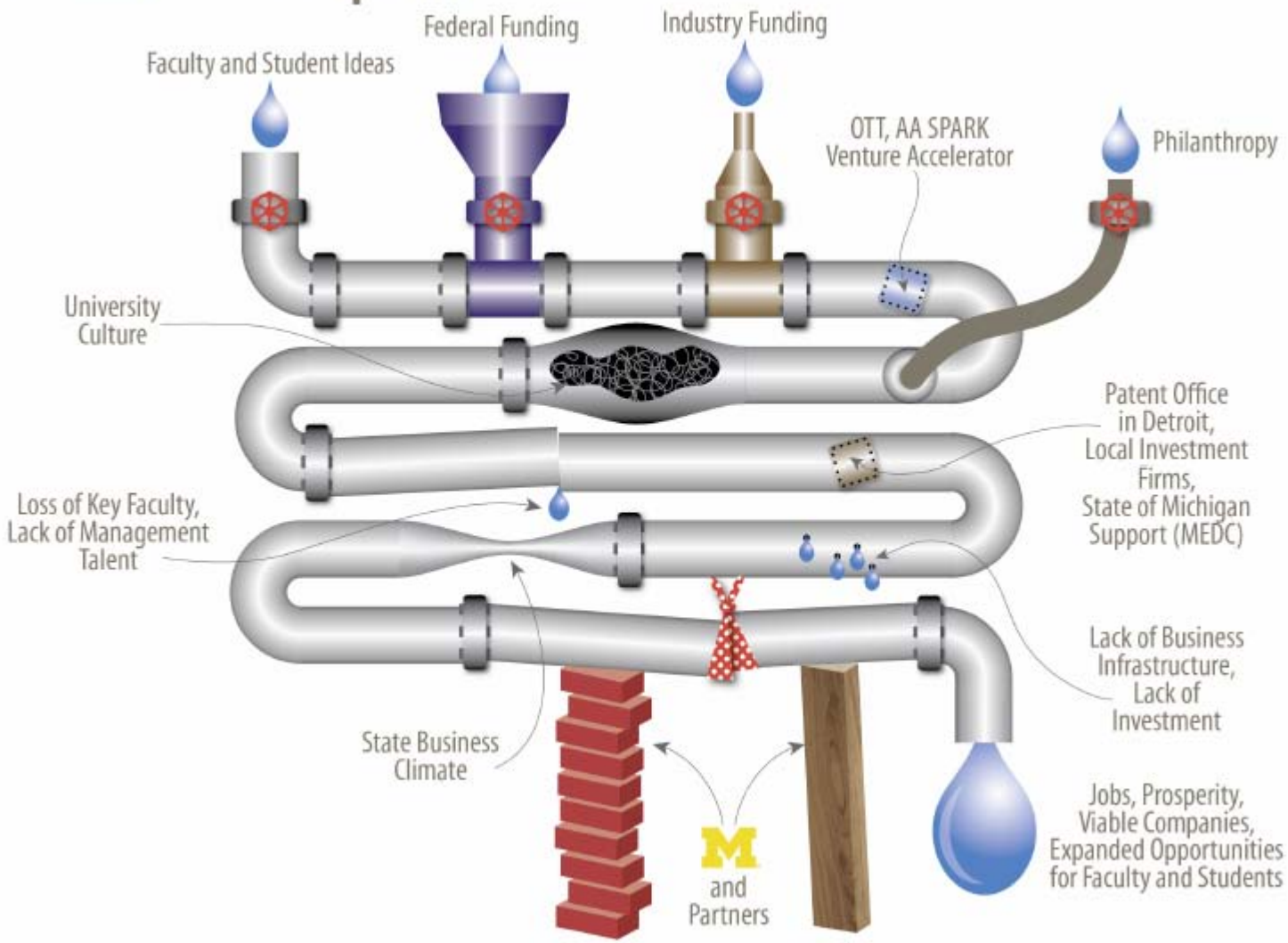
Announcements

- Volunteer RFE presenters for Fri Mar/30?
- Proposal due in 2 weeks, also Fri Mar/30 (2pm). No extensions unless you have a REALLY GOOD reason.

Background reports

- Average = 90/100
- Overall impressions/comments
  - I was looking for clarity and connectivity, even if I was not familiar with your research topic. So, I looked for a strong connection between your questions and the background information you provided. For example, if you say that you want to know how to manufacture something, then you should be discussing the important *details* of existing manufacturing processes.
  - If I was more familiar with your topic, I made more/pickier comments but I don't think this affected how I assigned points.
  - Think about turning your report into a perspective paper in a leading journal in your field (sometimes called a "minireview").
  - Picky things
    - Be very careful about spacing, font consistency, typos
    - Avoid vague adjectives – realize the power of a few extra words
    - Use descriptive figure captions
    - If you copy/modify a figure from a publication, reference it in the caption
    - Don't say "my research group"

Innovation Pipeline



Graphic from UMich OVPR

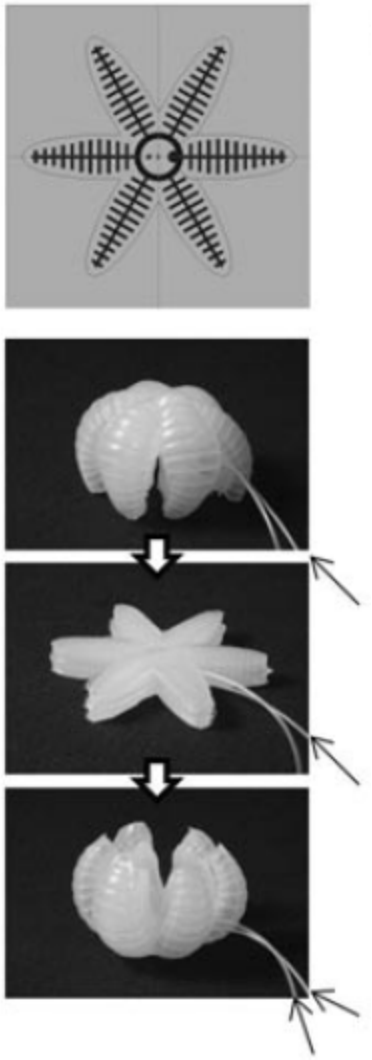
Today: proposals (part II)

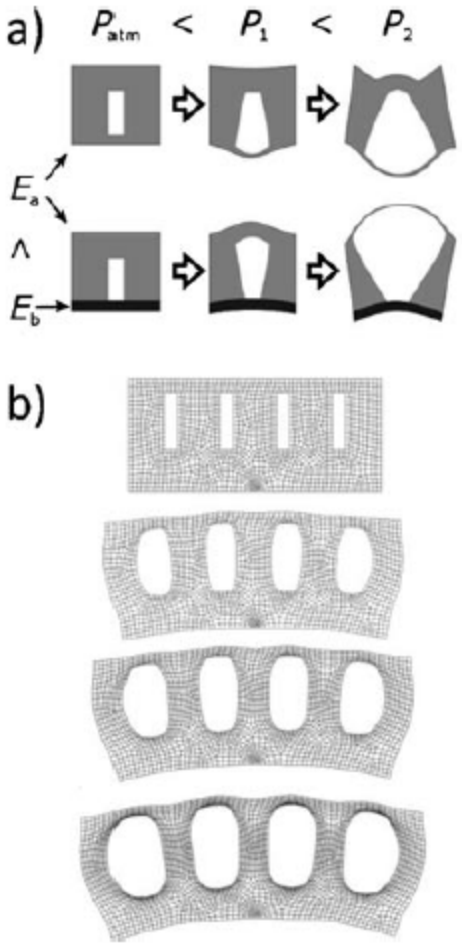
- Review our proposal exercise abstracts/aims
- Attributes of agency review processes
- Discuss the proposal assignment
- Advice for preparing each part of a typical proposal
- Other guidelines for readability and clarity
- If time permits, talk about the differences between writing proposals and papers

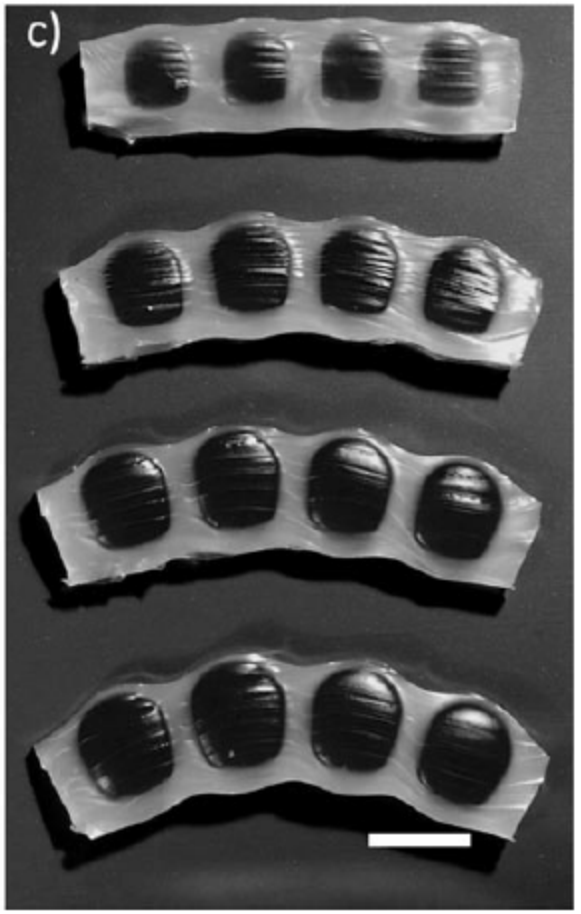
<u>New references on ctools:</u>

- Advice on the process of writing a research paper.

Example: pneumatically actuated grippers







Ilievski et al., *Angew. Chem. Int. Ed.* 2011, 50, 1890 –1895.

Group exercise –due next Friday March 16

- Write a 1 or 2-paragraph summary of a proposal based on the Ilievski paper, focusing on what you'd like to do **next** (anything)
  - The summary should follow the modified *Nature* format discussed during class (see reading on ctools)
  - The summary should identify both the intellectual merit and broader impact of your proposed work

- In addition to the summary, identify 3 or 4 specific aims of your proposed research. Each aim should be described in 1-2 sentences. You should also think of how you will measure your progress toward each aim (i.e., qualify/characterize results). You don't need to write about this though.

- For class on March 16:
  - Bring 10 copies of your team's summary (for a peer review exercise)
  - Be ready to explain and defend your aims in front of the class

Our review activity

- We form one review panel, with teams sitting together
- Everyone reads and scores 2 proposals (not theirs)
  - 5: excellent
  - 4: very good
  - 3: good
  - 2: fair
  - 1: poor
  - “multiple ratings” allowed, like 4.5 = E/VG
- Make notes on strengths and weaknesses for discussion
- We collect and tabulate the scores
  - Write the proposal code (A,B,C,D) and score on the paper
- We compare and contrast the proposals with the two highest scores
- We decide which proposal is recommended for funding

NSF review criteria

Criterion 1: What is the intellectual merit of the proposed activity?

How important is the proposed activity to advancing *knowledge* and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

Criterion 2: What are the broader impacts of the proposed activity?

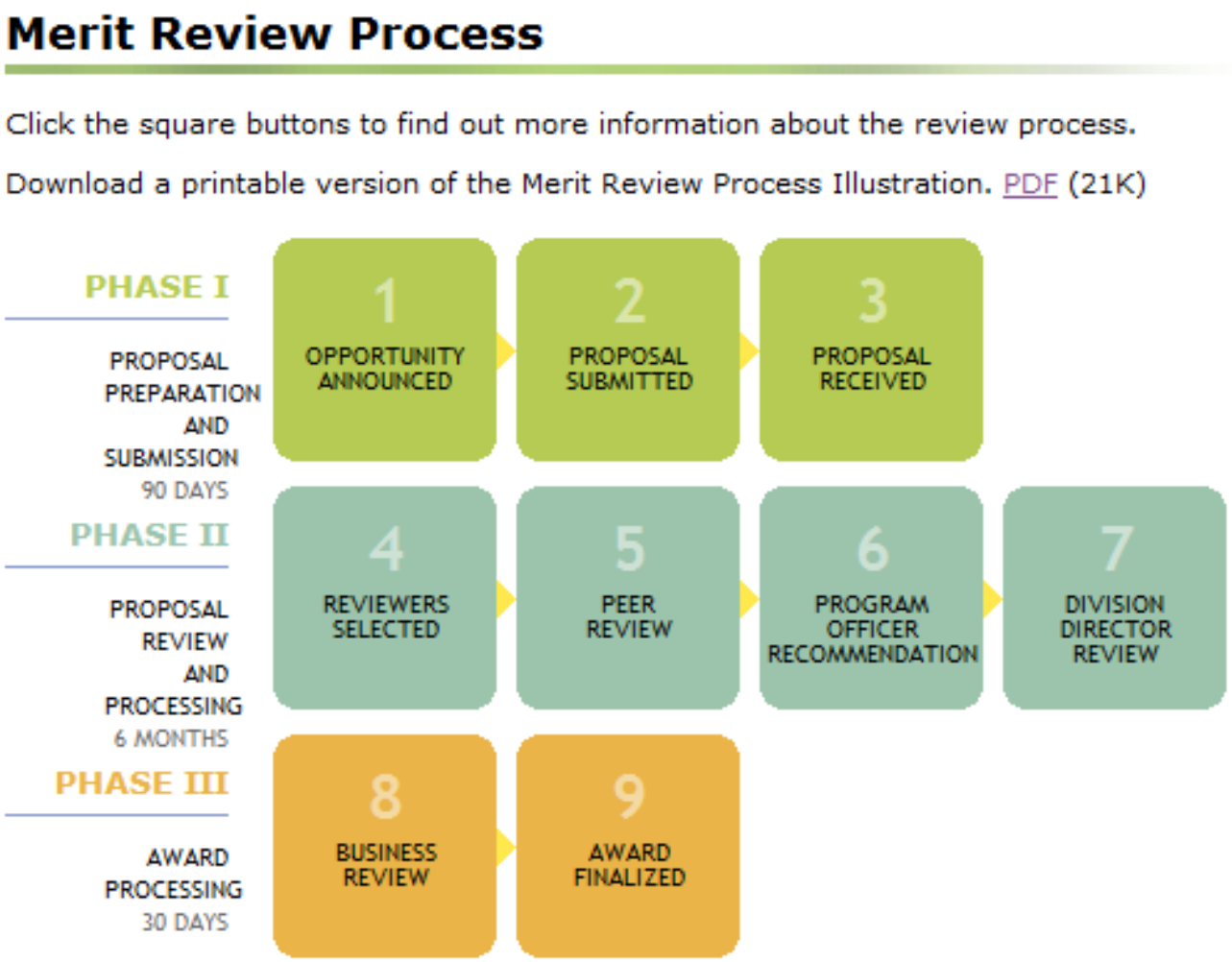
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? **Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?**

http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf

NSF proposal review process

- Program director receives proposals and sorts the proposals by theme within his/her program
- Program director recruits panels (approx. 10 people for 20 proposals) and assigns proposals to the reviewers, avoiding obvious conflicts of interest
- Reviewers read proposals (4-6 each) before the panel meeting and enter comments/scores online
- Panel convenes at NSF HQ (Arlington, VA) for a 1-day meeting
- Typically about half of the proposals are eliminated within the first hour
- Scores are revised according to panel discussion; summaries are written
- Program director makes final funding decisions, based on budget and other criteria (geographic/demographic)

NSF proposal review process



http://www.nsf.gov/bfa/dias/policy/meritreview/merit_animation.jsp

The review process in general

- Differs widely by agency/organization
- Reviewers are always pressed for time
- Most/all of the time, there is a surplus of high-quality (fundable) proposals
- The program director may have a lot of discretion
- Bias is, unfortunately, part of the process – this only makes it more important to be known among the “community”
- Find out as much as you can about how the review process really works, and what the program is *really* looking for
- This applies to fellowships too

Why proposals are rejected

…short-comings of 605 proposals rejected by the National Institutes of Health is worth pondering. The list is derived from an article by Dr. Ernest M. Allen (Chief of the Division of Research Grants, National Institutes of Health) that appeared in Science, Vol. 132 (November 25, 1960), pp. 1532-34. (The percentages given total more than 100 because more than one item may have been cited for a particular proposal.)

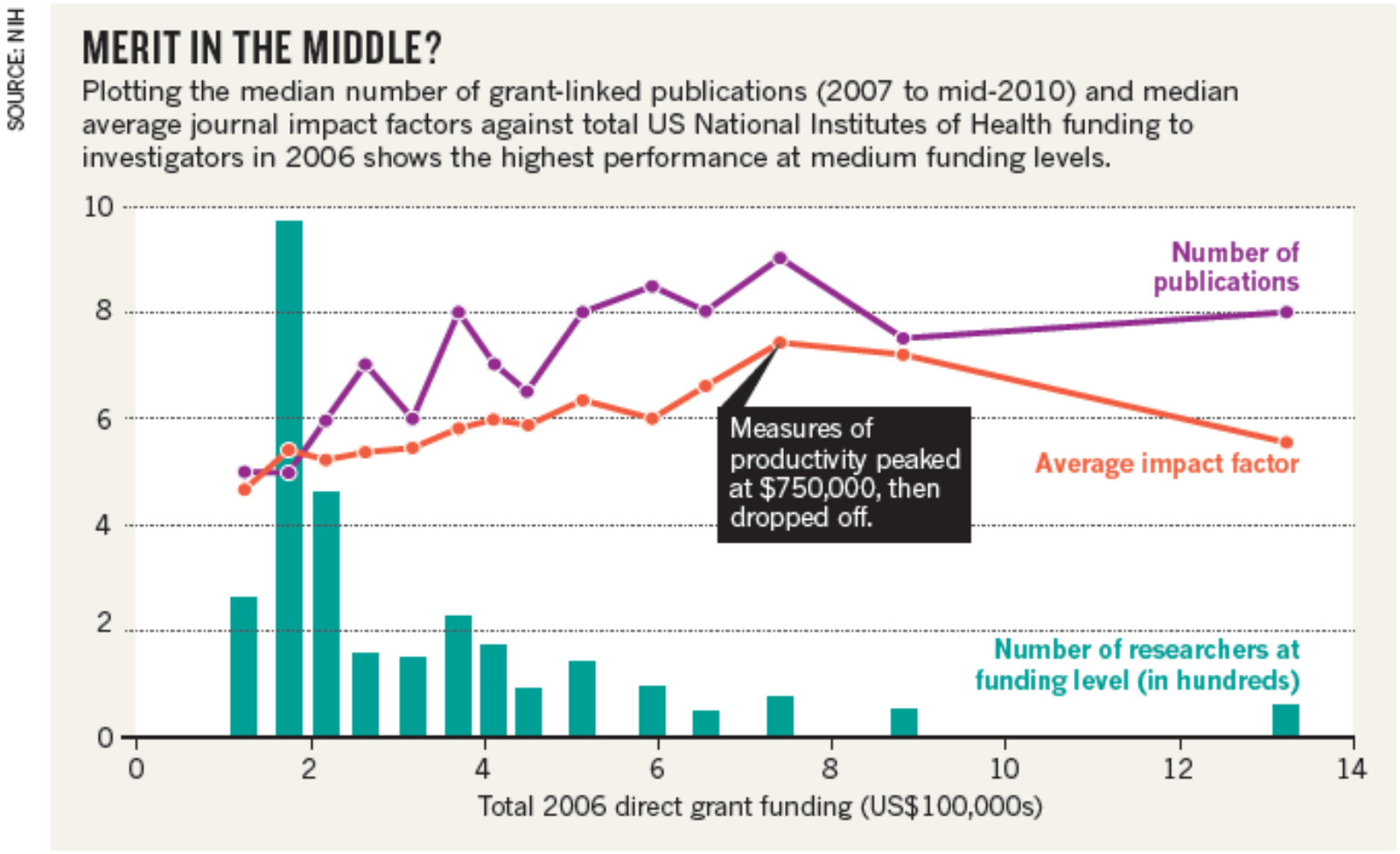
Problem (58 percent)
1.The problem is not of sufficient importance or is unlikely to produce any new or useful information. (33.1)
2.The proposed research is based on a hypothesis that rests on insufficient evidence, is doubtful, or is unsound. (8.9)
3.The problem is more complex than the investigator appears to realize. (8.1)
4.…

Approach (73 percent)
1.The proposed tests, or methods, or scientific procedures are unsuited to the stated objective. (34.7)
2.The description of the approach is too nebulous, diffuse, and lacking in clarity to permit adequate evaluation. (28.8)
3.The overall design of the study has not been carefully thought out. (14.7)
4.…

Investigator (55 percent)
1.The investigator does not have adequate experience or training for this research. (32.6)
2.The investigator appears to be unfamiliar with recent pertinent literature or methods. (13.7)
3.The investigator's previously published work in this field does not inspire confidence. (12.6)
4.…

Other (16 percent)
1.The requirements for equipment or personnel are unrealistic. (10.1)
2.….

From the other side



356 | NATURE | VOL 468 | 18 NOVEMBER 2010

PhD Research Process | Winter 2012

Research proposal assignment

Due on ctools at 2p Friday, March 30. Bring paper copy to class also.

a. Guided by your background report, identify the following (you don't need to submit this as a separate part of your assignment, and it doesn't count toward the page total):
   1. The key question/topic your research will seek to address. You should be able to express this in one sentence, a.k.a. your "mission statement".
   2. The steps you expect to take (i.e., the research activities) in order to answer your question. These will be refined into the specific aims of your proposal.
   3. The most relevant background info to motivate your key question, and to justify your choice of aims.

b. Based on the analysis from (a) write a proposal with the following sections:
   1. Summary (1-2 paragraphs) according to the modified *Nature* "first paragraph" format discussed in class. It should include your 1-sentence mission statement in **bold** text.
   2. Background. This is selected text, possibly written more compactly, from your report.
   3. Rationale and novelty, i.e., why your work fills an important need in light of the current status of your field, and why your approach is unique. This is VERY important.
   4. Description of proposed research, including at least 3 major tasks or aims. Each aim should be summarized in one sentence, followed by a more detailed description, and should have a measurable outcome. Each aim should stand reasonably well on its own, although later tasks may build upon previous findings.
   5. Expected outcomes, assuming your research is successful (BOTH scientific and practical).
   6. A timeline, indicating the start/end and duration of each of your research aims. The timeline resolution need not be finer than 3 months.
   7. Description of your qualifications (1 paragraph), i.e., why you are (or will be) qualified to do the proposed work.

c. The proposal must be 4-5 pages, with 1" margins (left/right/top/bottom), single-spaced, 11- or 12-point font. Sections should be divided with headings. The page limit excludes figures (plan for 0.5-1 page total area, more is OK) and references. Use the *Nature* reference format.

The modified *Nature* format

General and specific background (WHY)

*One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline.*

*Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines.*

Your mission statement (WHAT NOW)

*One sentence clearly stating the **general problem** being addressed by this particular study.*

Summary of aims/methods (HOW)

*One sentence summarising the main result (with the words "**here we show**" or their equivalent).*

*Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge.*

Expected outcomes: both intellectual merit and broader impact should be clear (WHAT LATER)

*One or two sentences to put the results into a more **general context**.*

*Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline, may be included in the first paragraph if the editor considers that the accessibility of the paper is significantly enhanced by their inclusion. Under these circumstances, the length of the paragraph can be up to 300 words. (The above example is 190 words without the final section, and 250 words with it).*

During cell division, mitotic spindles are assembled by microtubule-based motor proteins[1,2]. The bipolar organization of spindles is essential for proper segregation of chromosomes, and requires plus-end-directed homotetrameric motor proteins of the widely conserved kinesin-5 (BimC) family[3]. Hypotheses for bipolar spindle formation include the 'push–pull mitotic muscle' model, in which kinesin-5 and opposing motor proteins act between overlapping microtubules[2,4,5]. However, the precise roles of kinesin-5 during this process are unknown. Here we show that the vertebrate kinesin-5 Eg5 drives the sliding of microtubules depending on their relative orientation. We found in controlled *in vitro* assays that Eg5 has the remarkable capability of simultaneously moving at ~20 nm s^{-1} towards the plus-ends of each of the two microtubules it crosslinks. For anti-parallel microtubules, this results in relative sliding at ~40 nm s^{-1}, comparable to spindle pole separation rates *in vivo*[6]. Furthermore, we found that Eg5 can tether microtubule plus-ends, suggesting an additional microtubule-binding mode for Eg5. Our results demonstrate how members of the kinesin-5 family are likely to function in mitosis, pushing apart interpolar microtubules as well as recruiting microtubules into bundles that are subsequently polarized by relative sliding. We anticipate our assay to be a starting point for more sophisticated *in vitro* models of mitotic spindles. For example, the individual and combined action of multiple mitotic motors could be tested, including minus-end-directed motors opposing Eg5 motility. Furthermore, Eg5 inhibition is a major target of anti-cancer drug development, and a well-defined and quantitative assay for motor function will be relevant for such developments.

http://www.nature.com/nature/authors/gta/Letter_bold_para.doc

The summary must be convincing!

> Working through a tall stack of proposals on voluntarily-donated time, a committee member rarely has time to comb proposals for hidden answers. So, say what you have to say immediately, crisply, and forcefully. The opening paragraph, or the first page at most, is your chance to grab the reviewers attention. Use it. This is the moment to overstate, rather than understate, your point or question. You can add the conditions and caveats later.

- See my NSF project summary

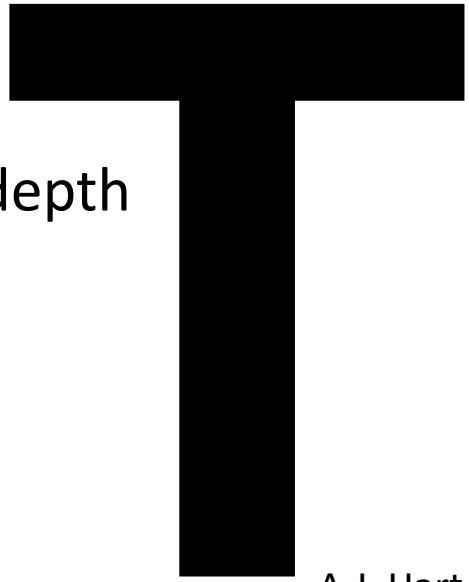
Przeworski and Salomon, "On the Art of Writing Proposals"

The background

- First, state the general importance of your research topic
- Then, highlight key findings that relate to your proposed work
  - Important findings that motivate your study
  - Important background information (including fundamentals)
  - This can include your own preliminary work (sometimes that's a separate section)

- Don't criticize past work (= makes reviewers angry), rather state *opportunities* for improvement

- This section is a difficult balance of breadth and depth

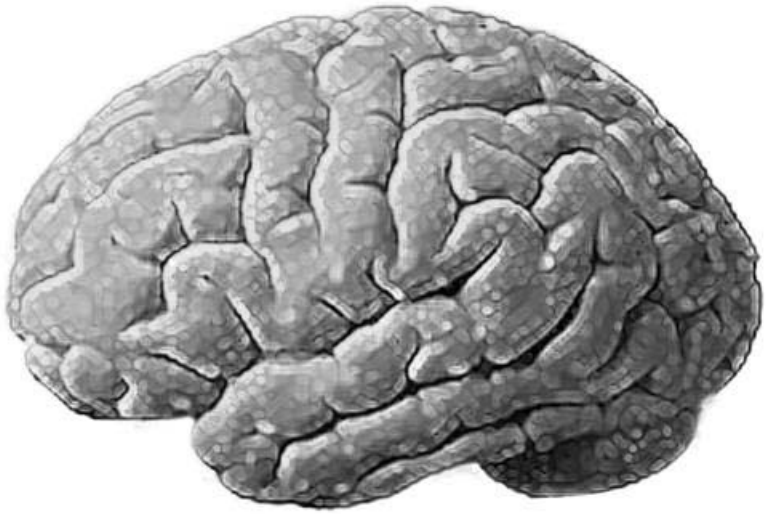


The rationale and novelty

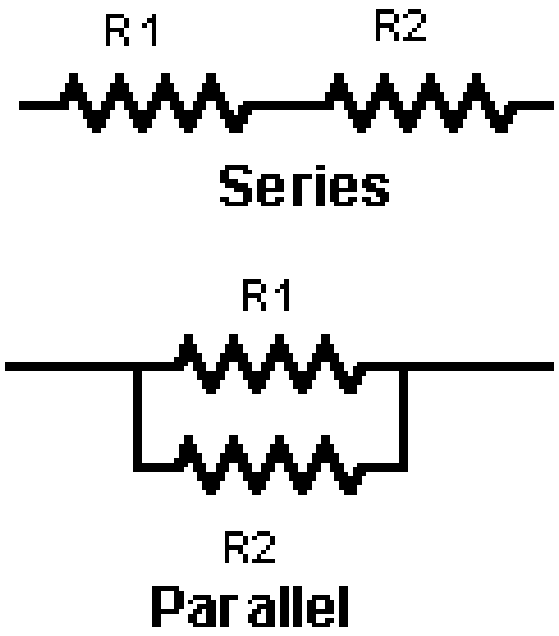
- What is the main idea of the proposal?
- Why is it important? (why is it needed?)
- Why is it unique?
- What is the GAP?

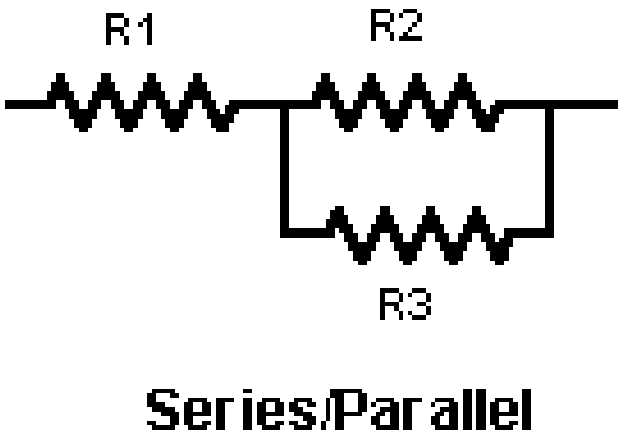
relationship-economy.com

Dividing the big idea: objectives/aims



Planning: series and parallel





- What happens if a wire breaks?

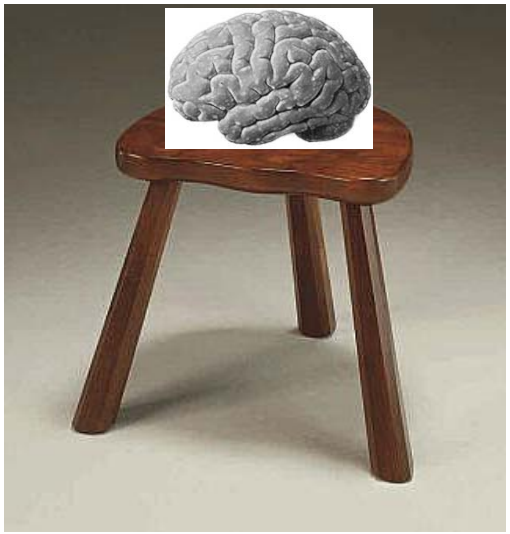
  → *Risks and countermeasures*

http://www.guitarnuts.com/wiring/serpar.php

Think long-term

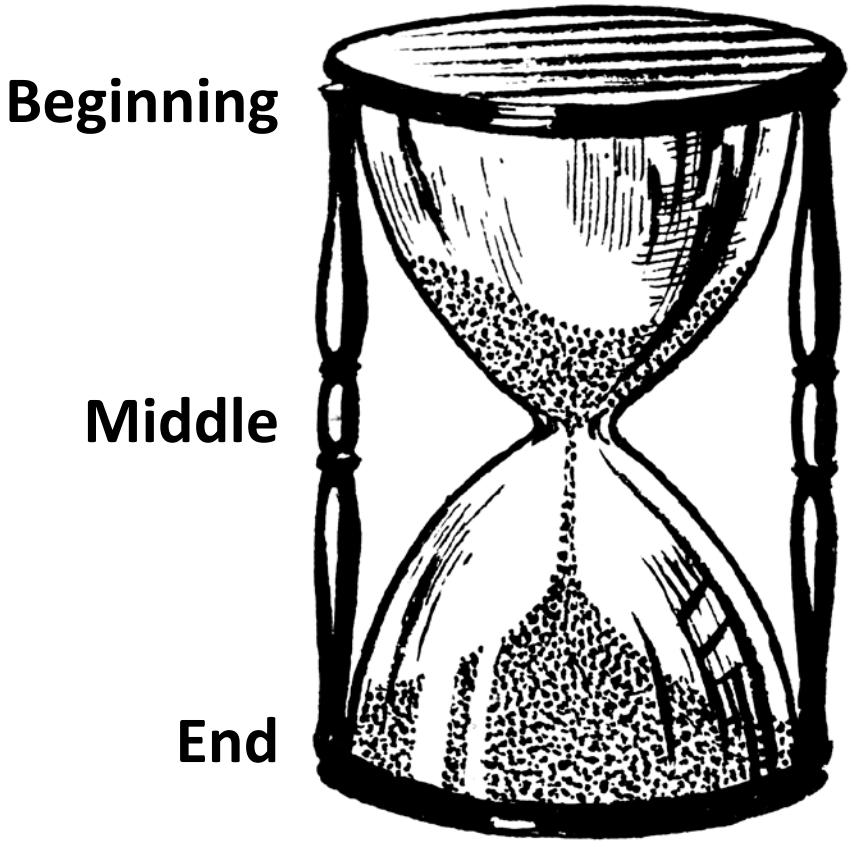
By the time you write your proposal, obtain funding, do the research, and write it up, you might wish you were working on something else. So if your instinct leads you to a problem far from the course that the pack is running, follow it—not the pack: nothing is more valuable than a really fresh beginning.

A good proposal has a lot of legs

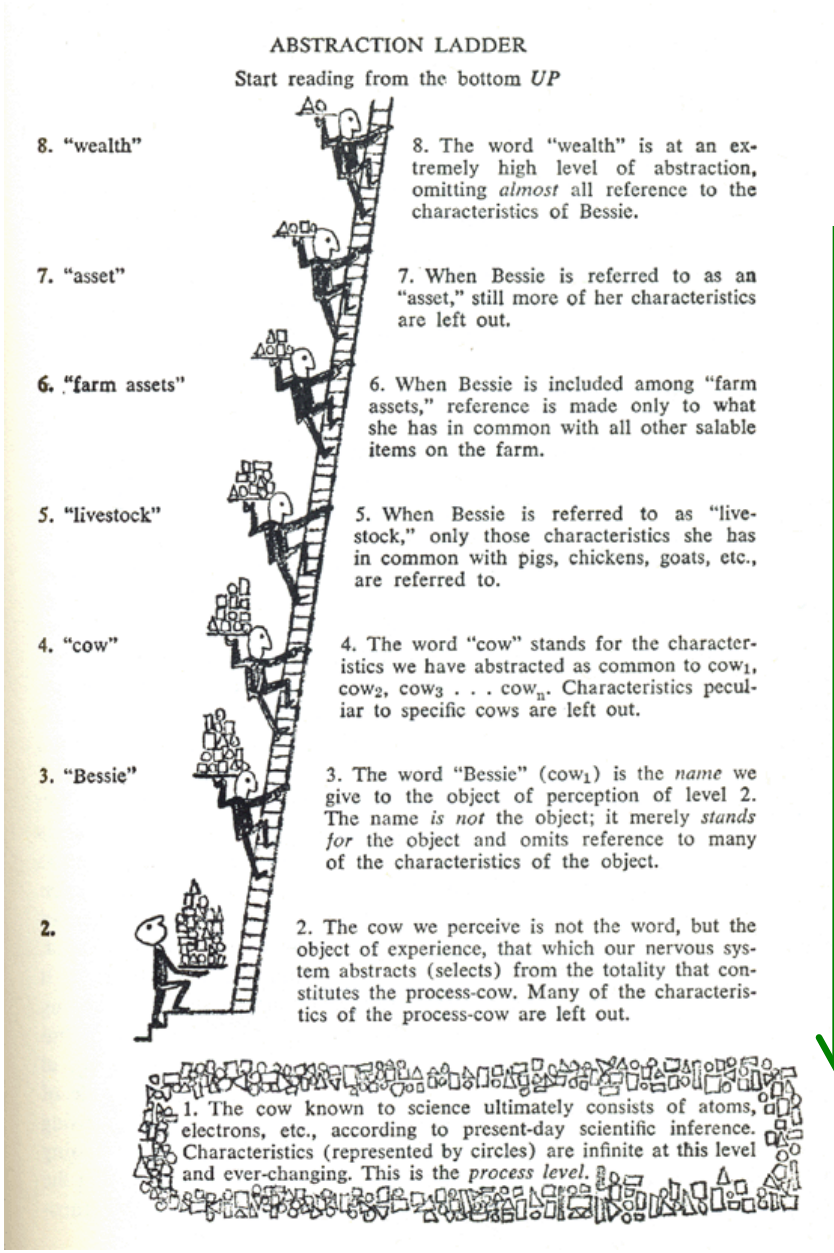


A good idea is necessary but not sufficient for a successful proposal. Especially, the reviewers will want to know what you will do if something goes wrong. Your idea and approach must be robust to their concerns.

Overall: the hourglass design



The ladder of abstraction [Hakayawa]



Level Four	economy
Level Three	farm assets
Level Two	cattle
Level One	**Bessie, the cow**

Use action words (see ctools)

ACTION WORDS

A resume should sound alive and vigorous. Using action verbs helps achieve that feeling. "I changed the filing system" lacks punch and doesn't really indicate if the system was improved. "I *reorganized* and *simplified* the filing system" sounds much better and provides more accurate information.

Review the sentences below to get a feel for action words. Then quickly scan the words in the following list and check any you think you might want to use in your resume. Don't try to force them in; use them when they feel right.

Conducted long-range master planning for the Portland water supply system.

Monitored enemy radio transmissions, analyzed information, and identified enemy strategic and tactical capabilities.

Planned, staffed, and organized the intramural sports program for this 1,200-student college.

Produced daily reports for each trial and made sure documents and evidence were handled properly.

Presented seminars to entry-level secretaries and worked to increase the professionalism of secretaries in the county system.

Improved the coordination, imagination, and pantomime techniques of adults through mime and dance training.

Allocated and dispensed federal moneys to nine counties as board member of the CETA Advisory Board.

However, don't be too dreamy (foofy)

- *Foofy* -- Vague, evasive, betraying lack of mastery and confidence; exaggerated claim without evidence
- *Foofy example:* "Nanotechnology promises enormous economic benefits."
- *Less foofy:* "Smith, writing in the Wall Street Journal, estimates that nanotechnology will have a $100 billion impact on the world economy in five years [ref]."

- Some of you made really dramatic impact statements in your background report, but these statements were not supported by rationale. Be specific, and be quantitative where possible.
- It's most important to know the expected contribution of your work, and then you can make a jump to the overall impact of the field and longer-term efforts.

Another angle: have a clear context and clear objectives

WHY WHAT HOW/WHO

- Context
  - Defined broadly with clear motivation (e.g., quantification if possible)
  - Connect the big issue to your specific focus
  - It should be clear why your work (if successful) is unique and will make a difference

- Objectives/tasks should be
  - Specific (= what will be done)
  - Measurable (= how you will measure the outcome)
  - Practical (= can be done)
  - Logical (= makes sense, on its own and in combination with other tasks)

Know your audience

- Who will review the proposal?
- What are their selection criteria? (even if your idea is great…)
  - Person/expertise vs. what the research is about
  - Relevance to their interests
  - Fundamental understanding vs. practical applications
  - Education/outreach?
  - …
- Talk to someone who knows the agency/program/topic
  - Faculty talk to program managers
  - Students talk to others who applied for the fellowship before
- Envision the match
  - They may have a problem looking for a solution
  - You may have a solution looking for a problem

Formatting influences reviewer comfort

- Font size and margins; spacing between paragraphs
- Clarity of figures
- Often, less is more! The decision is based on the **important** things, and you want the reviewer to find those quickly.

11pt
1" margins
3pt betw parag

3. **Proposed research**

This section details our plans to fabricate active 3D CNT microstructures, to characterize their mechanical properties and dynamic performance, and to demonstrate their utility as sensors and responsive surfaces. First, we introduce the capillary forming technique which is the foundation for this project, and then we describe the three main research tasks.

3.1 Fabrication of 3D CNT microstructures by capillary forming

The proposed research on morphing CNT microstructures will build from our novel "capillary forming" [1] method of fabricating robust 3D CNT microstructures from vertically-aligned CNT templates. The capillary forming process is shown in Fig. 4. First, a film of Fe catalyst (1 nm thickness) is patterned by optical lithography on a silicon wafer substrate. Next, microstructures made of vertically aligned CNTs (CNT "forests") are grown by atmospheric pressure thermal chemical vapor deposition (CVD) [61, 62]. Next, a solvent such as acetone is condensed on the substrate. This is done by inverting the substrate with CNTs over a beaker containing a boiling solvent such as acetone, or within a low-pressure chamber where the substrate rests on a cold stage. The solvent condenses on the substrate, and, due to capillary rise, the solvent is drawn into each CNT microstructure independently. After the substrate has been exposed to the vapor stream for the desired duration, the substrate is removed from the beaker and the liquid is evaporated under ambient conditions. During infiltration and evaporation of the liquid, the CNTs within each structure densify, and each structure is shaped individually by the forces resulting from capillary action. Different starting forest shapes give different force distributions, enabling design and fabrication of the 3D structures shown later.

Fig. 4. Fabrication of 3D CNT microstructures by capillary forming: (a) schematic; (b) SEM images of contracting (circular) and bending (semicircular) shapes; (c) schematic of corresponding densification mechanisms.

During capillary forming, surface tension causes the CNTs to aggregate locally due to an elastocapillary energy balance [63-65], and the CNT forest globally contracts toward the centroid of its cross-sectional shape. Thus, for a circle, the contraction is toward the center (Fig. 4c); while for a semicircle, the contraction is toward the point at a distance $4R/3\pi$ from the straight edge of the semicircle (Fig. 4c). As this contraction occurs, the CNTs near the substrate are pulled inward toward the centroid, and this in turn pulls down on the upper portions of the forest. For circles, the force distribution is axisymmetric and the final structure therefore slopes toward its apex. For semicircles, the force distribution is asymmetric due to the asymmetric location of the centroid. This causes the structure to deflect laterally, creating a curved beam.

Understanding capillary forming of circular and semicircular CNT forests has guided us in fabrication of a variety of novel 3D microstructures (Fig. 5). For instance, circular arrangements of bending structures can be designed to face inward or outward from a common point, resembling trusses or flowers. Intricate micro-twists with deterministic handedness are formed from shapes comprising semicircles merged with a thin annulus. These catalyst shapes combine the elementary motions of contraction and bending, and the helical angle and pitch of the final structure are determined by the dimensions…

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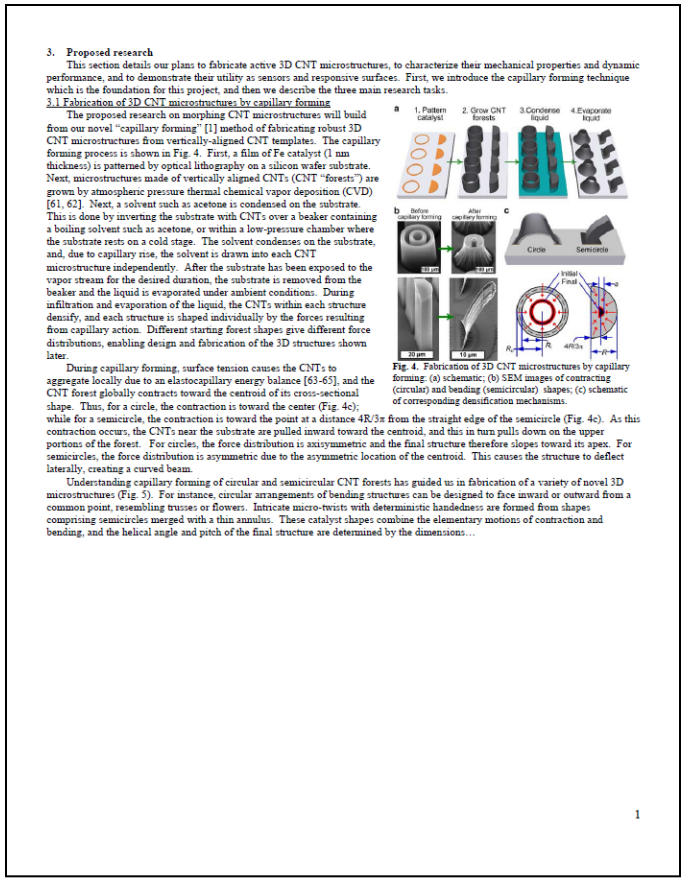
10pt
0.5" margins
0pt betw parag



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1

Procrastination is the enemy of good proposals

- Success not proportional to how much time you spend!
- -but success is proportional to how clear your ideas are
- -and, clarifying your ideas takes time
- So, it's important to be efficient, and it's obvious when you read a proposal that has been rushed
- My experience agrees with this, both as writer and reviewer

The infamous Procrastination Monster // by jordanspilman

George Whitesides on writing a paper

- http://pubs.acs.org/page/publish-research/episode-1.html
- Also see http://onlinelibrary.wiley.com/doi/10.1002/adma.200400767/abstract

Writing a proposal vs. writing a paper

- When do you start planning to write paper?
- Envisioning the “paper” can be a tool for planning research, as soon as you can see the light.
- Study example papers that you really like.
- Background and results content from proposals often gets used in papers, and vice-versa.
- Establish an efficient process for outlining, drafting, and revising (get everyone’s opinion, but not too often).
- Always try to take your work to its full potential.
- It’s important to understand the journal review process.
- Don’t be discouraged by rejection (it is not a failute); negative comments can be very useful to understand how others interpret your work and how you can improve communication.
- Lots more stuff: see ctools resources for today (zip file).

Ashby's approach

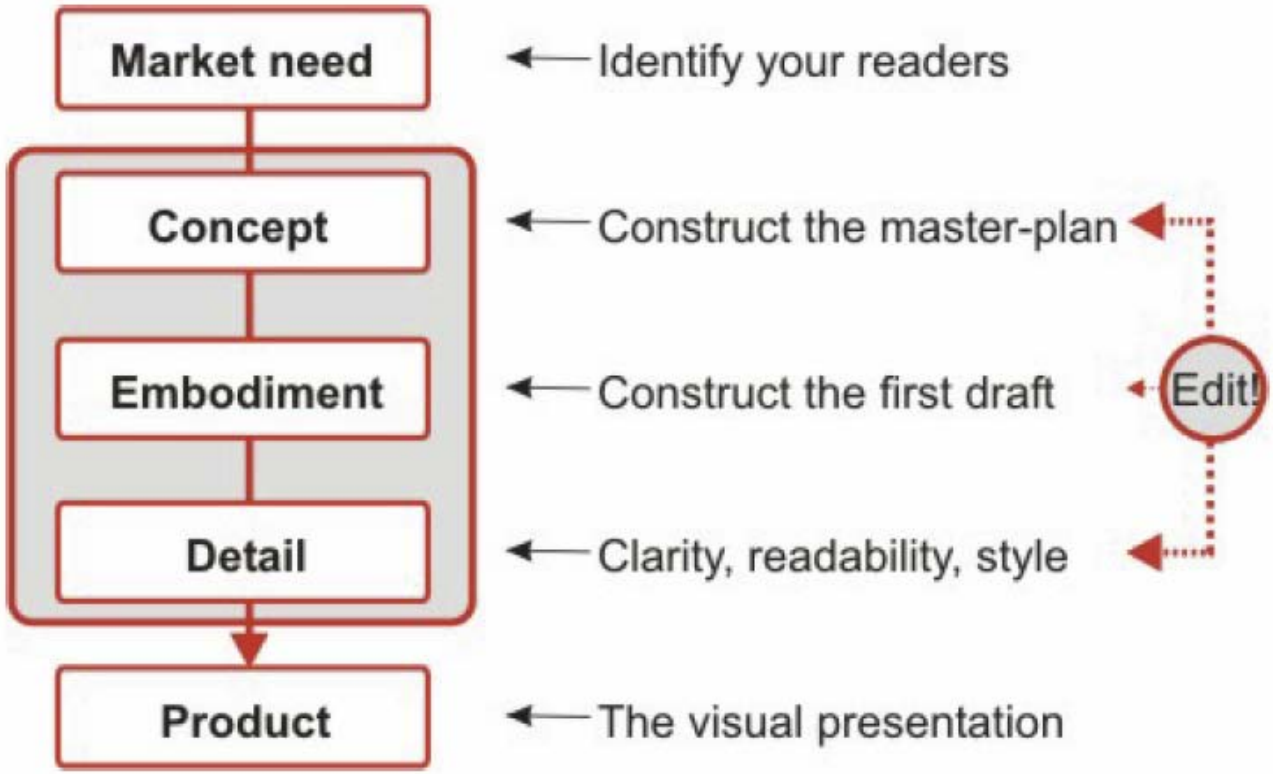


Figure 1. The Design Process. Designing a paper is like designing anything else: there are five essential steps.

Ashby's visual outline

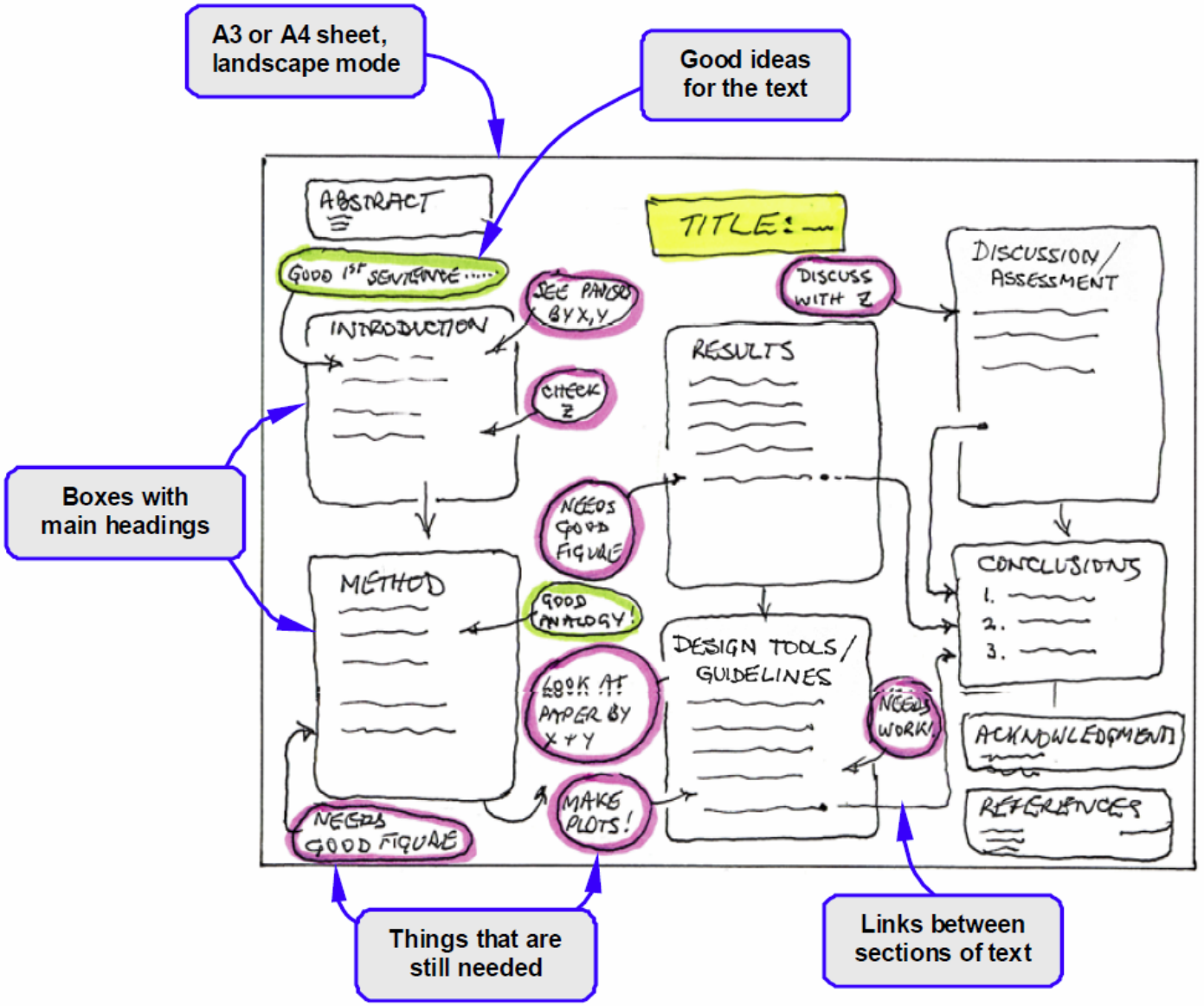
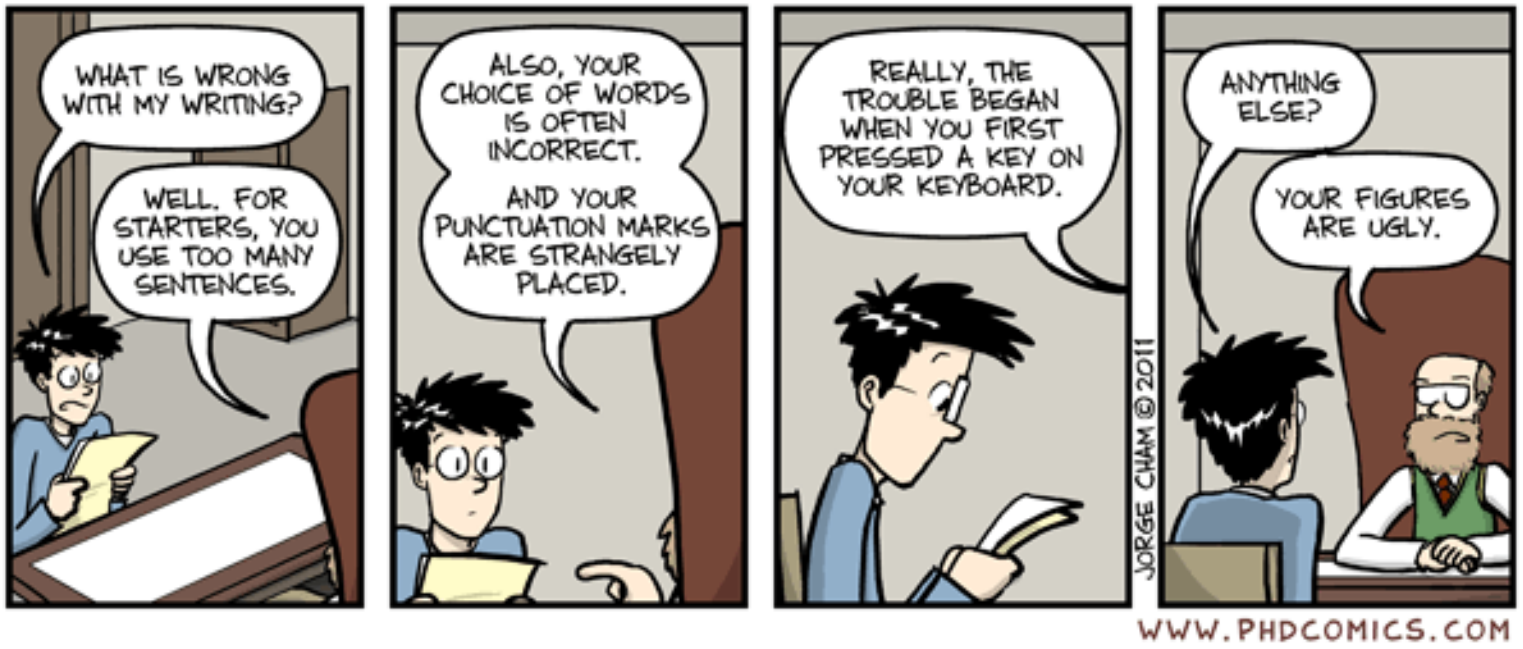


Figure 3. A model for a concept sheet.

Your advisor will probably be critical, but this is part of the process



You can write a good a paper about almost anything

Polar Biol (2003) 27: 56–58
DOI 10.1007/s00300-003-0563-3

SHORT NOTE

Victor Benno Meyer-Rochow · Jozsef Gal

Pressures produced when penguins pooh—calculations on avian defaecation

Received: 17 July 2003 / Accepted: 5 October 2003 / Published online: 31 October 2003

Abstract Chinstrap and Adélie penguins generate considerable pressures to propel their faeces away from the edge of the nest. The pressures involved can be approximated if the following parameters are known: (1) distance the faecal material travels before it hits the ground, (2) density and viscosity of the material, and (3) shape, aperture, and height above the ground of the *orificium venti*. With all of these parameters measured, we calculated that fully grown penguins generate pressures of around 10 kPa (77 mm Hg) to expel watery material and 60 kPa (450 mm Hg) to expel material of higher viscosity similar to that of olive oil. The forces involved, lying well above those known for humans, are high, but do not lead to an energetically wasteful turbulent flow. Whether a bird chooses the direction into which it decides to expel its faeces, and what role the wind plays in this, remain unknown.

Introduction

Penguins spend most of their life in the water. An extended period ashore only occurs during breeding. Anyone who has then watched a penguin fire a "shot" from its rear end must have wondered about the pressure the bird generates, but apparently no published data on the
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stand up, turn their back nest-outward, bend forward, lift their tail, and shoot. The expelled material hits the ground maximally 40±12 cm away from the bird and then leaves behind a whitish or pinkish streak that can end a few centimetres from the nest's periphery and may be up to 1 cm wide. The colour of the streak depends on whether the penguin had enjoyed a meal of fish (mostly white) or krill (pinkish). According to Jackson (1992), the time required to excrete 50% of the total faecal mass is 9.1 h and 14.5 h for fish and prawn food, respectively.

From a few "spot-on" photographs, we estimated the aperture, from which the semi-liquid excretory material is released, to possess a maximal diameter of 8 mm at the moment of "firing". Hind-gut diameters of 4.2 mm for the smaller rockhopper and 13.8 mm for the larger gentoo penguin are on record (Jackson 1992). Although the *orificium venti* generally opens through a horizontal slit in the Spheniscidae, the orifice becomes circular during evacuation (King 1981; Watson 1883). Since penguins, prior to venting, ascend the rim of pebbles that forms the edge of the nest, and are then somewhat higher than their surroundings, we place the elevation of the cloaca 20±6 cm above ground (Fig. 1). By adopting average (=typical) values, we can mathematically examine which pressures would have been needed to achieve the faecal distances we measured around a penguin's nest. The model would then allow compari-
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V. B. Meyer-R
Faculty of Eng
Bremen (IUB),
E-mail: b.meye

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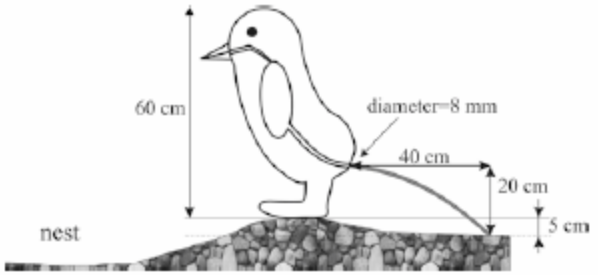

Fig. 1 Position of model penguin during defaecation and physical parameters used to calculate rectal pressure necessary to expel faecal material over a distance of 40 cm

APPLIED MICROBIOLOGY, July 1967, p. 899–906

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Microbiological Laboratory Hazard of Bearded Men

MANUEL S. BARBEITO, CHARLES T. MATHEWS, AND LARRY A. TAYLOR
Industrial Health and Safety Office, Fort Detrick, Frederick, Maryland 21701

Received for publication 6 March 1967

An investigation was conducted to evaluate the hypothesis that a bearded man subjects his family and friends to risk of infection if his beard is contaminated by infectious microorganisms while he is working in a microbiological laboratory. Bearded and unbearded men were tested with *Serratia marcescens* and *Bacillus subtilis* var. *niger*. Contact aerosol transmission from a contaminated beard on a mannequin to a suitable host was evaluated with both Newcastle disease virus and *Clostridium botulinum* toxin, type A. The experiments showed that beards retained microorganisms and toxin despite washing with soap and water. Although washing reduced the amount of virus or toxin, a sufficient amount remained to produce disease upon contact with a suitable host.

Indirect contact transmission of disease from the microbiological laboratory to persons outside by means of contaminated clothing has been reported in the instances of Q fever in laundry workers (11) and in a veterinarian's wife who may have acquired Q fever by handling the clothing of her husband (6).

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a full-length, natural-hair beard on a mannequin was contaminated with Newcastle disease virus (NDV) and *Clostridium botulinum* type A toxin. Chickens and guinea pigs were used as test animals.

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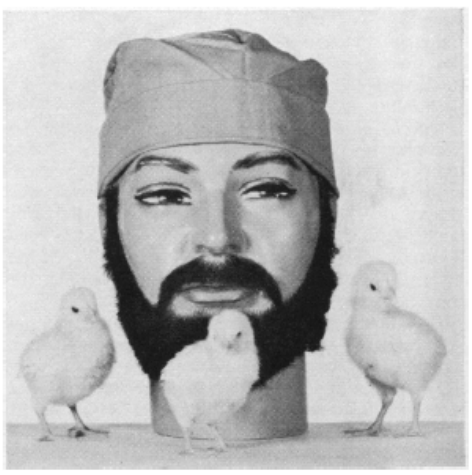

FIG. 3. *Chickens exposed to natural hair beard on mannequin.*

Homework

- Draft aims of your proposal. Bring 3 copies for peer review in class next week.

Extra slides

Graduate fellowships = freedom!

- You'll be decoupled (mostly) from external funding sources
- Access to new opportunities, e.g., workshops
- Excellent for your CV

- As a result, graduate fellowships are considered recognition of you, not just the research you're doing
  - However, a strong proposal is indicative of your ability to do research
  - Same is true for faculty young investigator awards

The NSF GRFP essay

In a clear, concise, and original statement, present a complete plan for a research project that you may pursue while on fellowship tenure and how you became interested in the topic.

Your statement should demonstrate your understanding of research design and methodology and explain the relationship to your previous research, if any. Describe how you propose to address the two NSF Merit Review Criteria of Intellectual Merit and Broader Impacts. Refer to the program announcement for specific guidance.

Format: Include the title, key words, hypothesis, research plan (strategy, methodology, and controls), anticipated results or findings, literature citations, and a statement attesting to the originality of the research proposal. If you have not formulated a research plan, your statement should include a description of a topic that interests you and how you would propose to conduct research on that topic.

2 pages!