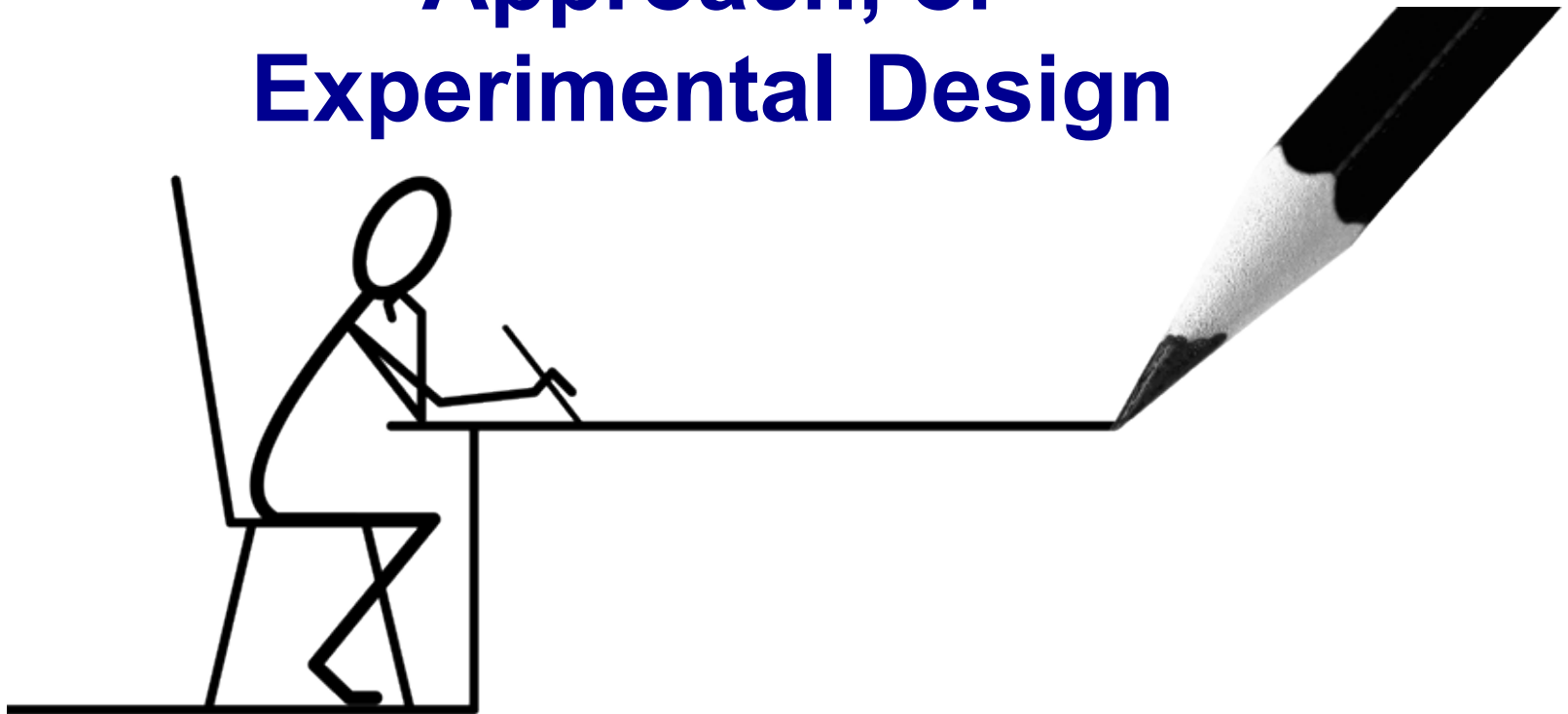


# **Scientific Writing IMB521:**

## **Research Plan, Approach, or Experimental Design**



# Deconstruct the Proposal

**Specific Aims** (1 page)- outline of the overall proposal; mini-, stand alone grant

**Significance** (~0.5-1 page)

- What is being studied?
- Why is it important?
- What is already known?
- What are you going to contribute to the body of knowledge?

**Innovation** (0.25-0.5 page)

- How is what you propose conceptually innovative?
- How is what you propose technically innovative?

**Experimental Design** (up to 11 pages)

- What are you going to do to address aims
- How will the data be analyzed and interpreted
- What are you going to do when things do not work

# Preliminary Data

Make it stand alone

All figures MUST have legends!!

Details need to matter (find the sweet spot)

Simplify as much as possible

Aesthetics

Should be your OWN work

Cartoons vs. Data vs. Summary table

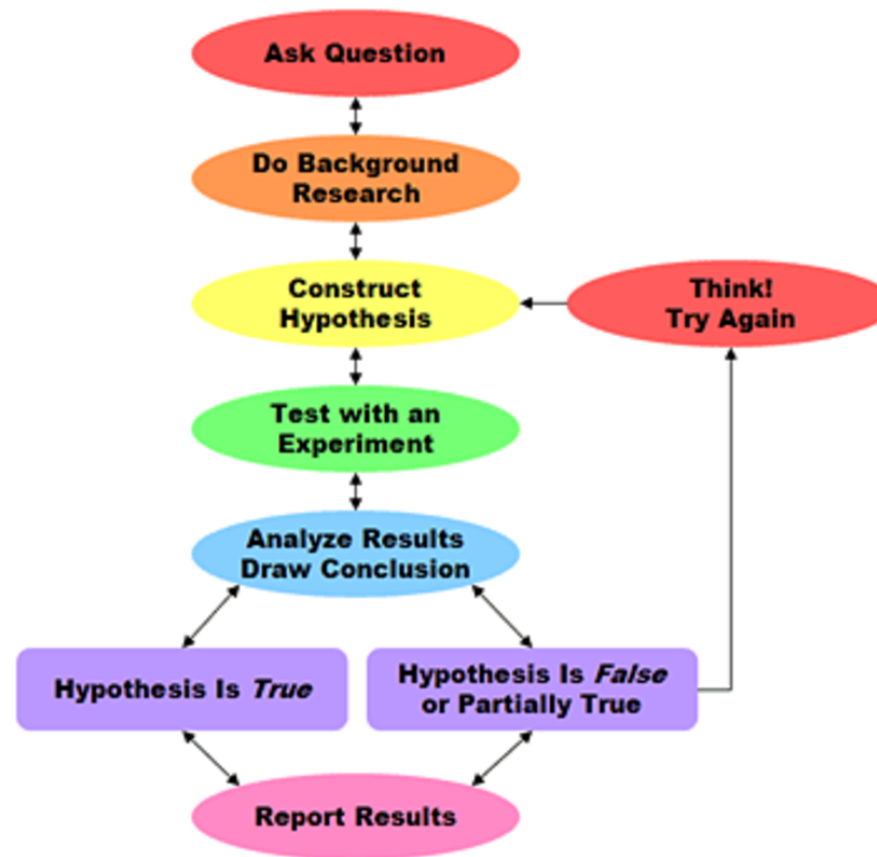
Should tell an integral part of the story or prove feasibility

## The Approach: Instructions from NIH

- Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims of the project.  
*This is the how. This is the easy part that almost anyone can do.*
- Include how the data will be collected, analyzed, and interpreted.
- Discuss *potential problems, alternative strategies, and benchmarks for success anticipated* to achieve the aims.
- If the project is in the early stages of development, describe any strategy to establish feasibility, and address management of high risk aspects of the proposed work.

**The Approach: Should reveal that you know and use the...**

## **Scientific Method**



# Overall Approach the Research Plan

- Formulate your research plan into logical sections so that the reader approaches it in bite size chunks
- This section should reiterate the big picture, questions, hypotheses, and tell the story of how you are going to accomplish it accounting for how things will be controlled and what alternatives you are ready for when things do not go as you hope
- Not nitty gritty detail—the details you include must be carefully chosen to build confidence, create a cohesive and clear plan

- Sections of aims

Preliminary Data

Aim 1

Aim 2

Aim 3

]

Define a set of subsections that are consistent throughout each aim

# The Approach: Format up to you



For each aim, you need to incorporate:

1. Background and Rationale. A concise narrative overview to create a partnership with your reviewers that will make them want to read the details of your research plan. An introduction.
2. Experimental Plan. This is the how. What are you going to do? (subaims)
3. Expected Outcomes. What will you produce?
4. Potential Problems and Alternative Strategies. What problems might be encountered and how will they be overcome?
5. Timeline and future directions. How long will the work take and what will come from it?

# The Approach: Background and Rationale.

Pen to paper/fingers to keyboard:

1. Begin with a sentence that **justifies** why the work should be done (maybe a place to refer to or use some preliminary data)
2. What is the aim's **objective**? Write this in such away that attaining this objective will solve a problem or a gap in knowledge. "The objective of this aim is to....."
3. Now tell the reviewer how you will attain the objective by stating your **hypothesis** (repeat verbatim from aims page).
4. A sentence or two about the overall strategy as to how you will test the hypothesis. This is big picture—no details yet! (use or refer to prelim data)
5. State the rationale for the work proposed. "the rationale for this aim is that successful completion will contribute a missing, fundamental, critical piece of knowledge. (use or refer to prelim data)
6. Finally, state what will be gained—big picture. "At the completion of this aim, it is our expectation that we we will have..., which would allow for the first time....."



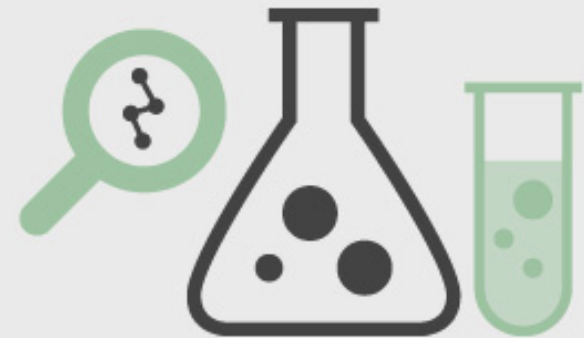
## The Approach: Experimental Plan

- Keep it conceptual. No buffer concentrations or volumes. They need to know what you are going to do and how you will control and interpret it-- not be able to go into the lab and actually repeat it.
- Comprehensive enough the outcomes will actually attain the objective... Approaching the question from multiple directions with more than one experiment is a MUST.
- An outline is critical in writing this section.
- How much detail is sufficient?
  - Has anyone published on this method?
  - Do I have any experience/training that makes it obvious that I can do this?
  - Do I have preliminary data that makes it clear I can do this?
- At the end of any aim or detail-heavy section, bring the reader back to the big picture by stating what will be gained from these experiments

# The Approach: Experimental Plan.

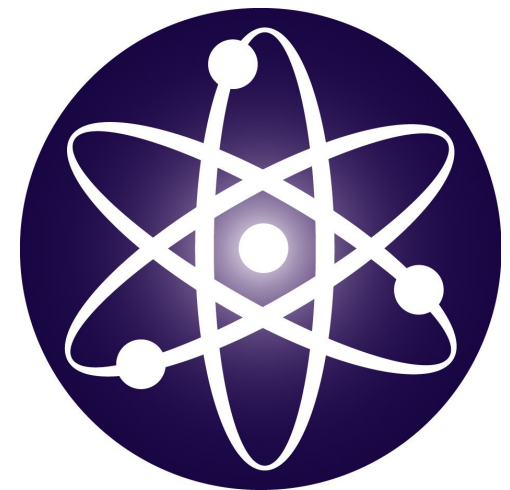
Pen to paper/fingers to keyboard:

1. Approach to be used
2. Overview of methods with pertinent literature referenced, especially to your publications using this method
3. Essential reagents (are they available or do they have to be made?)
4. Critical equipment (do you have it or does it have to be attained?)
5. Numbers of subjects and animals (how are these numbers derived—power calculations)
6. Statistical analysis needed
7. Controls, controls, controls.
8. Replicates required
9. Detailed expectations
10. How will the results be interpreted
11. Time required to complete studies.






## The Approach: Expected Outcomes.

- Outcomes can be combined with the Research Design or with Potential Problems and Alternative Strategies if it makes sense to do so (consider the flow)
- Critical to highlight the return on the investment
- 1/3-1/2 page
- Create excitement
- Underscore why the results are important
- How will these results address the hypothesis



## The Approach: Potential Problems and Alternative Strategies.

- You cannot use this section to discuss insurmountable problems. All problems must be within reason to deal with...otherwise, revise the plan!
- Your *goal* is to recognize and then eliminate justified concerns for the reviewer
- You do this by presenting alternative strategies   
- This section makes or breaks many many grants!!!
- There is no problem free research so do not pretend there is, embrace this and your reviewers gain all kinds of respect for you.
- To the potential problems you identify, provide a feasible and credible solutions...another place to provide some preliminary data.
- Highlight big things....not every little tiny thing.
- State where you have appropriate expertise that resolves any concerns

# The Approach: Potential Problems and Alternatives.

Pen to paper fingers to keyboard:

1. The nature of the problem perceived
2. The reason you think it is likely (or not!) to arise
3. Alternative approaches and strategies you will employ if



Use a conditional tone that suggests these things will only be done if something else does not work

Be careful to state this in a positive way to build confidence.

## **Pitfalls and Alternatives: EXAMPLE**

Our working hypothesis will..... Although our preliminary data solidly support the hypothesis for this aim, and are complemented by recent work published by Strong and colleagues, there is a remote possibility that it could be invalidated by... In that unlikely even, we would address xxxx as the next mostly likely explanation. As noted in the presentation of our preliminary data for this aim, some of our data point to this alternative, although the majority argues against it. Another potential problem in our approach to determine yyyy is ..... We expect this approach to work because... We acknowledge, however, that this new, rapid and inexpensive technology might not prove sufficiently sensitive to quantify X in up to 5% of samples. Were this problem to arise, we would employ the labor-intensive, but gold standard approach. We have used these methods successfully in the past (cite paper)

## Polish - Revise, revise, revise

The key to strong, clear scientific writing

Takes time and space

Do this 3-5 times after you think you cannot do it anymore

*ADD* things missing

*DELETE* things not needed

*CLARIFY* things clear to you but not the reader

*REORDER* for better flow and logical organization

Use the eyes and minds of others

# **The final walk-through....going from good to great**

## *Focus on the Pitfalls and alternatives sections*

- Are they tight?*
- Have you left anything out?*

## *Leave no loose ends hanging*

- Work on the transitions from one aim to the next (sumarize big picture)*
- Constantly re-enforce your big picture and the novelty of the proposal and how each aim/subaim fits in.*
- Have you painted a picture and told a story?*
- Are the details relevant? Is the data adding to the strength of the proposal?*
- Do your figures have the correct numbers and are all references to figures correct?*
- Have you projected future directions? Have you conveyed your vision?*
- Read the grant backwards*



# The Title

## Examples

Maximally informative and interesting  
Investigation of *Bacillus megaterium* (too generic)

Should convey novelty of the project

Metabolic regulatory mechanisms essential for influenza replication  
Emphasizes the payoff (product of research)

Neuronal transcription factors regulate HSV2

New approaches toward cultivating *Molluscum contagiosum* virus

Cellular and molecular insights into CMV reactivation following kidney transplantation

HBV replication and persistence in mouse models

Using solid particles as the heat transfer medium in solar central receivers



## PROJECT SUMMARY (Abstract)

Very important sections! Read by everyone.

Succinct and accurate description of the proposed work when separated from the application

State the applications broad:

- objective
- aims
- make reference to health-relatedness

Avoid describing past accomplishments and use of the first person

Write this last, but not at the last minute

Make it punchy!

# PROJECT SUMMARY

Open with a sentence the defines the gap in knowledge to be addressed

Copy and paste in sentences from the specific aims that you highlighted

Add aims and approaches

Conclude with the contribution statement from the significance section and statement of innovation from the innovation section.

# Common Pitfalls to Kill a Grant

- Proposal is overambitious—you can't cure cancer
- Proposal is full of technical jargon...never assume that your reviewers are experts in your field
- Poor grammar, spelling, and adherence to defined formats. Neatness and attention to detail count.
- The success of subsequent aims is contingent on the outcome of previous aims.
- Don't overwhelm the proposal with experimental details. Focus on logic and rationale.
- Topic not focused (sometimes reviewers will say that a proposal is “diffuse”)
- Too much background information, not enough rationale. Give only the background information that is necessary to understand the importance of the problem and the rationale for your proposed experiments.