Phys 3113: Discovering Modern Physics
How to Give Effective Informal Talks about Physics

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Introduction. Here's a situation you're going to find yourself in very frequently throughout the rest of your career. You've got to get up in front of a group and talk about your work or some research you've done. You've only got about 10 minutes to talk. What do you do?

No, no. "Panic" isn't the right answer. The art of giving interesting talks without excessive nerves can be learned by following a few simple guidelines. Most of these are pretty obvious (be prepared, rehearse); others appear here as a result of my having seen a *lot* of talks in which easily avoided mistakes undermined the speaker.

The Three Most Important Rules of Giving Talks of Any Sort of any Length on Any Subject.

1. **As you prepare your talk, think carefully about the nature of your audience—their background, their interests—and make sure that your talk is appropriate for your audience.**
2. **Practice—a lot.**
3. **Never, under any circumstances, talk beyond you allotted time.**

How do I plan an effective short talk?

The structure of a good short is like that of a short paper. Say you have 10 minutes. Here's (roughly) how you should allocate your time.

1. **Introduction (∼2 min).**
2. **Body of the talk (∼7 min).**
3. **Conclusion (∼1 min).**

The trick to constructing an effective, engaging, interesting short talk is to develop it "from the inside out": body first, *then* the conclusion, and *last* the introduction. First, choose a **talking point**. In 10 minutes you can't give a (good) talk that deals with more than one point. So, before you do anything else decide what *single* point you want your audience to take away from your talk.[1]

Your choice of talking point is crucial; around this choice you'll construct your entire talk—including your visual aids, which should reinforce and reiterate your talking point.[2]

Your talking point will be the thing you explain most carefully and thoroughly, so it should be the thing you consider the most *interesting and important* about the topic of your talk. For example, in a short technical talk (e.g., for an audience of engineers or physicists), good talking points include the nature and purpose of *a single* device; the general idea, key result, and implications of *one* experiment; the highlights and consequences of *one* particular discovery or idea, etc.

Now that I've got my talking point, what do I do next?

Brainstorm your talk! *Don't skip this step! A brainstorming session will only take about 10 minutes. Brainstorming will markedly improve the quality of your talk. It will also save you a lot time as you prepare it.* Here's what you do: sit down somewhere quiet with your research notes. Write down rough answers to the following questions:

[1] For a longer talk, a useful (rough) rule of thumb is: don't try to make more than one point per 10-minute block of time. So if you're brainstorming a 30-minute talk, ask yourself, What *three things* do I want my listeners to remember from my talk?

[2] **Never** actually say "My talking point is. . . ." Instead, use your knowledge of the topic and the structure of the talk to make crystal clear to your audience what your talking point is. For example, state it in a single sentence in the introduction. Build up to it in the body of the talk. Reiterate it in the conclusion. And put it on at least a few of your transparencies—most importantly and prominently on your concluding transparency.

1. How much time do I have?
2. What is my audience? What background will they have? How can I connect what I want to talk about with their background? What about my topic is most likely to interest them?
3. What are some possible **talking points**? Jot down several alternatives. Then play around with each one to decide which don't work (too advanced, too intricate, too unimportant, too boring, etc.). Toss those and choose one from what's left.
4. What must I tell my listeners about the overall **topic** so they will be able to understand my talk. (That is, what **context** must I build so my listeners will get my point?
5. How can I engage the my listeners' interest so they'll pay attention and not doze off?

How do I build my talk around the talking point?

1. **Set up your talking point in the introduction to your talk.** Early in your talk, state your talking point, describe a context for it, and connect it to something related to it that your audience already knows.
2. **Explain your talking point in the body of your talk.** In the body of your talk, you take your audience (in steps that flow together logically) from their state of knowledge before your talk to an understanding of your talking point. Here's where you use most of your transparencies.
3. **Recap your talking point in the conclusion of your talk.** Here you "back your audience" out of the more detailed focus of the body of your talk, remind them what you've explained to them, and, if possible, leave them with a provocative question or bit of information beyond what you've already told them.

What's the single most important thing I should do before giving my talk?

Want to avoid stage fright? Want to make your presentation as effective as possible? Then practice. Practice as many times as you can stand to. You should run through a 10 minute talk at least five times, then at least once in front of a sympathetic audience that will give you constructive criticism.

First practice in a quiet room, with and without your transparencies. Then find a room with an overhead projector and practice there. If you can get access to the room where you'll give the talk, practice there. Run through your talk enough times that you're comfortable saying the words and your transparencies and that you won't run overtime. (*Don't run overtime!*) As you practice, cut, add, or revise material to make the talk the way you want it. *Then* practice in front of others. Revise the talk based on their constructive comments. (If their comments aren't constructive, seek another audience.)

- **Time your practice talks.** If your practice talk takes more than the allotted time, *cut stuff* (removing the corresponding transparencies) and try again. Keep cutting until you can *comfortably* give your talk in the allotted time.
- **Don't look at the overhead projector.** Train yourself to look at your audience. If that makes you nervous, look at the projection screen.
- **Don't block your audience's view of the screen.** All that work you put into preparing your transparencies is worthless if your audience can't see them. (If, most of the time, you stand near the screen, you're unlikely to get in their way.)

What elements absolutely must be in a talk?

Every talk, no matter how short, must have an introduction and a conclusion. The worst talks are those that start in the middle, chug along for a while, then just stop.

1. **The Introduction (∼2 min).** Orient your audience Ease them into your topic. Lay some foundation. Remind them of things they already know that will help them understand your talk. At the end, focus their attention on your talking point.

2. **The Body (∼7 min).** Explain and discuss your talking point. As you develop this part of your talk, figure out ways to *help your listeners stay focused on your talking point.* Above all, *be selective.* Include *only* background, details, and illustrations you *must* discuss in order to develop and clarify your talking point. Don't pad.
3. **The Conclusion (∼1 min).**: Ease your audience "out" of your talk. *Briefly* recap the context of your talk, the things you consider most important, and your talking point. If possible, leave them with something interesting: a new insight, an unanswered question, etc.

How can I prepare effective transparencies?

Why are transparencies so important in a technical talk? Among other things, they give you and your audience a "crutch." You will be less nervous because the key elements of your talk are on transparencies. Your audience will be happier because they can follow your talk. The job of transparencies is to reinforce and focus what you say.

1. Keep transparencies simple, clear, and readable. Avoid clutter. Transparencies must not contain anything other than what you want your audience to pay attention to.
2. Transparencies must be large enough and clear enough so that everyone in your audience can read them. *Use a large enough font that people at the back of the room can read every word.*

Except in unusual circumstances (e.g., you've received a Nobel Prize) transparencies shouldn't be fancy. Avoid elaborate drawings or fancy fonts or (especially) *too much color*; these will *distract* your audience from whatever you're trying to explain to them.[3]

The easiest way to prepare a transparency—if you can do so legibly—is to print directly on it, using pens you can get at the campus store.[4] If your transparency involves a figure, copy the figure onto the transparency first, then print on it.

Should I include graphs and/or tables on my transparencies?

Use graphs. *Never* show a table unless you absolutely have to. (Tables take a long time to explain, are hard to read, are boring, and make your point *far less effectively* than a graph.) If you must show a table, include very few numbers and use a large font! Your transparency must be readable by everyone in the room: so the numbers in your table must be about 1/2 inch high.

Can I make a transparency of a figure or photo from a book or paper?

Sure. But don't make the transparency directly from the page on which the figure appears. Published figures, when projected, are too small to read and are cluttered with (unreadable) captions labels. Instead, copy the page, cut out the figure, then tape it to the center of a separate piece of paper. Now *enlarge the figure as much as possible.*[5] Add the minimum number of words or symbols required to make the figure clear. Then make your transparency from the enlarged copy.

How can I effectively use the transparencies I've prepared?

Lousy transparencies abound in physics talks. Lousy transparencies are worse than no transparencies at all. Here are some important pointers:[6]

[3] Color is okay—but only if used thoughtfully and sparingly. Use color to link related items, to highlight *a few* points, and to make your transparencies less drab. But beware! Color can distract. **Never use color just for decoration or in a random way, disconnected from the logic of the transparency.** *Never* use light colors, like yellow and brown; they aren't readable well when projected.

[4] I recommend water-soluble rather than permanent ink pens for transparencies. Don't buy pens marked "superfine"; they can't be seen clearly. Instead use "medium" pens.

[5] Don't get carried away. If you put anything outside an 8"×8" square centered on the middle of your page, that stuff won't be visible when you project your transparency.

[6] Another time saver: don't waste time preparing your final transparencies until you've practiced your talk enough to be sure you know what will stay in it when you actually give it. It's too easy to waste lots of time preparing stuff you later have to toss out. Instead, for your early practice sessions (no projector) just lay out each transparency (including whatever words, equations, sketches, etc. you think you'll use) *on a piece of paper* and use those. For practice talks in which you want to try out your transparencies, just print the information on each transparency (legibly enough so your practice audience can read them). Revise each transparency (as necessary) according to the feedback you get and your evolving sense of what should be on it. *Then and only then* do them up right.

- **Limit the number of transparencies.** Plan on about 2–3 minutes to explain each transparency. To estimate the number of transparencies you should use in a short talk, take the number of minutes you're allocated to speak, divide by 2, and add 1. (For a long talk, take the number of minutes, divide by 4, and subtract 2.)
- **Don't write out your talk on transparencies and read it to you audience!** There are few surer ways to bore your listeners silly.
- **Limit the amount of information you put on a given transparency.** Your transparencies *must* be clean, logical, and simple. Use phrases, not complete sentences. Avoid equations if possible. Avoid tables. Avoid unnecessary or elaborate graphs. Rule of thumb: **no transparency should contain more than 10 separate items of information.**
- **Never put anything on a transparency that you're not going to talk about.**
- **If you show graphs (or, if absolutely unavoidable be sure each graph is labeled clearly, completely, and legibly.** Use words, rather than symbols in axes and graph labels. For instance, if you're plotting momentum versus wavenumber, label the horizontal axis "wavenumber" (not k), and the vertical axis "momentum" (not p).
- **Print large.** Your transparencies *must* be readable by your audience, no matter where in the room they're seated. For a fairly large room, a good rule of thumb is that each letter or number *when projected on the screen* should be about 4 inches high. This means that each letter or number on your transparency should be about 1/2 inch high.
- **Avoid Transparency Cutoff.** You want your transparencies to be readable and your manipulation of them to be as comfortable and smooth as possible. **The dimensions of the region of your transparency projected onto the screen are not 8 1/2" × 11"**. Nearly all overhead projectors show a region about 8"×8". This means that if your transparency contains *anything* (information, header, title, your name) outside an 8"×8" square, either your audience will be unable to read it or you'll have to move it around so they can. Either way, you wind up distracting them and yourself.

How can I effectively use equations on transparencies?

Don't. *Avoid equations unless absolutely necessary.* The fewer equations, the better. If you must use equations, here are some suggestions.

- **N**o more than one equation per transparency.
- **Emphasize concepts and results, not details and mathematics.**
- **Never show a derivation.**
- **Replace equations with "word pictures."** For instance, you could replace the de Broglie relation $E = h\nu$ with

  $$\text{energy} = \text{Planck's constant} \times \text{frequency}$$

  Even better, if the point is to emphasize the relationship between energy and frequency, write

  $$\text{energy} \propto \text{frequency}$$

- **In your talk, describe every equation in words, including the reason you're showing it.** (If you can't think of a good reason, drop the equation!) For instance, in a talk about Rutherford scattering, you might show a transparency which contains the key equation and, as your audience looks at it, say something like. "This equation gives the differential cross section as a function of angle. It shows that this cross section depends inversely on the fourth power of half the scattering angle."
- **Define every symbol in every equation aloud and on your transparency.**
- **Don't clutter symbols with unnecessary superscripts and subscripts.**

How can I effectively describe experiments on transparencies?

Transparencies are essential if you're describing an experiment or an application.

- **Keep if simple!** Your transparency should contain a *simple* sketch or diagram that describes the *major components* of the apparatus. Don't show detailed schematics or sketches you prepared for the shop!
- **On a separate transparency, summarize the physics that underlies the experiment.** When you state the underlying physics, you don't want your audience distracted by sketches, diagrams, picture, or equations.

Relax.

Perhaps the most important way to avoid stage fright is to remind yourself of a few truths. If you've followed the guidelines on this sheet, then the following are true:

- Since you've practiced your talk several times, you know how it feels to give it and that you can comfortably give it in the allotted time.
- You know (far) more about your topic than your audience.
- Since you've tried out your transparencies on a practice audience, you know they are readable. Moreover, you can rely on them as "mental triggers" in the unlikely event that you forget something.[7]

Lighten up. Have fun. Enjoy sharing what you've learned with your audience. That way you (and they) will have more fun.

Never, under any circumstances, talk beyond you allotted time.

[7] If you're still nervous, here's an old debater's trick. Print (in large letters) the first few sentences of your talk on an index card. This will get you started. Then you can switch to notes or transparencies. It's also a good idea to write out a sentence or two of your conclusion, just to have on hand.