Communicating Science—How to Give Better Talks

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Today, we'll look at some ways to enhance the communications value of your slides and some tips to avoid humiliation.

The standard software for most scientific talks is MS PowerPoint. Like it or hate it, that's what nearly all AV systems at conferences are set up to use. If you are determined to be an iconoclast and use some other presentation software, fine, but be prepared for last-minute technical difficulties that will annoy your colleagues and cut into your presentation time. If you demand to use something other than PPT, take a PDF version of your talk that you can use when the computer in the seminar room can't run *Photoshop* or *LibreOffice*.

Alexei Kaptarev's *Death by Powerpoint* is an Internet classic not to be missed: http://www.slideshare.net/thecroaker/death-by-powerpoint/

Disclaimer 1: The opinions expressed in this talk are solely the author's and are not necessarily shared or endorsed by the Department of Materials Science and Engineering, the Department of Physics, the College of Engineering, or the University of Illinois. But they should be.

Disclaimer 2: I am not a scientist—I'm a science writer and technical editor—and all of my experience has been in physics and nuclear engineering. But I think these suggestions are broadly applicable to communicating in the physical sciences and engineering.

One thing I've learned in physics, you have to satisfy both the theorists and the experimentalists…

…so this talk has two parts:

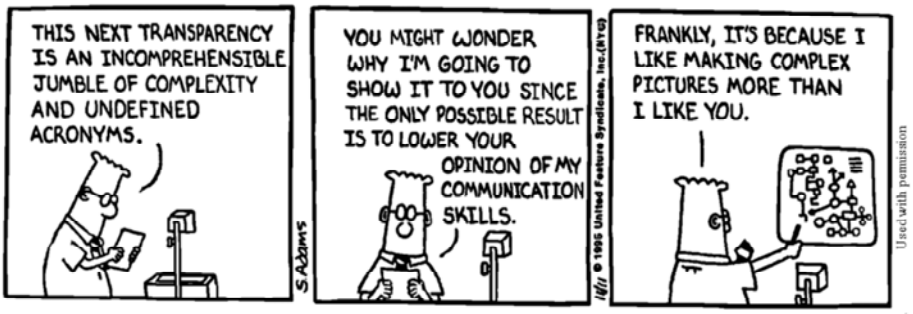
I. a theory of what makes good talks

II. the nuts and bolts of making effective, meaningful slides

A hotly debated issue among speakers is whether or not to use an outline slide. For short talks, they're unnecessary, but for longer (≈ 1-hr) talks, an outline is helpful to let the audience know what's coming.

First, the theory…

Before you turn on PowerPoint



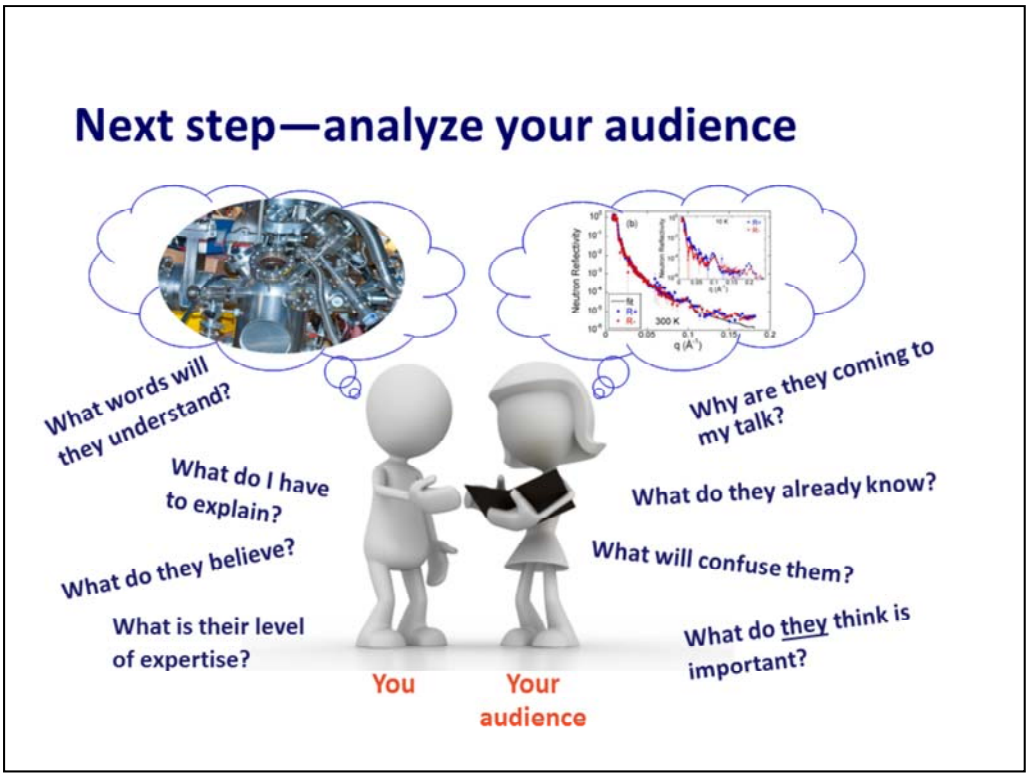
Determine your goal(s) for the talk

Consider your audience

Before you start the first slide, decide what your ultimate goal is

- Disseminate a new result
- Provide an overview of the topic
- Reinterpret existing results
- Propose a new experiment
- Explain a new concept or method
- Stimulate new collaborations
- Educate the audience on a specific concept
- Get a job

Overarching goal: Tell a memorable story & teach the audience something interesting



A common error that beginning researchers make is that they emphasize what they found most interesting, or what they spent the most time doing, and not what the **audience wants to *know***.

Know thy audience! It's absolutely critical to producing a successful talk or paper (or anything else).

For many of the talks you will give or papers you will write as a scientist or engineer, nobody listening or reading will know as much about the subject as you do. You don't have to dumb-down your messages, but you do have to draw your listener in and explain things in terms s/he can understand.

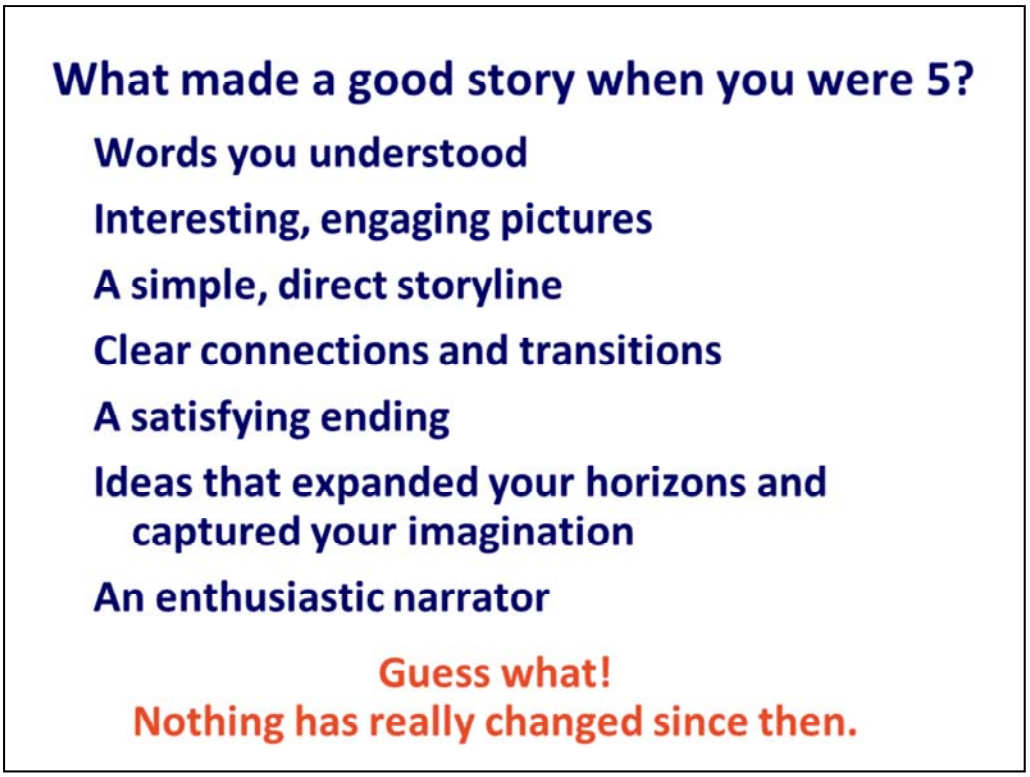
So the first rule of effective scientific communications is understand your audience. Who are they? What do they want to know? What do they already understand? What is going to confuse them? What will engage their interest?

Good advice from Elmore Leonard: "Try to leave out the part that readers tend to skip." (Elmore Leonard's Rules for Writers, 24 Feb 2010, http://www.guardian.co.uk/books/2010/feb/24/elmore-leonard-rules-for-writers)

Another consideration as you analyze your audience: think about cross-cultural implications. The use of humor, references to popular culture, and sports analogies are very culture-specific. Will your audience understand your reference to the 2017 Super Bowl or an American sitcom?

Close your eyes and picture in your mind your favorite storybook

Think about what made it so attractive



Think about what made a good story when you were 5 years old. The same elements that attracted you as a child still work—interesting pictures, words you understand, simple, direct storyline, a logical structure, analogy, an enthusiastic narrator, something that stimulates your imagination and makes you think.

If the first rule of giving a successful talk is to know your audience, the second rule is ***tell a good story***.

Your next biggest constraint: How many points can you make in the time allotted for your talk?

Elliott equation:

$$p = \frac{t}{8}, \qquad [1]$$

The amount of time you're allotted determines how much material you can cover in your talk.

It takes about 6 to 8 minutes to adequately introduce, explain, and summarize one major idea or point in a scientific talk.

N.B. Equation [1] is also about as complicated as anything you'd want to show in a talk. Think about how long it took you to process and understand the point that was being made in this slide, using an equation. Do you really want to tackle

$$\left.\frac{\partial f}{\partial t}\right|_{\text{coll}} = \iint g(\mathbf{p}-\mathbf{p}',\mathbf{q})\left[f(\mathbf{x},\mathbf{p}+\mathbf{q},t)f(\mathbf{x},\mathbf{p}'-\mathbf{q},t) - f(\mathbf{x},\mathbf{p},t)f(\mathbf{x},\mathbf{p}',t)\right] d\mathbf{p}'\, d\mathbf{q}$$?

Your next biggest constraint: How many points can you make in the time allotted for your talk?

Elliott equation:

$$p = \frac{t}{8}, \qquad [1]$$

The number of main points you can make in an oral presentation

Your next biggest constraint: How many points can you make in the time allotted for your talk?

Elliott equation:

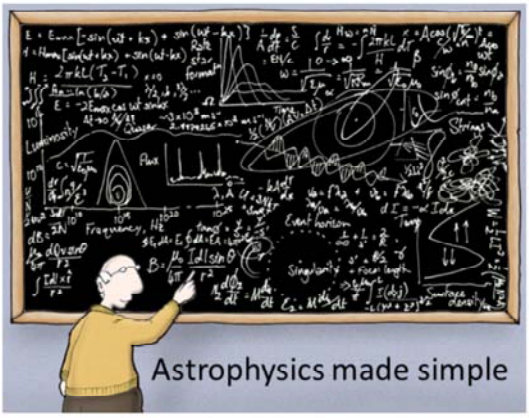
The time allotted in minutes

$$p = \frac{t}{8}, \qquad [1]$$

TIP: It takes at least 6 to 8 min to adequately introduce, explain, illustrate, give examples of, and summarize a major point in an oral talk

Eschew amateur mistakes

- Covering too much material
- Including excruciating detail
- Compensating by skipping slides or talking faster



Don't try to tell "the whole story"*

*Your objective is to get the audience interested enough to remember your name and *read the paper*

Distill your talk to a few key points (q.v. Eq. 1)

Present only enough data to

- **Illustrate your main points**
- **Support your conclusions**
- **Demonstrate the originality of your work**

A talk is not your paper projected onto the wall.

Your job as a speaker is to thoughtfully select the important points in the paper and convey them in a way that is meaningful and memorable for the audience.

How many slides should you prepare?

$$\mathcal{S} = \frac{t}{2}, \qquad [2]$$

The amount of time you're allotted also determines the number of slides you should prepare. In general, allow at least 2 min per slide, and more time for slides that present equations, plots, complex figures, or tabular data.

How many slides should you prepare?

$$\mathcal{S} = \frac{t}{2}, \qquad [2]$$

The number of slides you can reasonably show in an oral presentation

How many slides should you prepare?

$$\mathcal{S} = \frac{t}{2}, \quad [2]$$

The time allotted in minutes

How many slides should you prepare?

$$\mathcal{S} = \frac{t}{2}, \qquad [2]$$

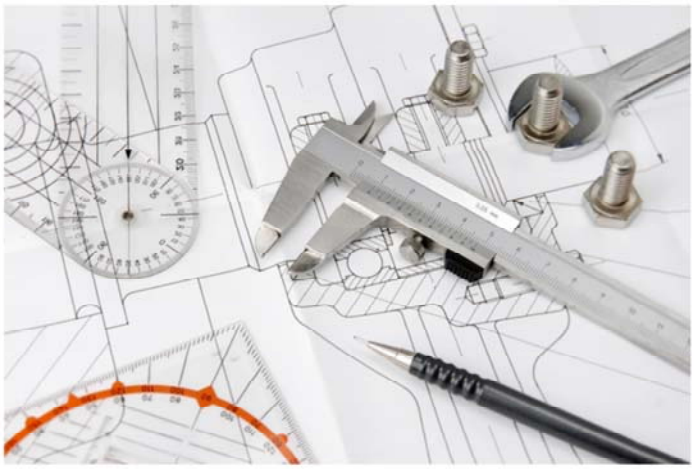
A good "rule of thumb" is to allow about 2 minutes per slide

Allow more time for equations, complex plots, complicated figures, tabular data

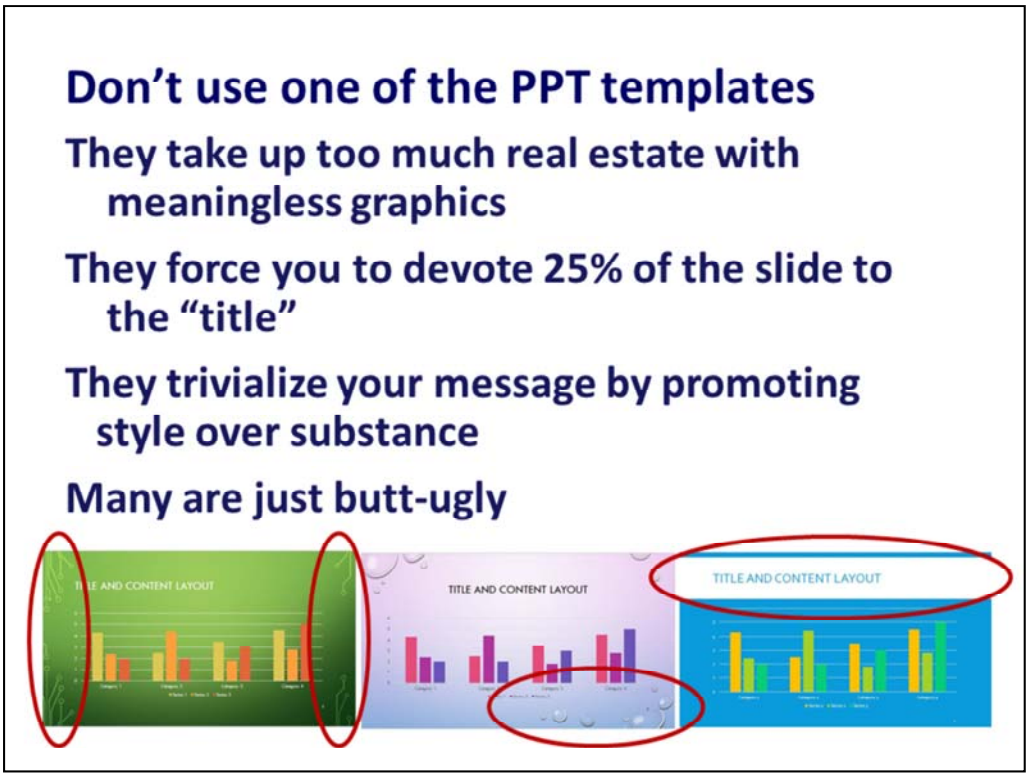
Tip: You cannot show 44 slides in a 15-min presentation, *no matter how fast you talk*

Here endeth the theory

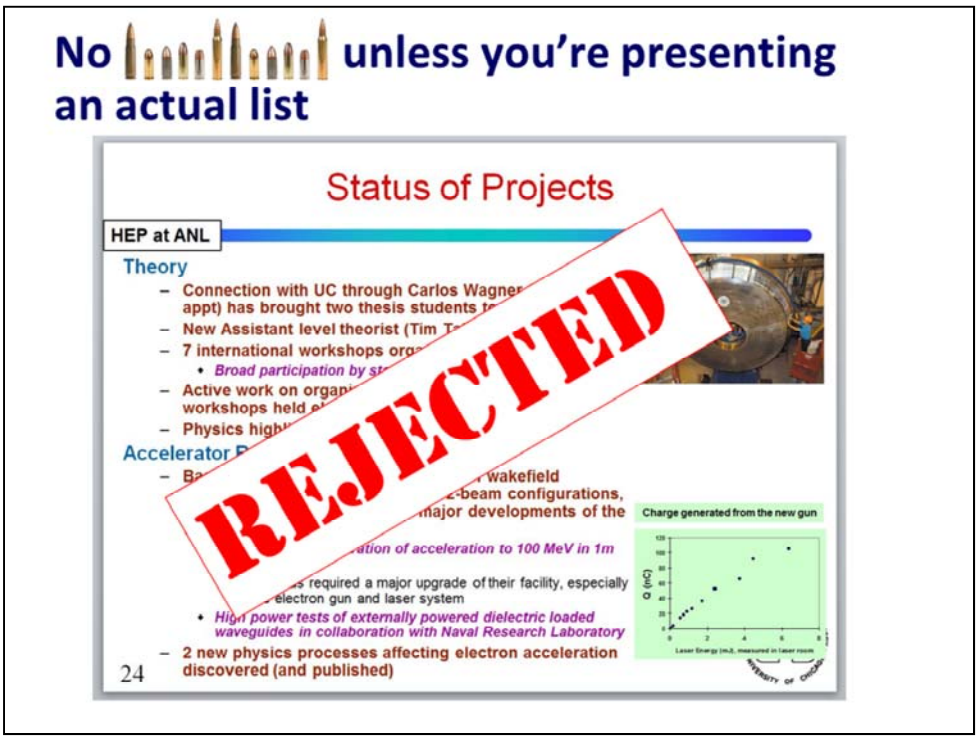
Now, putting together effective, memorable slides…



Don't use photographic or textured backgrounds—just don't do it. They're distracting, they get boring after you've seen the first one, and the superimposed text is often impossible to read on them.



You want the audience to be thinking about what you're saying and looking at the evidence you're presenting, not swooning (or snickering) over your artistic taste.

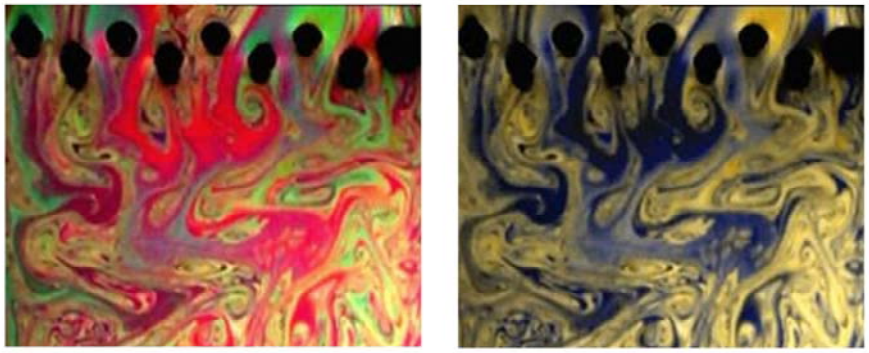


I recommend turning off the "bullet list" format, which is the default in PPT. Presenting ideas in bulleted lists implies hierarchies or relationships that may not, in fact, exist.

"Lists can communicate only three logical relationships: sequence (first to last in time), priority (least to most important, or vice versa), or simple membership in a set (these items relate to one another in some way, but the nature of that relationship remains unstated). A list can show only one of those relationships at a time." Gordon Shaw, Robert Brown, Philip Bromiley, "Strategic Stories: How 3M is Rewriting Business Planning," Harvard Business Review 76, 42–44 (1998).

Turning off the bullets also gives you more slide real estate to work with.

Don't use red or green to convey important information*

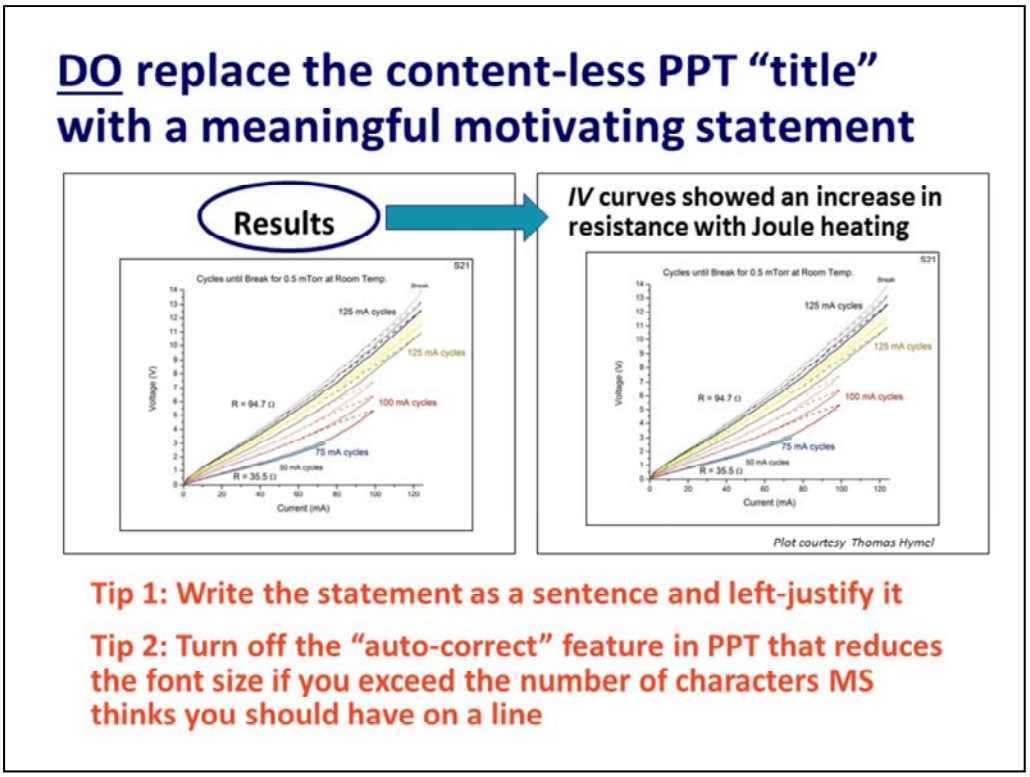


Development of turbulence in a soap film as its surface is raked by a wire comb. *Courtesy Nigel D. Goldenfeld*

*Between 8 and 12 percent of white males are red-green colorblind—who's your audience?

If you use color to convey information, make sure that information transfers as you intended it and is accessible to everyone in your audience.

Another good resource is http://www.colourblindawareness.org/colour-blindness/.

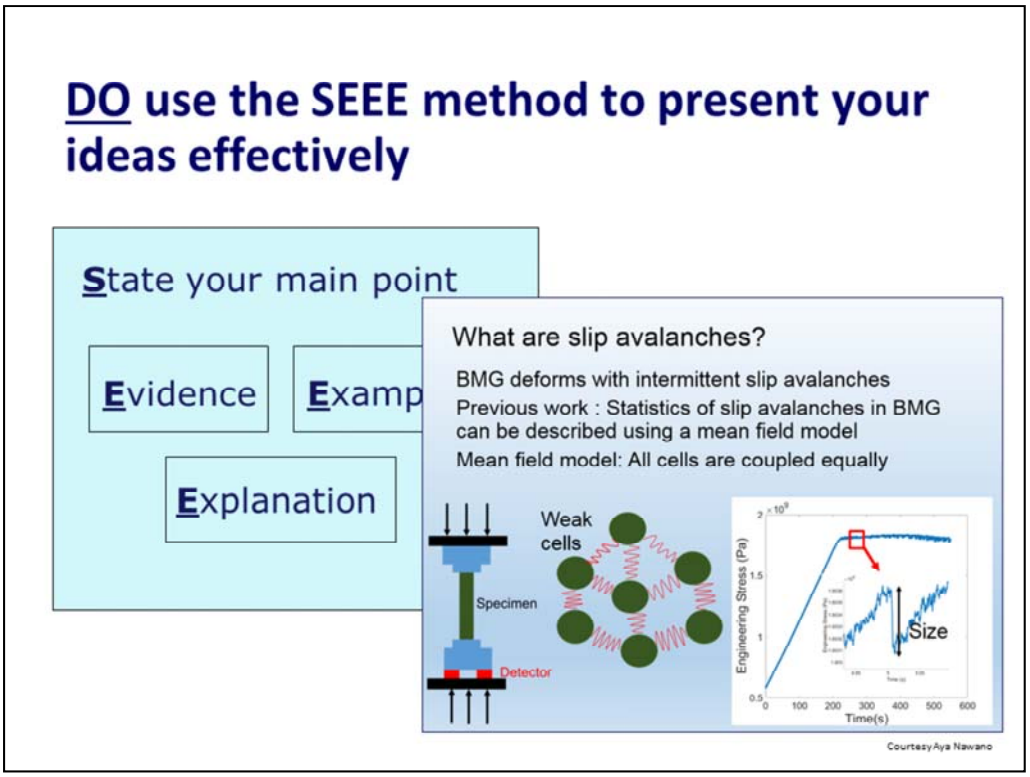


The default for PowerPoint slide "titles" is centered. Change it to left-justified.

Turn off the automatic "fitting" functions in PPT to avoid having PPT reduce your font size if you exceed the number of characters MS thinks you should have on a line.

In PPT 2010, right click inside the text box, then select "Format Shape" from the drop-down menu. In the dialogue box, click on "Text Box" on the left navbar, and then turn on the "Do not Autofit" radio button in the "Autofit" section.

In PPT 2013, from the "File" menu, click on the "Options" link, and then select "Proofing" from the menu. In the dialogue box, click on the "Autocorrect Options" button. When that dialogue box opens, uncheck the "Autofit Title" and "Autofit Body Text" boxes.



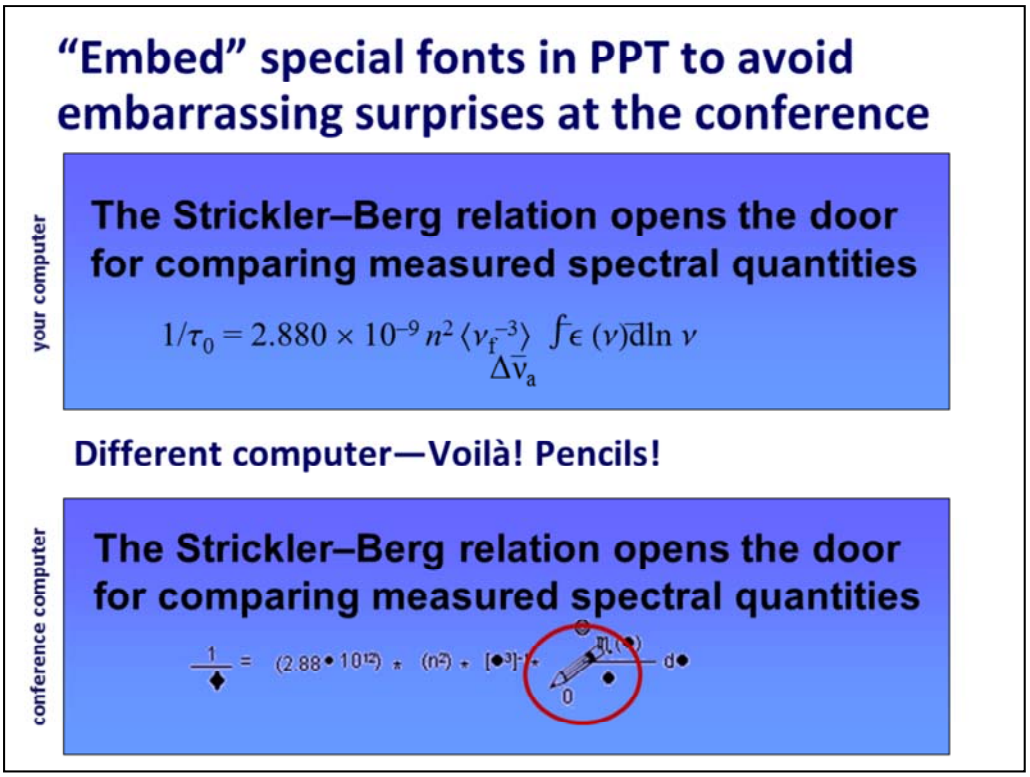
Put a motivating statement at the top of your slide that summarizes the point of the slide.

People pay attention when something changes in their environment—for instance, when a slide changes. Take advantage of that sharpened attention to articulate your message in an immediately identifiable, memorable way.

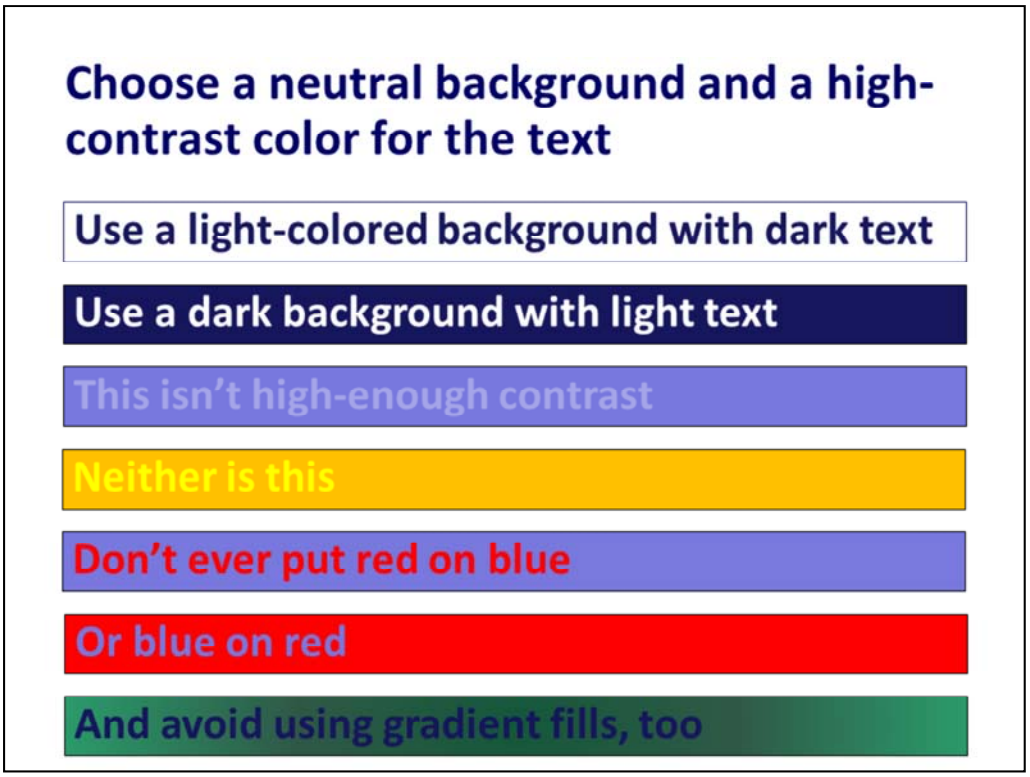
Use the rest of the slide to explain, give evidence for, or provide examples of the idea presented in the motivating statement at the top of the slide.

Do as I say, not as a do. This slide, while typical of an academic lecture to facilitate note-taking, has **w-a-a-a-a-a-y** too much text on it for a science talk.

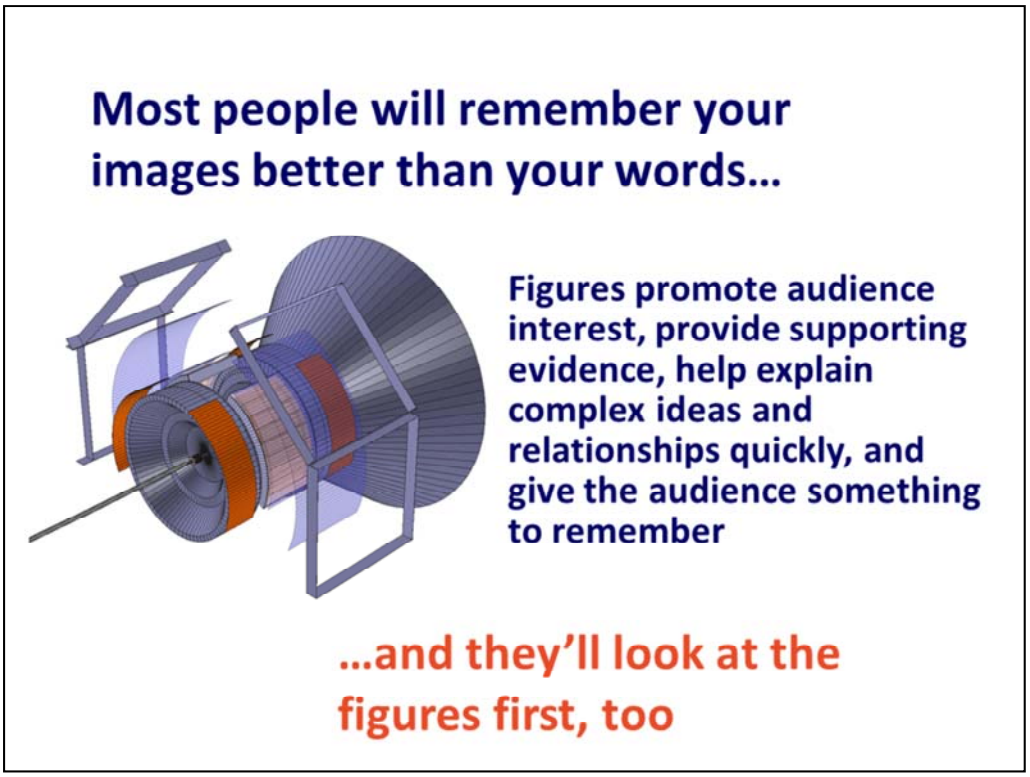
Keep text to a minimum—use just enough words to orient the audience to what they are seeing. You want them to be listening to you, not reading a novella off the screen.



Every computer has its own individual "library" of fonts; if PPT cannot find a font when you open your presentation on a different machine, it just arbitrarily substitutes a font that it thinks is "close." Often, it isn't...



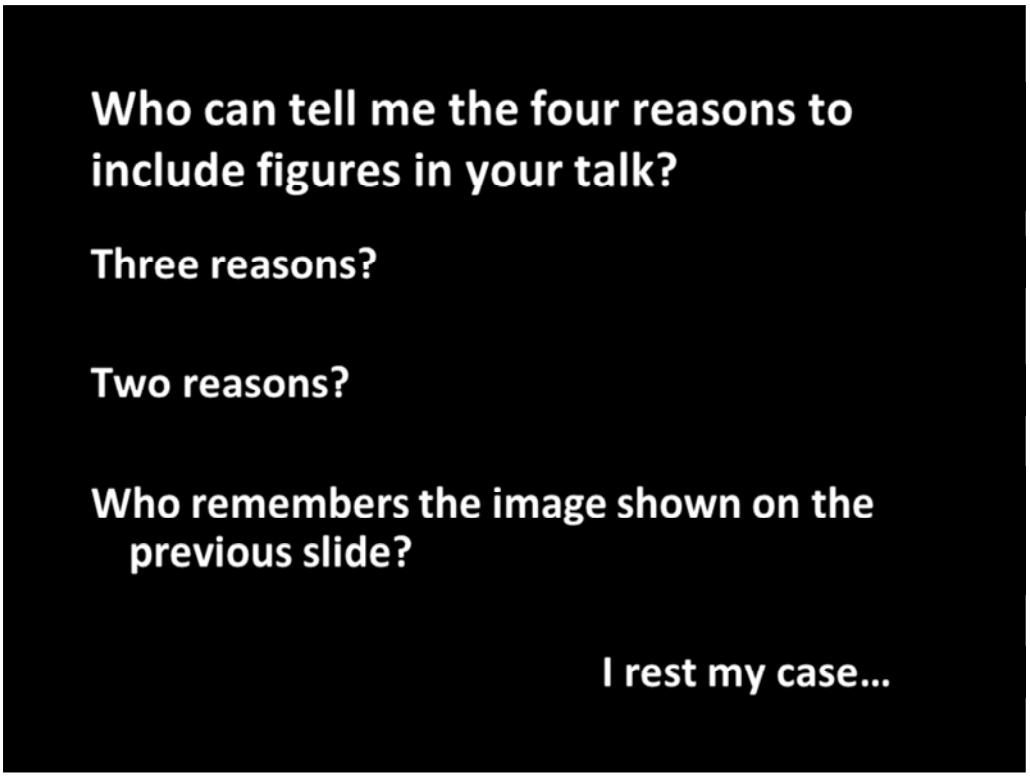
Be aware that colors that look bright and crisp on your monitor may look entirely different when projected. In particular, pastel colors and thin lines fade away. Use bright, primary colors, bold fonts, and thick lines.



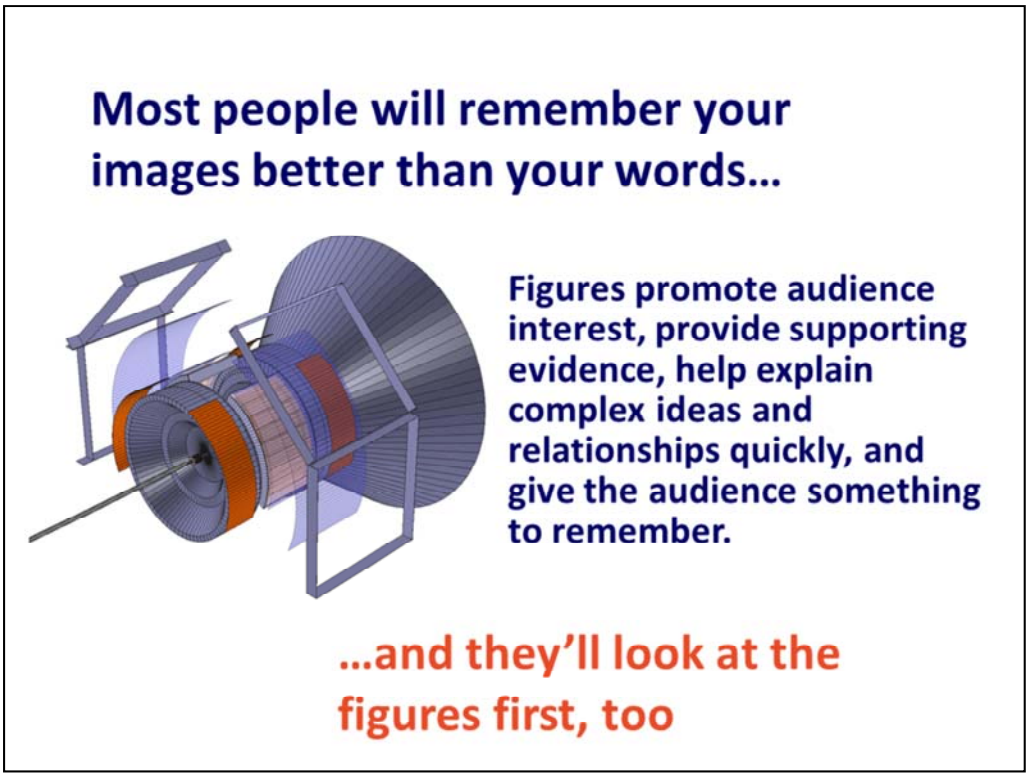
Use engaging, visually interesting figures to draw a reader in to your story and give them something to remember.

Illustrate each of your main points with an engaging image.

"Graphic excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest place."—Edward Tufte



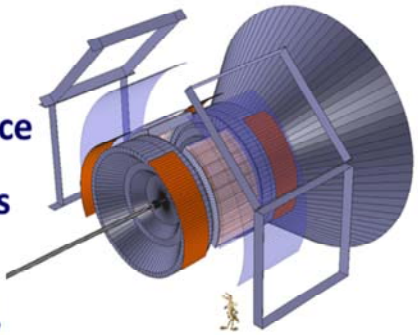
People remember pictures much longer and better than they remember words.



Let's look at this slide again. If its purpose was to convey the four reasons why speakers should include figures in their talks, the slide was set up from the beginning to fail because of the way the information was presented.

Figures serve four purposes in talks

1. Engage the audience and capture their interest
2. Provide supporting evidence
3. Help explain complex ideas and relationships quickly
4. Give the audience a visual, memorable "hook" to hang your key ideas on



Phenix detector at the Relativistic Heavy Ion Collider
Courtesy M. Grosse Perdekamp

Tip: Add a brief caption to orient the audience immediately—they're going to look at the figure before you explain it—and always add a scale

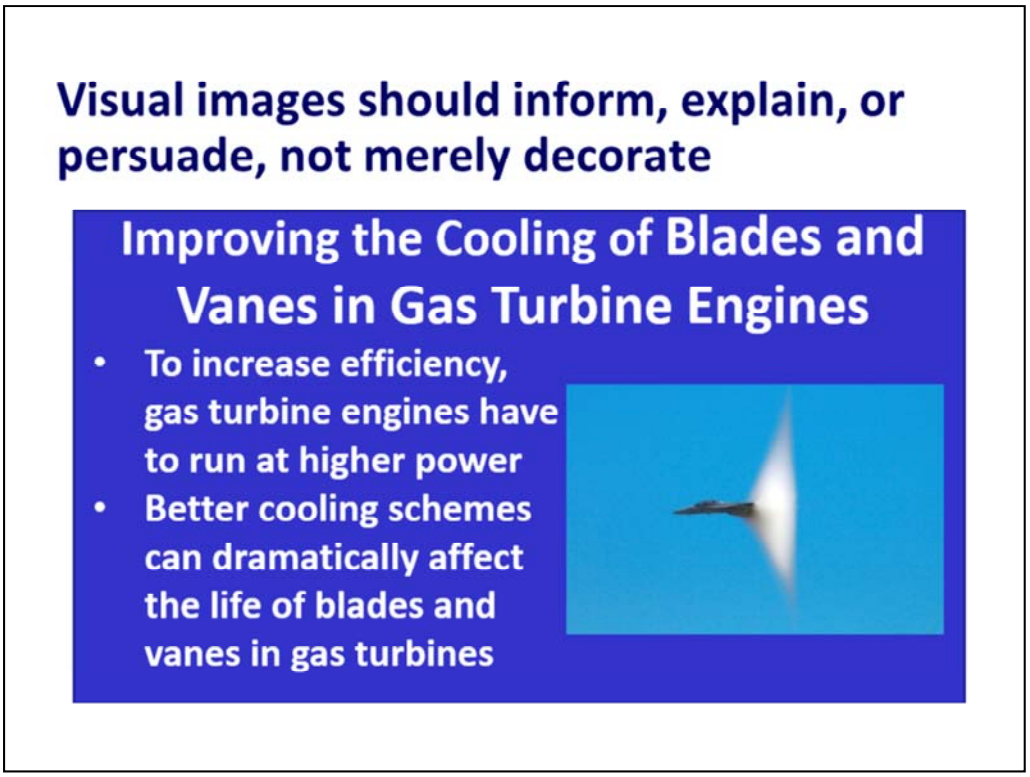
First, change the motivating statement at the top of the slide to emphasize the idea that there are ***four*** reasons to use figures. In the original slide, the message in the title is "remember the figure," and the subtitle is "look at the figure first."

Present the points in a numbered list—easier to process (and remember) that there are four reasons than to sort them out from narrative text presented in paragraph style.

Most Western languages are read from left to right and top to bottom. Place your important points strategically—at the top of the slide and along the left margin. Put your illustrative pictures at the right and lower down on the slide.

Put important ideas in a contrasting color—people look at color first, too.

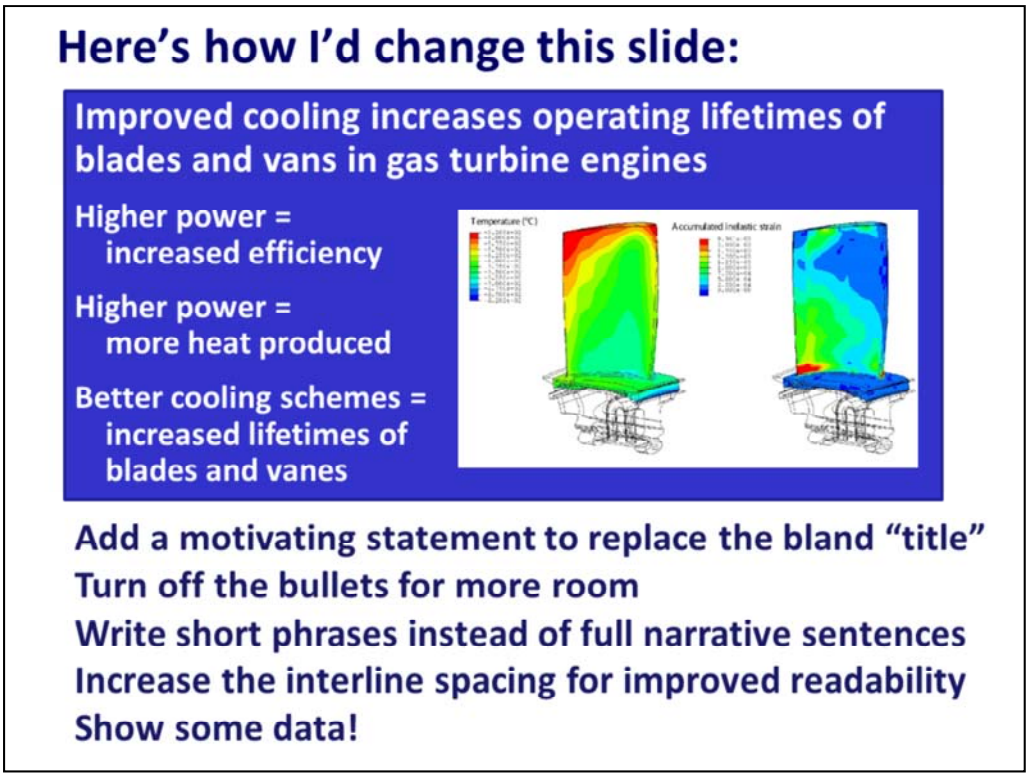
And always, always, always include a scale for any illustration.



While a spectacular and captivating photo (of a vapor cloud forming around an F-18 Super Hornet as it approaches the sound barrier), this image has ***nothing*** to do with cooling schemes for gas turbine engines. Instead of explaining or amplifying the talk, the photo competes with it.

Anybody going to this talk probably already knows what a jet airplane looks like. All this image does is distract the audience from the information the speaker is trying to convey. Who wants to pay attention to the boring, dense text when they can try to figure out what kind of fighter jet this is and why a vapor cloud is forming around it?

This slide also illustrates a problem with presenting information in bulleted lists. The narrative text all runs together.



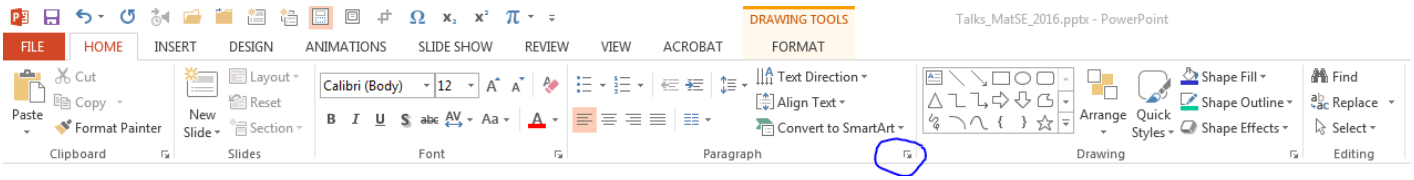
Here's how to improve this slide:

Change the centered title to a left-justified statement.

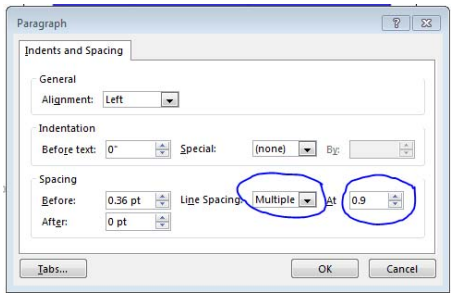
Turn off the bullets, "hanging indent" the text, and add extra space between items to make the text easier to read.

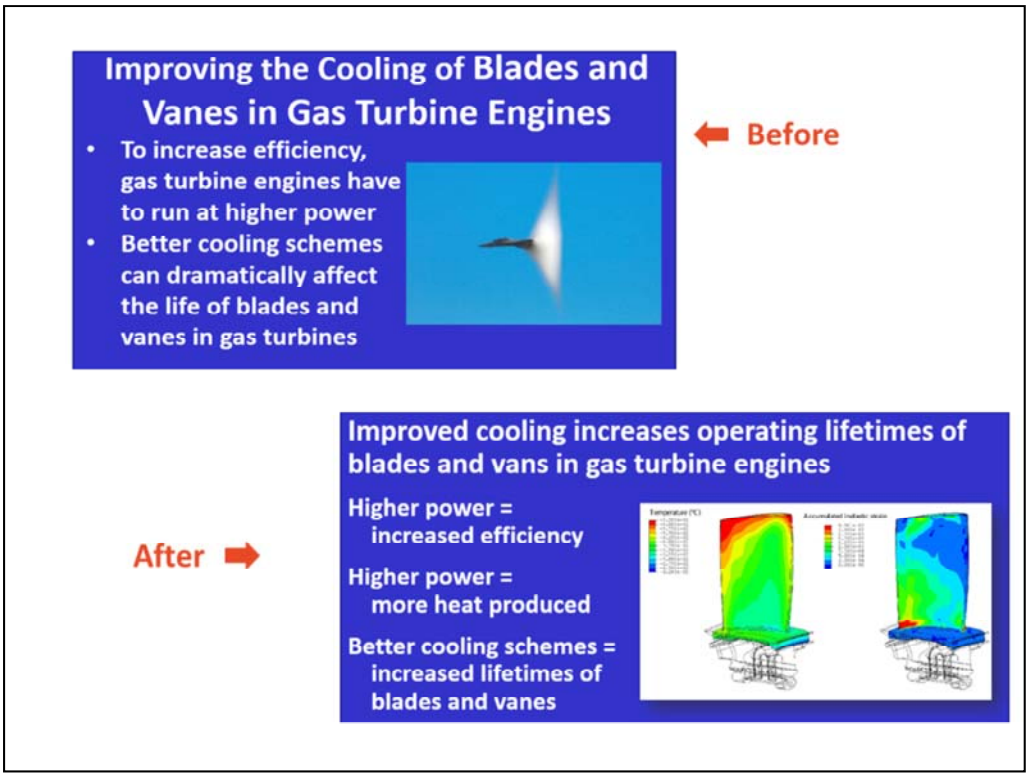
Write short phrases, not full narrative sentences, to make the text easier to read.

Change the interline spacing to make the text more compact, which allows more text per vertical inch and more inter-item spacing. On the "Paragraph" section of the ribbon, click on the down arrow to open the dialog box:

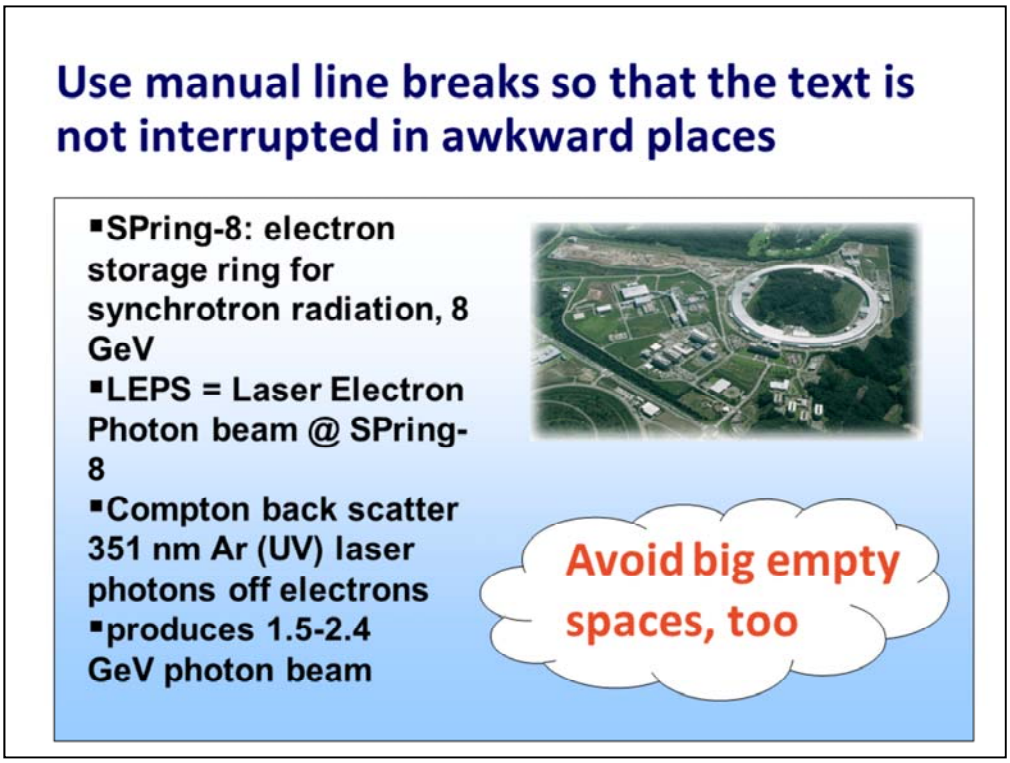


Then change the spacing to "Multiple" and type 0.9 in the box.





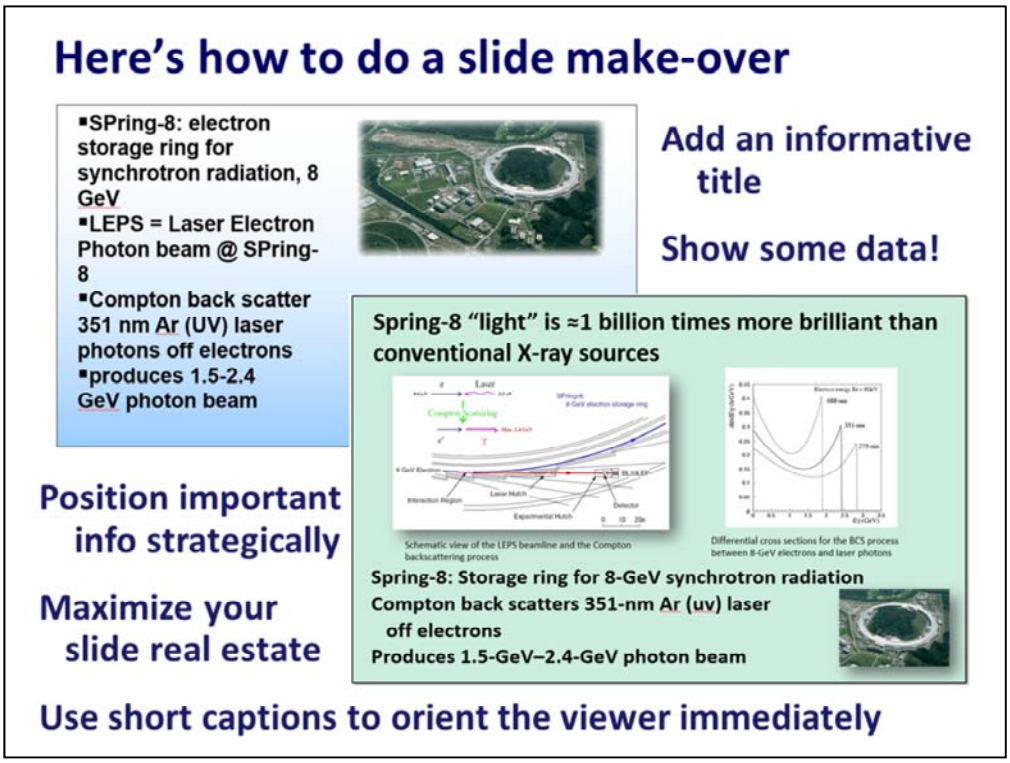
Here's the "before" and "after" versions of the slide. Which do you think does a better job of informing, educating, and persuading the audience?



To make a line break without starting a new item, press Shift+space bar.

Use the "Order" command on the "Draw" toolbar in PPT 2003 to arrange text and figures in layers. Right click on the item you want to arrange and then click on the arrow to the left of the "Send to Back" or "Bring to Front" options to arrange layers.

Extra text boxes don't cost *anything.* You can use more than one on a slide.



Here's how I would improve the previous slide.

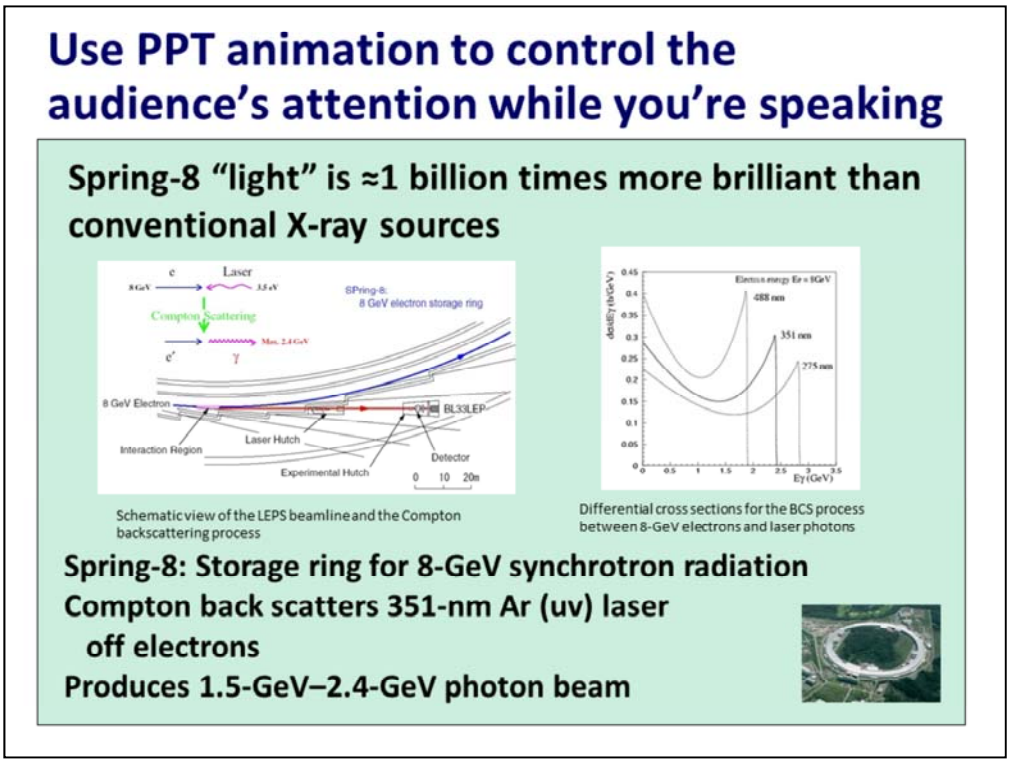
- Add a motivating statement at the top of the slide.
- Make the obligatory aerial photo of the accelerator smaller and stick it at the lower right of the slide.
- Turn off the bullets and tighten up the prose to reduce the number of lines of text.
- Use the additional space you've freed up to show a cartoon of the physical process, a schematic of the beamline, and the energy spectra of the photons, and put those images at the top of the slide to emphasize them.

If you just ***have*** to show the mandatory aerial photo of the accelerator, make it smaller, move it off center-stage, and crop to emphasize the ring, not the surrounding countryside. A scale would be really nice, but although I found 48 different aerial photographs of SPring-8 on the Internet, not one showed how big it is. A label superimposed on the photo that shows where LEPS is located on the ring would be a good addition, too.

Some technical-editing changes:

- A hyphen is required between 8 and GeV in the first line, 351 and nm in the second line, and 1.5 and GeV and 2.4 and GeV in the last line of text. In every case, the number is combined with the unit to make an adjective that describes the size of the following noun; you indicate that it's an adjective by hyphenating the two components.
- The abbreviation for "ultraviolet" (and infrared) is always written lower case.
- Provide both lower and upper units for numbers in a range.
- Indicate a range by an en dash, not a hyphen.

Images taken from http://www.rcnp.osaka-u.ac.jp/Divisions/np1-b/lepsbl.html.



When you present an audience with a complicated slide like this one, they don't know what to look at first and they try to look at everything instead of listening to you. Control their attention by using animations to present bits of information at a time, synchronized with what you are saying.

Using animations requires practice and rehearsal—we've all forgotten about an animation and then were surprised when something popped up when we were expecting that click to bring up the next slide.

Mark up your notes pages to indicate animations so you can keep track of them as you are speaking.

Use PPT animation to control the audience's attention while you're speaking

Spring-8 "light" is ≈1 billion times more brilliant than conventional X-ray sources

Spring-8: Storage ring for 8-GeV synchrotron radiation
Compton back scatters 351-nm Ar (uv) laser
off electrons
Produces 1.5-GeV–2.4-GeV photon beam

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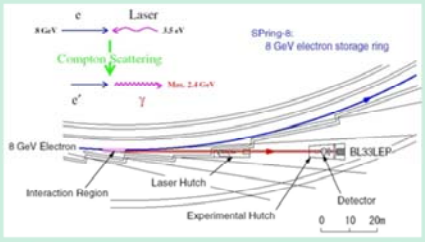
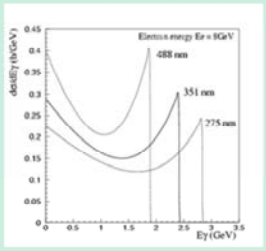
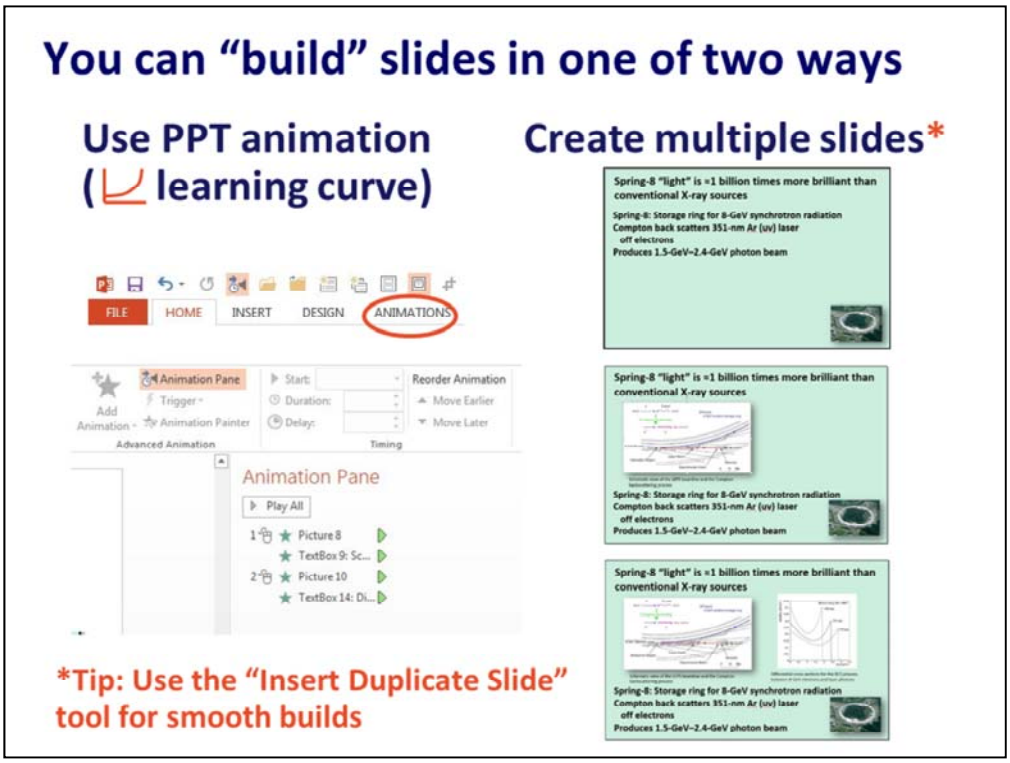


The Compton backscattering process and schematic view of the LEPS beamline



Differential cross sections for the BCS process between 8-GeV electrons and laser photons

Spring-8: Storage ring for 8-GeV synchrotron radiation
Compton back scatters 351-nm Ar (uv) laser off electrons
Produces 1.5-GeV–2.4-GeV photon beam



The animation tool gives you more control and offers a variety of special effects. However, like anything else, there's a learning curve associated with it, and you'll have to invest time to get good at it.

Creating multiple slides is easier—at least initially—and extra slides don't cost a dime. For best results, do the first, stripped down slide, and then use the "insert duplicate slide" tool to make each subsequent slide. That way, you don't have slight variations in the position of text and figures (which is distracting and annoying) when you switch from one slide to the next.

On the main toolbar in PPT, click on the "Insert" tab.

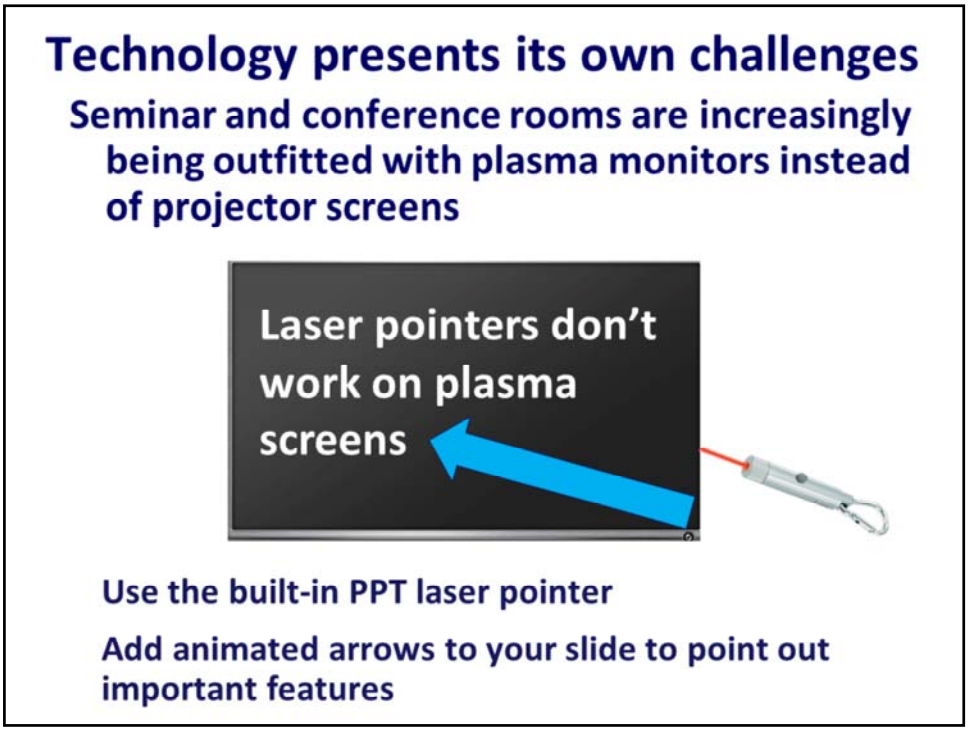
When the "Insert" ribbon comes up, click on the down arrow on the "New Slide" icon (first one on the far left), and scroll to the bottom of the menu to "Duplicate Selected Slides" and click on it. (I have no idea why MS uses this language; when you click on that item, PPT inserts a duplicate of the slide you are on—you cannot "select" multiple slides. <sigh>)

Never *ever* put *anything* on a slide that you do not thoroughly understand

That figure you got from somebody else and added at the last minute…

…will be all the audience asks questions about

And don't put anything on a slide that you don't explicitly talk about, either!



You could point out features with your hand, but the monitors are often mounted on the wall across the room, or behind you, where you cannot easily reach them without really distracting the audience.

Don't try to use your laser pointer and then say, "Huh! The laser pointer doesn't work. Wow! Now what do I do? Well, I guess you can see what I mean…"
Turn on the built-in laser pointer in PPT. Click on it again to turn it off.

To recap:

- Determine your goal(s) for the talk
- Analyze your audience
- Decide on the major points you want to make
- Use motivating statements at the top of your slides, not bland, generic "titles"
- Select colors and images judiciously—pay attention to slide aesthetics
- Control the audience's attention using animation

$$p = \frac{t}{8}$$

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Notes and Questions: