How to give a presentation focused on an experiment

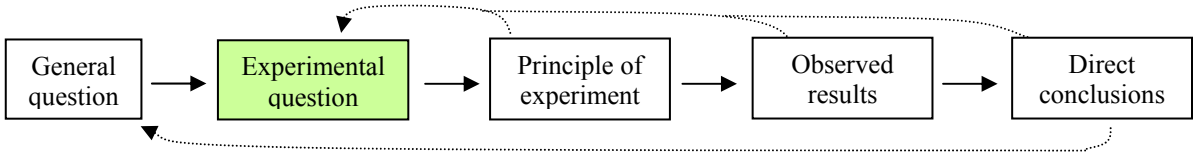
I. Purpose of a presentation

You are called upon to tell an audience of your peers a scientific story. The story begins with the evolution, through a series of logical steps, of a compelling question that has been addressed through experiment. That question is the principle around which the presentation is organized. The story ends when you have brought the issue to some resolution, not necessarily answering the question but showing how our insight into the question and related matters is enriched by the experiment presented.

I've just described a grant proposal, a research article, an answer to someone's question "What have you been doing in lab recently?", and also a research presentation. Good scientific communication is good scientific communication.

I take it as given that the purpose of the communication is more than to entertain, though some measure of entertainment is usually necessary to keep your audience in place. A more fundamental purpose is to help your audience see something important about the world. It is therefore necessary to ground the presentation firmly in reality.

This can be done by focusing on a specific question about the world, first showing how that question is of interest to us and then following an attempt to answer that question through an observation of the world. Graphically, the plan looks like this:



Without the underlying observation, a conclusion is arbitrary. Without the principle of the underlying experiment, a result has no meaning. Without the underlying question, there is no reason to consider any of this. The question is the central focus that guides all aspects of the communication.

Of course a presentation is different in important respects from the other means of communication. You generally are confined to a fixed length of time. If time is short (say five or ten minutes), you'll have to resist temptations to go off on unnecessary excursions and instead make the story as tight as possible. You may well have to toss out interesting aspects of the work you're covering, focusing on just one part from which a coherent story can be drawn. Also, the kind of attention you expect from your audience is different if it's watching a screen rather than reading a page. Words that may be perfectly comprehensible if a reader is curled up on a couch will often be gibberish in the context of a presentation. Graphics are far more important in a presentation than in other modes of communication.

II. Sections of a presentation

If you feel constrained by the structure presented below, then absorb its lessons and work out a structure that better captures the goals of your particular presentation. However, make sure that there ***is*** a structure and that the goals of the presentation (and your audience) ***are*** well served.

II.A. Introduction: What question is the focus of your presentation and why was it asked?

The purpose of this section is to engage a general audience and to bring that audience to the specific question you intend to address. This question should be the climax of the section, and it should feel like a climax, the inevitable result of what has come before it. This is achieved by creating a hole that is fit exactly by the question you raise.

- Start from a vantage point available to everyone. Offer a general question whose importance is immediately obvious, like *What distinguishes a bacterium that causes disease from one that does not?* or *What strategies are used to form a complex organism from a simple cell?*
- Do not start from jargon sure to confuse and depress your audience. Specifically, there is seldom any advantage in beginning a presentation with a confusing title of the work on which you focused.
- Have a goal. Derive from the general question a thread that leads through carefully selected prior results to the question you will ask.
- Underscore the question. When you ultimately reach the focus of your presentation – the question that was addressed by experiment – make certain that its centrality is obvious to all. Here is a possible place to cite the paper, if you're presenting the work of others. It is certainly a place to set forth in a large font the central question.

II.B. Method: How was the question addressed by experiment?

The purpose of this section is to present the logic of the experiment and the principles underlying the techniques used. Your purpose differs from that of a research article, in which it is necessary to outline procedures in sufficient detail that others may replicate them. It is neither necessary nor desirable to give experimental details that do not aid in the audience's understanding of the experiment.

- Start from a broad view. What *kind* of experiment is necessary to answer the question? Restating that central question couldn't hurt.
- Avoid black boxes. Explain the principle behind any technique essential to the understanding of the experiment.

II.C. Results: What observations came of the experiment?

The purpose of this section is to present the actual observations (not the conclusions) from the experiment you have described. It is essential that the audience understand how any observation you present arose from the experiment.

There may be occasions where you have no results to present – for example, you may be presenting a proposal for experiments that have not yet been performed. That's OK. You can still present results by making them up, showing possible directions that the experiment might go – not only the directions you're hoping for but all conceivable directions.

- Start from the question. Make sure that the central question addressed by the experiment is at no time absent from the audience's consciousness.
- Set up the result. Make the audience active participants by presenting no result until you have set up expectations in their minds. *If x were true, then you might expect this result, but*

if y were true, then this other result might arise instead. It is often useful to make up hypothetical results (including hypothetical figures) to illustrate the possible outcomes.

- Show actual data: *They found that their hypothesis was correct.* No they didn't. They made an observation about nature. The observation is true for all time. The hypothesis is open to negotiation. But showing actual data does not mean showing a figure that appears or could appear in a research article. Your audience doesn't have time to read figure legends. You will undoubtedly need to modify a figure from a research article to make it more comprehensible at a glance, adding labels, highlighting regions of interest, and cropping the figure to exclude parts you don't intend to discuss.
- Explain the result: It is very easy to forget that the graph that is so clear to you now was mud only a few days ago. Make sure that terms, units, axes, etc are all explored.

II.D. Synthesis and recapitulation: What have we learned from the journey?

The purpose of this section is to examine the observations within the context of the question addressed by the authors and the general issues that began your presentation. Doing so should evoke a satisfying sense of closure.

- Connect to the focus question. Your first obligation is to return to the focus question and assess whether (or to what extent) it was answered. You might bring back points made during the Results section as a list, so we can see now that all is presented the progress we have made towards an answer.

  If you are giving a proposal seminar and therefore have no results, then your first obligation is to summarize how your proposed strategy will indeed lead to progress in answering the focus question.
- Snares and pitfalls. What are explanations for the results different from what you presented? How might you have been taken in? What steps could you take to address alternative explanations?
- Reconnect to the general question. How does progress (or potential progress) made in answering the focus question advance our interest in the general question that opened your presentation?
- End with an ending. If you feel compelled to say, *That's it!* then your ending was probably not strong enough.

III. Presentation strategies

III.A. Graphics

- Use them. You will probably have less time than you'd like to accomplish your task. Graphics make it easier for your audience to grasp relationships at a glance and understand new concepts.
- Steal shamelessly. Give credit where credit is due (in small text at the bottom of the graphic or the graphic) but have no compunction about using graphics where you can find them (so long as you use them solely for presentation in a nonpublic setting).
- Adapt, extract, and simplify: Especially when you present graphs or tables from an article, you will often need to edit a graphic. The audience doesn't have time to read a legend, so

add ***labels***. Neither can we readily see the region of a complex table that is pertinent to the presentation, so ***eliminate*** unnecessary information or ***highlight*** information you want us to focus on.

- Invent your own graphics. In many, perhaps most cases, no premade graphic will serve your particular purposes. Be creative.

III.B. Text

- Use text sparingly. Audiences can't read complex sentences and listen to you at the same time. Text should be used to summarize and underscore.
- Use words and phrases, not sentences. Sentences are too complicated (and also tempt you to read what's on the screen – certain death in presentations). If a single line in a big font is not enough to say what you want, you're asking the screen to say too much.
- Present small chunks. When presenting a list, show one item at a time to focus the audience's attention. This can be achieved by what PowerPoint calls "animation" or by duplicating pages, for example showing item #1 on the first page, items #1 and #2 on the second, and so forth.

III.C. General

- Engage the audience. You can't shove insight into another's mind. Insight comes only when an active mind reaches for it. If audience members believe that they are magically controlling the flow of the presentation – questions that occur silently to them somehow elicit the screens that answer them – you will gain the cooperation necessary for a presentation to be successful. One technique is to ask rhetorical questions, e.g. *How is it that DNA integrases appear in pathogenic bacteria but not their nonpathogenic relatives?* However, overusing this device can be irritating. Find more subtle ways to achieve the same end.
- Make the structure of your presentation transparent to all. One way of engaging the audience is to let them know where they are heading and to indicate at regular intervals where they are in the journey.
- Serve the forces of light, not darkness. Do not export your confusion to your audience. There will inevitably come a time when you encounter a section of an article that seems to defy all human understanding. There are many solutions to this problem, but undoubtedly the worst is to pass on to your audience without comment the source of your confusion. If you were unable to pierce the shroud after lengthy consideration, what hope is there for your audience to do better in the limited time available within a presentation? ***Never utter an unqualified word or phrase that you yourself do not understand.***

  Alternatives:

  a. Is this confusing issue essential for the thread of your story? If not, throw it away.
  b. If it is essential, then do whatever is necessary to reach a level of understanding that enables you to help your audience past this spot, even if it means learning a bit of matrix algebra or invertebrate taxonomy.

     Corollary: *Start early, allowing time for others to help you and for you to help yourself.*

Credo: *There is no thought that has sprung from a human mind that is more than several steps away from your own.*

c. If all fails (i.e., if you run out of time), the last resort is to admit your ignorance (and perhaps invite suggestions). This approach at least does not crush the audience's spirit by implying that they should understand what you could not.

- Work out the Results section first. If you are presenting an experiment from a research article, a reasonable first step is to choose the experiment first and only then decide what principles you need to introduce and how to guide the Introduction to point to the experiment.
- Consider outlining. As you work out your presentation, an outline can compress your work so that you can pinpoint holes in the narrative or material that is not well connected to the thread of the story.
- Underscore important points. Not everything in your talk is of equal weight. When you come to something that is of special importance, do something special. Some people can get red in the face and go pyrotechnic. The rest of us should consider more subtle solutions. Pause or repeat the point using different words. Use a bigger font. Use color.
- Avoid general headers. Headers like *Results* or *What did they do next?* may help you organize your talk, but they're not very informative. Don't waste the prime real estate at the top of the slides. Use it to give the audience a basic thought to hang onto.
- Focus on your audience, not on yourself. The discomfort you may feel pales in significance to your obligation to help each member of your audience come to appreciate the view of the world seen through the work you are reporting. If you know the people in your audience, consider what particular problems each may have in grasping the message that's yours to give. If you don't know your audience, imagine audience members and speak to their needs.