supported below by images (at least one image for each slide) and by short groupings of words. At that year’s meeting, Lawrence Livermore’s presentations were very well received—so well received, in fact, that managers from Sandia vowed never to be shown up again.

When slides are chosen to communicate the images and results of a scientific presentation, their design becomes important for the success of that presentation. Typically, as soon as a slide is projected, the listener shifts attention from the speaker to the screen. When the slide has words that cannot be read, the listener is distracted with the question of what those words are. Likewise, when the slide does not quickly orient the listener, the listener is disoriented, wondering what the point of this slide is. If the presentation does not allow for questions or if the listener is not confident enough to ask a question, then these questions fester in the listener. Given these two distractions, presenters should strive to design slides that are easy to read and that quickly orient the audience.

Despite the importance of designing slides that are easy to read and that orient the audience quickly, many presenters appear to have designed the slides with the opposite intention. For instance, in one recent invited lecture, the presenter used a thin serif font (Garamond) that was hard for the audience to read, even for those sitting in the front row. Even more problematic was that the presenter chose type sizes between 10 and 12 points—far too small given that the room seated thirty. Causing even more problems was that the presenter chose a color combination of bright red lettering against a white background, a combination that would have been difficult to read even with a bold sans serif typeface, such as Arial, at 24 or 18 points. Worst of all, the presenter had placed by far too many words and almost no images on the slides. For thirty minutes, this engineer flipped through these presentation slides, most of the time with his body turned to the screen reading what he had created. Mean-
while, the audience listened halfheartedly and regretted that they had come.

Few slide designs used at scientific conferences and in technical meetings communicate as effectively as they should. One reason is that the defaults and templates in the most common program used for creating these slides (Microsoft’s PowerPoint) do not serve scientific presentations. This section not only challenges these defaults and templates, but also proposes specific guidelines for typography, color, and layout of slides for scientific presentations.

Presented in Table 4-2 is a summary of these guidelines. Some guidelines, such as number 1 on layout and numbers 1 and 4 on style, go against the defaults of PowerPoint and therefore against what are commonly projected at conferences, meetings, and university lectures. Reasons exist for this break with tradition. The most important of these concern the differences between scientific presentations and general business presentations. First, the content of scientific presentations is typically specific and complex. Second, the audience at a scientific presentation is usually taxed to understand the content. Third, generally in a scientific presentation, images are essential for that understanding. Accompanying Table 4-2 is Figure 4-6, which gives a template for slides. An assumption for this template is that the type is sized for a presentation room that can accommodate one hundred or so. For larger rooms, the presenter might need to increase the type size.

An assumption for both Table 4-2 and Figure 4-6 is that the primary goal of the scientific presentation is to inform or to persuade an audience about technical results. In doing so, the presenter strives to have the audience remember those results after the presentation and to understand the steps for how those results were reached. Given the diversity of scientific presentations, such is not always the case. For instance, in a classroom lecture, the speaker often wants to emphasize the pro-
Table 4-2. Guidelines for slides at a scientific presentation.

<table>
<thead>
<tr>
<th><strong>Typography</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a sans serif typeface such as Arial</td>
</tr>
<tr>
<td>Use boldface (Arial)</td>
</tr>
<tr>
<td>Use type sizes at least 18 points (14 points okay for references)</td>
</tr>
<tr>
<td>Avoid presenting text in all capital letters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Color</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use either light type against a dark background or dark type against a light background</td>
</tr>
<tr>
<td>Avoid red-green combinations (many people cannot distinguish)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Layout</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a sentence headline for every slide, but the title slide; left justify the headline in the slide’s upper left corner</td>
</tr>
<tr>
<td>Keep text blocks, such as headlines and listed items, to no more than two lines</td>
</tr>
<tr>
<td>Keep lists to two, three, or four items; make listed items parallel; avoid sublists, if possible</td>
</tr>
<tr>
<td>Be generous with white space</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Style</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Include an image on every slide</td>
</tr>
<tr>
<td>Make the mapping slide memorable; for instance, couple each section of the talk with an image that is repeated in that section</td>
</tr>
<tr>
<td>Limit the number of items on each slide</td>
</tr>
<tr>
<td>Limit the number of slides so that you can dedicate at least one minute to each</td>
</tr>
</tbody>
</table>

cess for solving a problem, rather than the results of the problem. Likewise, in a management presentation, the speaker sometimes wants to communicate only the results and not the steps that led to those results. For that reason, such speakers might have justification to deviate from the design guidelines advocated here. Sadly, some speakers present so many slides and pack them with so much detail that the goal seems to be neither to inform nor to persuade the audience. Rather the goal appears to be to impress the audience. For such speakers, these guidelines do not apply.
The headline succinctly states the main point of the slide (bold sans serif, 28 points)

The body supports with images

Sample Image

The body supports with words

First-level Info (24 points)

Second-level info (18 points)

Figure 4-6. A template for the format of presentation slides (excluding the title slide). The type sizes on this template are appropriate for a room that can accommodate one hundred. For a larger room, one might need larger type sizes so that people in the back can read the text. For an example title slide, see Figure 3-8 on page 70.

Guidelines for Typography

The typography of a document, be it a journal article or presentation slide, communicates much about the document. One important choice in typography is the selection of a typestyle (also called font). For instance, Garamond conveys a sense of tradition in documents, which is why Garamond is used in several journals. Garamond belongs to a class of typestyles known as serif fonts, which have projecting short strokes, such as the little feet on a serif “m.” Another category of typestyles is sans serif. These fonts do not have the projecting strokes (consider a sans serif “m”). One of the most common sans serif fonts is Arial. Other important choices of typography include the type size, the choice of all capitals or lowercase, and the choice of bold, italic, or normal type.
1. For presentation slides, use a sans serif font rather than a serif font. Just because a typestyle such as Book Antiqua, Times New Roman, or Garamond is appropriate for reports and papers does not mean that it is appropriate for presentation slides. The most important consideration in choosing a typestyle for a presentation slide is not tradition, but reading speed. In a presentation, reading speed is important because the audience members, splitting their concentration between what the presenter shows and what the presenter says, give themselves only a few seconds to read each projected slide. In general, when the numbers of words are few such as on presentation slides, sans serif fonts are read more quickly—especially by those looking at the screen from the sides of the room. Within this category of sans serif typestyles (see Table 4-3), you might choose Arial or Univers for formal situations and Comic Sans MS for less formal situations.

For some reason, the default typestyle of Microsoft’s PowerPoint is Times New Roman, a serif font that is not read as quickly as sans serif fonts are. That difference in reading speed is especially noticeable for an audience seated on the sides of a room rather than in the room’s middle. When viewed from a sharp angle, sans serif type is easier to read than serif type. That difference in reading speed is also particularly noticeable when the optics

Table 4-3. Common type faces appropriate for presentation slides.

<table>
<thead>
<tr>
<th>Typestyle</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arial</td>
<td>A body in motion will remain in motion</td>
</tr>
<tr>
<td>Arial Narrow</td>
<td>A body in motion will remain in motion</td>
</tr>
<tr>
<td>Comic Sans MS</td>
<td>A body in motion will remain in motion</td>
</tr>
<tr>
<td>Univers</td>
<td>A body in motion will remain in motion</td>
</tr>
</tbody>
</table>
of the projection system are not optimal. Such was the case when a manager recently held a ninety-minute meeting for twenty engineers off site. Because the computer projector’s bulb had degraded and because the manager had chosen this default typestyle, the slides were unreadable, and the manager and attending engineers were frustrated. Conversely, using that same projector the next day, another presenter projected readable slides that relied on a bold sans serif font.

2. For presentation slides, use boldface. In addition to advocating a sans serif typestyle, many graphic designers also recommend using the bold version of that typestyle. Boldfacing the letters (Arial or Comic Sans MS) makes the letters more readable from a greater distance. Boldface also allows the lettering to reproduce better when placed onto an overhead transparency. Again, for some reason, the default of Microsoft’s PowerPoint does not call for a boldface type.

While boldface is recommended for presentation slides, other options such as italic, underline, and outline are not. Granted, in instructional documents, italic type in small blocks is useful for emphasis. However, on presentation slides, italic type is too slow to read (particularly when viewed from the sides of the room).

3. Choose an appropriate type size for the room. The size of the type is also a consideration. The size of type is measured in points (a point is about 1/72 of an inch). When a bold sans serif font is used, appropriate type sizes for all slides except the title slide are between 18 and 28 points, as shown in Table 4-4 (for the title on a title slide, using 32 or 36 points is appropriate). Not surprisingly, if the default of Microsoft’s PowerPoint is used (an unbolded serif font), the presenter has to use a larger type size for legibility. That is why the default type size for headlines in PowerPoint is 44 points.
Table 4-4. Recommended type sizes for presentation slides.

<table>
<thead>
<tr>
<th>Size</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 points</td>
<td>headline of slide</td>
</tr>
<tr>
<td>24 points</td>
<td>primary type for body of slide</td>
</tr>
<tr>
<td>18 points</td>
<td>secondary type for body of slide</td>
</tr>
<tr>
<td>14 points</td>
<td>reference listings and logos</td>
</tr>
</tbody>
</table>

For footnotes that the speaker does not expect the audience to actually read during the presentation (but may want to read on a copy of the presentation slides afterwards), 14 points is appropriate as long as it is clear to the audience that the text block is a footnote. Also, for a small room such as a conference room, you can drop down one size level: 24 points for the headline and 18 points for the primary text of the body. Likewise, for a large auditorium, you might consider increasing the size to 32 points (or even larger) for the headline and 28 points for the primary text of the body.

At a recent national conference in which presenter after presenter used 12 and even 10 point type on their slides—a size that people sitting in only the first couple of rows could read—one person in the audience decided that he had had enough. This person moved to the back of the auditorium, stood on a chair, and focused a pair of binoculars onto the screen. Because most of the audience members had long since given up trying to read the tiny lettering on the screen, they soon spotted the man in the back with the binoculars. A wave of laughter passed over the auditorium. The commotion was so loud that the presenter became flustered and turned off the projector. For
this presenter, I have no sympathy. Not taking the time to create a slide that the entire audience can read is inconsiderate.3

4. Avoid presenting text in all capital letters. Many presenters mistakenly use all capital letters on their slides. These presenters fail to recognize that readers recognize words not only by the letters in the word, but also by the shape of the letters: for instance, the shapes of ascenders such as b, d, and f and the shapes of descenders such as g, j, and p. As shown in Figure 4-7, using all capital letters dramatically slows the reading because using all capitals prevents readers from recognizing the shapes of words.

Another problem with using all capitals is that type set in all capitals takes up much more space (about 35 percent more space) than type set in upper and lower case.4 On a presentation slide, space is valuable, and what space you do not need for type and images, you want to leave blank, to make the slide more inviting to read.

**Figure 4-7. Difference between reading all capital letters and type set in uppercase and lowercase letters.**
The Morton Thiokol presentation slides referred to in Chapter 2 demonstrate how using all capitals makes it difficult to discern the message. One of the slides from that presentation is shown in Figure 4-8. Not only does the slide suffer from having too many words, but all the lettering is in capital letters. The slide would have been easier to read if the presenters had used upper and lower case. For the slide to have been effective, though, the presenters would have had to use fewer words, written a sentence headline that clearly indicated the slide’s main point, and incorporated an image to support that point.

**Figure 4-8.** Weak presentation slide from Morton Thiokol presentation to NASA on January 27, 1986. The use of all capital letters makes reading difficult. Also a problem is having so many words on the slide, far too many words for the audience to comprehend in a presentation.

**Guidelines for Color**

At a thirty-minute contractors’ presentation before sixty engineers and scientists, most of whom had flown to the meeting, an engineer projected a set of computer slides.
with a dark rust type against a brown background. The audience at first thought that the engineer had begun with a blank brown background upon which he would build a slide. Unfortunately, nothing ever appeared. The engineer proceeded to project another slide with the same blank brown background, and the audience began whispering among themselves. The speaker, sensing the agitation from his audience, turned to look at the screen. Not even he, standing a couple feet from the screen, could read the words. This engineer, who later claimed that he could see the contrast on his computer screen, had neglected to try out the color combination on a projected screen. Even if the engineer could see the contrast on his computer screen, he should have given more thought to the colors that he had chosen.

1. Consider the representative colors of your institution. For a company that has blue as its identifying color, incorporating blue into the color scheme of its presentation slides is natural. Sandia National Laboratories, for instance, uses blue as an identifying color. For that reason, many presentation slides representing Sandia use blue—either blue lettering on a white background or white lettering on a blue background. Likewise, Lawrence Livermore National Laboratory has green as an identifying color and uses green in a similar fashion.

The color associated with your institution should not be the only consideration in choosing a color. For instance, I teach at Virginia Tech, which has maroon and orange as its representative colors. While these colors work well on our team’s football jerseys amid the beautiful autumn leaves of the Appalachian mountains, these colors do not work well as the main colors on presentation slides. For that reason, I use maroon as an accent color on the slides, but choose a cool color combination, such as white lettering on a dark blue background, as the main color combination for the slide. When printing out
overhead transparencies or handout pages, I usually reverse that combination (blue lettering against a clear background) to save on toner.

2. Consider how readable the combination is. As you might infer from the anecdote about the engineer who used rust letters against a brown background, choosing a color combination with a high contrast is important. Not all color combinations are read with equal speed. The color combination that is read most quickly is black lettering against a yellow background, which is one reason that caution signs use this combination. The next most quickly read combination is black lettering against a white background. One of the slowest-to-read combinations is black lettering against a red background, and even more slowly read is red lettering against a black background. Although dark blue or dark green lettering against a white background is not read as quickly as black against a white or yellow background, these combinations can be read quickly enough to serve a scientific presentation. In the end, what is important is that the contrast be high.

Another consideration is color blindness. About 8 percent of males and 0.5 percent of females have deficiencies in distinguishing certain color combinations. The combinations that cause the most problems for these people involve red, green, and brown. For that reason, avoid such combinations.

3. Consider the effect of the background color upon the audience. Blue and green are soothing colors. For that reason, audiences feel comfortable with either of those colors used as the background of a slide. Orange and red, on the other hand, are hot colors and can unsettle an audience. Unless you desire to rile an audience, avoid such colors as your background color. Even yellow as a background color can agitate. When I first learned that black against yellow was the fastest color combination to read, I tried that combination on my overhead transparencies.
That semester the students seemed unusually agitated in class, and their questions were often caustic. When I switched to white lettering against a blue background, the students calmed down noticeably. Interestingly, yellow lettering against a blue background does not have nearly the same agitating effect—unless you have too much yellow text and too many yellow lines.

**Guidelines for Layout**

On presentation slides, one of the main layout errors is having too many details. When a slide has too many details, the listeners are intimidated; they feel that they do not have time both to decipher the slide and to continue listening to the speaker. Specifically, what intimidates audiences are slides with large blocks of text (more than two lines per block), slides with long lists (more than four items per list), and slides that do not contain enough white space.

A second layout error that causes slides not to communicate effectively is an illogical arrangement of information. When a slide is projected, the audience turns from the speaker and looks at the screen. At this point, the audience’s attention is divided between the speaker and the slide. For this situation, it is important that the audience members quickly grasp the purpose of the slide and that they know how to read it: what to read first, what to read second, and so on. In poorly designed slides, the audience does not know on what to focus first.

Given in this section are guidelines for limiting the amount of information so that the audience is not overwhelmed. Also given here are guidelines for arranging the information so that the audience is quickly oriented.

1. For all slides except for the title slide, use a sentence headline to state the slide’s purpose. When you place a presentation slide before the audience, the audience immediately
turns to it and tries to decipher its purpose. A sentence headline, such as shown on the slide of Figure 4-9, serves this situation by orienting the audience quickly to the purpose of the slide so that the audience can turn its attention back to the presenter. Designing slides with short sentence headlines is not a new idea. For instance, in the 1960s, Robert Perry at Hughes Aircraft began advocating sentence headlines for slides, and since the 1970s, Larry Gottlieb of Lawrence Livermore National Laboratory has taught the design to hundreds of scientists and engineers.  

For a sentence headline to be effective, you should follow three principles. First, the sentence headline should begin in the upper-left corner of the slide. That way, the audience sees it first. Second, the sentence headline should be no more than two lines. Blocks of text longer than two lines on a slide are often not read. Third,

**Fillets mitigate leading edge vortices in nature and in engineering**

![Fillet on dorsal fin of shark](image1)

![Fillet on Seawolf submarine](image2)

**Figure 4-9.** Presentation slide that uses a headline-body design. This slide comes from a presentation that introduced a fillet design for reducing the vortices that occur along turbine vanes in a gas turbine engine.
to make it easier for the audience to read, the headline should be left justified, rather than centered, because a centered headline takes the audience longer to read, particularly if the headline goes to a second line.

Using a sentence headline is not the norm in scientific presentations. In fact, given the thousands of presentations that use phrase headlines (or, worse yet, no headlines), this advice swims against the current of what is most often seen. However, good reasons exist for using sentence headlines.

The first reason is that while a phrase headline identifies the topic, a sentence headline can show a specific perspective on the topic. Contrast the phrase headline in the top slide of Figure 4-10 with the sentence headline of the bottom slide. The sentence headline in the bottom slide orients the audience much more effectively.

A second reason to use sentence headlines is that although the speaker might make smooth transitions between slides, the audience might not catch those transitions. Often in presentations, a topic on one slide will cause members of the audience to think about their own work for a moment, which can cause them to miss the speaker’s transition to the next slide. The sentence headline allows those audience members to reorient themselves. Also, for those situations in which the speaker distributes or posts the presentation slides as a handout, the sentence headlines have many advantages over phrase headlines. For instance, an audience that views the slides weeks later or an audience that was not able to attend the presentation is in a much better position to see the organization, emphasis, and transitions of the talk if sentence headlines are used. In fact, when the sentence headlines are well written, the slides can serve as an informal report for the work.

A third reason to use sentence headlines is that a sentence headline not only orients the listener more effectively, but also orients the speaker more effectively
Figure 4-10. Two slides: (top) weaker slide with phrase headline, and (bottom) stronger slide with sentence headline.¹⁰
during the presentation. Often in science and engineering, people must make presentations that they did not themselves create. By having sentence headlines, the speaker can see what main point each slide has and can make the appropriate transition to that point.

Yet a fourth reason, and what my colleague Harry Robertshaw considers the most important, is that a sentence headline forces the presenter to come to grips with what the main purpose of the slide is. This point might seem obvious, but in the presentation slides sent by Morton Thiokol to NASA the night before the launch of the space shuttle Challenger, the presenters did not make clear their assertions and did not provide enough evidence for the assertions that they did make. Consider the second slide of that presentation again (Figure 4-11). If the presenting engineers had simply stated their main assertion “The lower the temperature of the launch, the more erosion the O-rings have experienced,” then the engineers might have reconsidered the evidence that they presented. Perhaps they would have come up with a graph, like that suggested by Edward Tufte in Visual Explanations, that plotted an erosion index for the O-rings versus launch temperature for all launches up to that point. As it was, Morton Thiokol had no real headline on that slide, and the evidence in the slide’s body lacked the key relationship between O-ring erosion and launch temperature.

2. Achieve a balance between what you say and what you show. Once you have established the purpose of the slide with the sentence headline, you should support that assertion with images and words in the slide’s body. In general, you want enough images and words to support the headline’s assertion, but not so many that the audience is overwhelmed. One example of a slide having a nice balance of white space with supporting words and images was shown in Figure 4-9.
### Figure 4-11. Weak slide that Morton Thiokol sent to NASA to request launch delay of the space shuttle Challenger (January 27, 1986).\(^\text{13}\) If the presenters had chosen an effective headline (such as “The lower the temperature of the launch, the more erosion that the O-rings experienced”), perhaps they would have seen that the key relationship of O-ring erosion to launch temperature was missing from the slide.

A common mistake in designing the bodies of slides is not achieving a balance between the words that are said and the words that are shown. In a strong presentation, although you often repeat words and phrases from the slides in your speech, your speech should include more than just the words on the slides—much more. In many weak presentations, all the words that the speaker says are given on the slides. Consider the slide shown in Figure 4-12, which my wife recently witnessed.\(^\text{14}\) This slide and similar ones in that presentation irritated the audience. The audience was not sure whether to listen or to read. In the end, they did neither. When the presenter asked for questions at the end of the presentation, a long and uncomfortable silence ensued. That silence contrasted sharply with all the questions and discussion of
Hefner developed a dynamic electro-thermal model for IGBT, from the temperature-dependent IGBT silicon chip, packages and heat sinks. The temperature-dependent IGBT electrical model describes the instantaneous electrical behavior in terms of the instantaneous temperature of the IGBT silicon chip surface. The instantaneous power dissipated in the IGBT is calculated using the electrical model and determines the instantaneous heat rate that is applied to the surface of the silicon chip thermal model. Hefner incorporated this methodology into the SABER circuit simulator.

Adams, Joshi and Blackburn considered thermal interactions between the heat sources, substrate, and enclosures walls as affected by the thermal conductance of the walls and substrate with the intent of determining which physical effects and level of detail are necessary to accurately predict thermal behavior of discretely heated enclosures.

Chen, Wu and Boronjevic are modeling of thermal and electrical behavior using several commercial softwares (I-DEAS, Maxwell, Flotherm and Saber) and 3-D, transient approaches.

**Figure 4-12.** Slide in which the presenter placed the entire speech onto the slide. Not surprisingly, no one in the audience bothered to read this slide.

the other presentations that morning. This presenter’s work was not only not well received; it was not received at all.

Another story that points to the importance of having a balance between what you say in your speech and what you show on your slides occurred several years ago at one of the national laboratories. On this occasion, the Secretary of Energy was visiting and attended a presentation given by a department manager. The department manager had worked for weeks on this presentation. He had booked the best conference room at the lab, he had recruited the best artists at the lab to design the slides, and he had practiced the presentation over and over until he could say every word on the slides without even looking at the slides. After the third slide, though, the Secretary of Energy raised his hand. The department manager stopped and said, “Yes, you have a question?”

“No. No, I don’t have a question,” the Secretary of
Energy said. “I have a comment. I can read. From now on, don’t say anything else. Just put the slides up one by one. I’ll tell you when to change them.”

As you might imagine, the department manager was humiliated. For this department manager, I have sympathy. Given the work that he put into his presentation, he deserved better treatment.

How much wording should be placed onto slides? My rule of thumb is to keep each block of text, including the headline, to no more than two lines. Audiences are much more likely to read blocks of text with one or two lines than blocks that are longer.

3. **Avoid lists with more than four items.** Genesis, Exodus, Leviticus, Numbers, Deuteronomy, First and Second Samuel, First and Second Kings—that list continues for another fifty-seven items. While we sometimes spend hours memorizing long lists such as the books of the Bible, we expect too much of our audiences when we ask them to remember long lists that we display for only a minute or so in our presentations. As mentioned in Critical Error 4, audiences remember lists of twos, threes, and fours. In a presentation, lists that have more items are soon forgotten. Worse yet, the audience often does not even try to read long lists. With a long list, the audience sees the length, perhaps reads the first couple of items, and then turns away. Presenters would do better to place only the four most important items from the list on the slide and reserve the less important details for the speech.

What if your work contains a set larger than four? For instance, what if you are evaluating seven characteristics of a receiver at a solar energy plant:

- Steady-state efficiency
- Average efficiency
- Startup time
- Operation time
- Operation during cloud transients
- Panel mechanical supports
- Tube leaks
Rather than giving your audience all seven characteristics up front, consider placing the characteristics into more memorable groups. One example is as follows:

- Efficiency of receiver
- Operation cycle of receiver
- Mechanical wear on receiver

When you discuss the efficiency of the receiver, you can then introduce steady-state efficiency and average efficiency as a group of two characteristics for that category. Likewise, when you introduce mechanical wear on the receiver, you can introduce panel mechanical supports and tube leaks as another group of two characteristics for that category. The advantage is that the audience is much more likely to recall the list of three categories than the longer list of seven characteristics.

An exception to excluding a long list is the case in which the presenter does not expect the audience to actually read the list. Rather, the presenter just wants the audience to see that many examples exist. For instance, a presenter might want to show the many negative effects of a drug. In this case, the presenter might use a long list of examples as overwhelming evidence for the assertion that this drug is dangerous.

No matter what the purpose of the list is, the items in the list should be parallel in structure. In other words, if the first item of a list is a noun phrase, all items should be noun phrases. In addition, if you include one subitem, logic dictates that you include a second. If possible, avoid sublists because audiences usually do not read them. That sublevel of information is better left in your speech.

4. Avoid unnecessary details. As mentioned, once you have established the purpose of the slide with the sentence headline, you should support that assertion with words and images in the body of the slide. A common error, though, is to place too many supporting details onto each slide. Placing all the details of your work on the presentation slides causes the audience to lose sight of the de-
tails that are most important. In other words, by placing too many details on your presentation slides, you run the risk of the audience not remembering the most important details. Worse yet, in cases such as that shown in Figure 4-13, you risk having the audience give up without even trying to understand the slide.

One way to prevent a slide from seeming overcrowded is to limit the number of items on the slide. Many graphic designers recommend a maximum of seven items. Figure 4-14 provides an example. This slide has seven main parts: the headline, the image, the three callouts, the sentence in the body, and the logo. What makes this slide readable is the white space that allows the audience to separate these items. This white space also allows the audience to find an order in which to read the information: in this case top to bottom. Contrast that order with the lack of order in Figure 4-13.

![Figure 4-13. Overwhelming slide from a military presentation. Although the presenter put much effort into making this slide, this slide overwhelms because there are too many details.](image-url)
Our goal is to test a fillet design for turbine vanes downstream of the combustor

The purpose of the fillet design is to reduce vortices that cause aerodynamic penalties

Figure 4-14. Strong slide in which the presenter has limited the number of details and arranged those details to allow enough white space.16

What if you have more than seven details to convey to the audience? How would you work those into the presentation? One way, if time allows, would be to have a second slide. Another way would be to present the secondary details in the speech. Granted, the audience will not be as likely to remember the secondary results if they are placed in the speech, but if the speaker packs every result and image into his or her presentation slides, the audience is likely not to remember any details, not even the primary ones.

A third way to work in more than seven items is to add them during the presentation. In a computer projection, this adding (or building) is easy: You have the program bring in additional items after the audience has digested the ones you have shown. With an overhead transparency, you can achieve the same effect by using overlays.

When building a slide, be careful about having too many stages. Some presenters go overboard and build
every detail, which tests the patience of the audience. In addition to being sensitive to the amount of building, be sensitive to the way that you bring in items. Avoid PowerPoint’s cute functions that bring in the details from all sorts of directions and with all sorts of fanfare. Unfortunately, one of those distracting functions happens to be PowerPoint’s default (Fly from left), which calls for items to stream in from the left. As my colleague Harry Robertshaw points out, a much less distracting way to bring items on the screen is the choice named Appear, which has the item simply and quickly appear on the slide. Although the Appear selection is not easy to find in PowerPoint, it is worth the effort. Finally, with regard to building a slide, avoid having any accompanying sounds. These sounds, which range on PowerPoint from clicks to whooshes to brakes screeching, just grate on the audience and have no place in a professional presentation.

Besides having too many details, many slides in scientific presentations suffer because the details contain too much complex mathematics. It is unreasonable to expect your audience to follow complex mathematics when you do not have the time to methodically work through that mathematics. I am not saying that you should remove all complex equations from the slides of a short presentation. What I am recommending is that when you show mathematics, you account for what the audience can comprehend during the presentation. If the presentation allots the audience enough time to follow your entire derivation, so be it. However, if the audience does not have the time to follow the derivation, then you should clarify for them what you expect them to gather from the display of the mathematics.

For instance, in showing a complex equation, you could state up front that you do not expect the audience to follow all the mathematics. Rather, you have shown this equation to point out what the terms physically represent. For instance, the first term might represent the rate...
of mass flow out of the control volume, the second term might represent the rate of mass flow into the control volume, and so on. By clarifying what you expect the audience to gather, you allow them to relax. Without that clarification, though, some in your audience will simply quit listening to the presentation because they realize that they have no hope of working through the mathematics.

Other slides suffer because the illustrations are too complex for the audience to absorb. For instance, the illustration on the slide in Figure 4-15 is much too detailed for an audience to digest in two minutes. In such situations, the presenter has to decide which details are important for the audience to understand. For example, if all the information in Figure 4-15 has to be communicated to the audience, then the slide should be split into two, possibly three, slides, with one slide focusing on the direction of the mission and another focusing on the timeline. In regard to the timeline, if all the details are important, so be it. However, if some are secondary, consider showing them in a muted way (perhaps in a light gray), so that the key details stand out and the audience is not overwhelmed by the graphic.

This chapter has challenged several defaults of Microsoft’s PowerPoint. A summary of these challenges can be found in Table 4-5. In addition to the challenges already discussed, two other challenges arise on the grounds that these defaults (or templates) create unnecessary details. One challenge is to the background designs that PowerPoint makes available as templates. Fireballs, meadow scenes, ribbons, party balloons—these backgrounds might be appropriate for fund-raising presentations at a fraternity house, but are distractions in scientific presentations. A much better choice of background is a dark blue or green with white or yellow for the type. Another good choice for the background is a very light color with a dark color for the type. To make a background color distinctive, the airbrush option on
Figure 4-15. Overwhelming slide. A possible revision would break up the slide into two slides: one with the map and one with the timeline.

Table 4-5. Format defaults in Microsoft’s PowerPoint that should be challenged for slides in scientific presentations.

<table>
<thead>
<tr>
<th>Format</th>
<th>PowerPoint Default</th>
<th>Suggested Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typeface</td>
<td>Times New Roman</td>
<td>Arial Boldface</td>
</tr>
<tr>
<td>Type in headline</td>
<td>Centered</td>
<td>Left-justified</td>
</tr>
<tr>
<td></td>
<td>44 points</td>
<td>28 points</td>
</tr>
<tr>
<td>Type size in body</td>
<td>32 points</td>
<td>24–18 points</td>
</tr>
<tr>
<td>Separation indicator</td>
<td>Bullet</td>
<td>Vertical white space</td>
</tr>
<tr>
<td>Main item in list</td>
<td>Sub-bullet</td>
<td>Indent</td>
</tr>
<tr>
<td>Secondary item in list</td>
<td>Fly from left</td>
<td>Appear</td>
</tr>
<tr>
<td>Background</td>
<td>Various templates</td>
<td>Light color (dark typeface)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dark color (light typeface)</td>
</tr>
</tbody>
</table>
PowerPoint works well. Another factor in choosing the background color is the kind of projection to be used: overhead projection or computer projection. When printing out the slides onto transparencies or handout pages, a light-colored background is preferable to save toner on your printer. A light-colored background is also preferred if you are incorporating line graphs and line drawings from programs that create those graphs or drawings on white backgrounds.

Another challenge to the defaults of PowerPoint concerns its overuse of bullets (which are black dots to indicate a new item in a list). The main problem with bullets is that they often pull emphasis away from the words in the list and place that emphasis onto the dots. Richard Feynman did not think much of the practice of using bullets,¹⁷ and neither do I. A much less distracting way to indicate the separation of items in a list is with extra white space placed vertically between the items of the list. Unfortunately, the defaults of PowerPoint not only call for bullets on all main text blocks, but also call for sub-bullets on any subordinate text blocks. Note that indenting subordinate points achieves the same goal without the distraction.

The overall message here is not that you should avoid programs such as Microsoft’s PowerPoint. The message is that you should assess the defaults of such programs to determine whether those defaults serve your audiences, purposes, and occasions. In those cases where the program’s defaults do not serve the presentations, then you should be proactive and change them.
Critical Error 6
Projecting Slides That No One Remembers

Approval for our 1.2 million dollar proposal came down to a short presentation with a maximum of two slides. Talk about pressure. The worst part was that I would not be making the presentation—a manager in the sponsoring program would be, and essentially all he knew about the project was the information on those two slides.¹
—Daniel Inman

In a presentation, the audience remembers on average about 10 percent of what is said and 20 percent of what they read on projected slides. However, when the presenter both says details and shows those details on well-designed slides, the retention by the audience can climb to about 50 percent.² How close to 50 percent this retention reaches depends on how well the slides are designed. While the discussion for Critical Error 5 centered on how to format slides so that the retention level is high, the discussion of this critical error centers on what to place on slides so that the audience retains what is most important to remember. As mentioned, if a presenter tries to place all the details of the work onto the slides, then the presenter overwhelms the audience, and the audience ends up retaining little. For that reason, presenters have to be selective about what they include. Unfortunately, many presenters place relatively unimportant information onto slides and, in so doing, leave off details that the audience actually needs.

So what information should you include? The answer lies in the reasons for projecting slides in the first place. One important reason to include slides is to show images that are too complicated to explain with words. A
second important reason is to emphasize key results. Given these two reasons, it is easy to see that slides should include the most important images and results of a presentation. Yet a third reason to include slides is to reveal the organization of the presentation. By making the audience aware of the presentation’s organization, the presenter keeps the audience more relaxed because the audience knows where they are in the presentation. Since they are not worried about where they are, they are able to focus more on what the presenter communicates.

**Showing Key Images**

Before the shot clock became part of college basketball, some teams would try to slow games down by having the players continue to dribble and pass until they had a sure basket. In these games, the opposing crowd would often chant, “Boring, boring, boring.” Boring—that describes the slides created by many scientists and engineers in a scientific presentation. In such presentations, the presenter has a stack of slides, each with a cryptic phrase headline and then a laundry list of bullets and sub-bullets. The effect of such a presentation on the audience is hypnotic—much like the repetitious swing of a hypnotist’s watch.

Images are one way to make slides engaging. Moreover, because many images are difficult to communicate with only speech, you should take advantage of the opportunity that a presentation provides to display the key images of your work. The brain processes visual information much more quickly than text—400,000 times more quickly according to some researchers.³ For a presentation on the dwindling numbers of Siberian tigers, images to include might be a photograph of a tiger in the wild, a map showing the range of tigers fifty years ago as op-
posed to today, and a bar chart showing the decrease in numbers over the past one hundred years. In situations for which you cannot think of an image, you should consider having at least a table with words and numbers as opposed to just a list of phrases, because the table would show the relationships of those words and numbers.

Another reason to include images is that the audience will remember images much longer than they will remember words. Think about your earliest childhood memories. Rather than words that people spoke to you, you are much more likely to remember images: white shirts hanging on a line, a neighbor's Dalmation lying in the grass, a tire swing tied to an apple tree. Likewise, when the audience tries to remember a presentation, the images that you have projected are much more likely to be recalled. Consider the difference between the top and bottom mapping slides in Figure 4-16. Although the top slide has many more words, this slide communicates much less than the bottom slide does. Note that most of the words in the body of the top slide are unnecessary. For instance, every presentation has an Introduction and Conclusion. Moreover, the word Background does not give enough information to help the audience. In addition, the audience should already know whether Questions are to occur at the end. The most important words on this slide are the words indicating what will occur in the middle of the presentation. Unfortunately, in this top slide, as in so many other mapping slides for presentations, these words are not memorable. The bottom slide, however, makes those words memorable by anchoring them with images. These images are much more likely to be recalled by the audience throughout the presentation, especially if the images are repeated at the beginning of the corresponding sections (as they were in this presentation of a fillet design for turbine vanes).

The mapping slide is not the only slide that benefits from images. All slides, including the title slide and
Presentation Outline

- Introduction
- Background
- Fillet Design
- Computational Results
- Experimental Set-Up
- Experimental Results
- Conclusions
- Questions

This talk presents a computational and experimental analysis of the fillet design

1. Fillet Design  
2. Computational Predictions

3. Experimental Set-Up  
4. Experimental Results

Figure 4-16. Two slides that map the same presentation: (top) weaker slide that relies solely on words, and (bottom) much more memorable slide that uses images.⁴
conclusion slide, become more memorable when a key image or icon is included. Example slides from the middle portion of the fillet presentation are presented in Figure 4-17 and Figure 4-18. Figure 4-17 shows the shape of a fillet for a turbine vane, and Figure 4-18 shows a design for a wind tunnel experiment used in testing the effectiveness of those fillet designs on preventing leading edge and horseshoe vortices.

**Showing Key Results**

Besides showing the presentation’s key images, slides should show key results. If what you say and show has the potential of increasing recall for the audience to 50 percent, you certainly want to place the most important results of the presentation on your slides. For instance, Figure 4-19 shows computational results predicting that a fillet will prevent the horseshoe vortex and delay the passage vortex. Another example appears in Figure 4-20, which presents experimental evidence that a fillet design prevents a leading edge vortex from forming at the juncture of the turbine vane and the endwall. In showing each of these slides with a computer projector, the presenter could begin by showing the slide without the image on the right. Then the presenter could bring in that image once the audience was oriented to the image on the left.

**Showing the Presentation’s Organization**

Besides presenting the key images and the key results on your slides, you should use slides to show the presentation’s organization. By showing the organization of the presentation, you make it easier for your audience to understand how details on the slides fit into the big
The fillet was made using rapid prototyping to create a model for silicon molds.

Figure 4-17. Slide from the presentation mapped in Figure 4-16. This slide shows a fillet design for a vane in a gas turbine engine. For this presentation, this fillet is a key image.

Combustor flows are simulated by injecting film-cooling and dilution jets into the primary flow.

Figure 4-18. Slide from the presentation mapped in Figure 4-16 that shows the experimental setup for testing designs of gas turbine vanes. This setup is another key image for the presentation.
Figure 4-19. Slide showing computational predictions that a fillet prevents the leading edge vortex and delays the passage vortex.

Figure 4-20. Slide showing experimental evidence that a fillet prevents the formation of the leading edge vortex. In this presentation, experimental evidence showing that the fillet delays the passage vortex appears on another slide.
picture of the presentation. With that understanding, the audience can catalogue information more easily and then recall that information more readily.

In a well-designed set of presentation slides, several slides serve to reveal the presentation’s organization:

- Title slide
- Mapping slide (showing sections of middle)
- First slide for each section of middle
- Conclusion slide

Figure 4-21 presents a set of these organizational slides for a presentation on ways to reduce sulfur dioxide emissions from coal-fired power plants.

The title slide contains key information: the title of the presentation in large lettering, the speaker’s name and affiliation, a key image from the work, and an icon for the affiliation. Contrast this slide with the title slide (shown in Figure 2-3) that Morton Thiokol sent to NASA in their failed attempt to postpone the launch of the space shuttle Challenger on January 28, 1986. Morton Thiokol’s slide contained a title, but that title did not reflect the ultimate purpose of the presentation: to delay the launch. Moreover, Morton Thiokol’s name, the names of the engineers petitioning for the delay, and Morton Thiokol’s logo did not appear on the slide. For that reason, this title slide did not carry the authority that it should have.

Another key slide that reveals the organization of a talk is the mapping slide of the presentation. In the sample presentation of Figure 4-21, this slide introduces the categories of methods that will be discussed in the presentation. Unlike typical mapping slides, this mapping slide does much more than just list the three categories of methods. This slide also depicts the process for bringing the coal to the plant, burning the coal, and emitting the combustion gases. These images provide the speaker with many opportunities to work in background information and therefore to leave this key organization slide up for a longer period of time. So often in typical presentations,
Methods to Reduce Sulfur Dioxide Emissions From Coal-Fueled Utilities

Cynthia Schmidt
Mechanical Engineering Department
University of Texas

Three classes of methods exist for reducing emissions of sulfur dioxide

Figure 4-21. Set of presentation slides that reveals organization of the presentation: title slide (top), mapping slide (bottom), body slide for each of the three main parts of the presentation (top right, bottom right, and top of page 150), and conclusion slide (bottom of page 150).
Coal switching and coal cleaning are two precombustion methods

The most effective combustion method is an atmospheric fluidized bed

- removal capability of 90%
- low capital cost
- able to use in existing equipment
- high operating cost
- ability to use different grades of coal

Figure 4-21 (Continued).
Absorption and adsorption are two postcombustion processes

By using these methods, coal utilities can greatly reduce SO₂ emissions

- coal cleaning: 40%
- coal switching: 80%
- fluidized bed: 90%
- absorption: 95%
- adsorption: 80%

Figure 4-21 (Continued).
the mapping slide is projected for only a few seconds, which is not nearly enough time for the audience to memorize the list of topics.

Other key slides that reveal the organization are the first slides for the different parts of the middle. This presentation’s middle was divided into three categories of methods. For that reason, the first slide for each category should signal the audience that a major transition is occurring. These three slides, also shown in Figure 4-21, do so both with repeated words (precombustion methods, combustion methods, and postcombustion methods) and with repeated images. For a long section, the first slide is often a mapping slide for that section, as in the case of the first slides for the section on precombustion methods and the section on postcombustion methods.

A final organization slide is a conclusion slide. The conclusion slide should help signal the audience that the end of the presentation is at hand. In addition, the conclusion slide should emphasize key results from the presentation. In the sample presentation of Figure 4-21, the conclusion slide emphasizes results from the most important criterion of the evaluation: the effectiveness of each method at reducing sulfur dioxide emissions. Granted, other criteria such as cost exist, but the results of those secondary criteria could be repeated in speech so that the results of this most important criterion receive the most emphasis.

On their conclusion slides, many presenters unfortunately resign themselves to using bulleted lists. As shown in Figure 4-22, the conclusions can be presented in a more memorable fashion. This presentation compared two computational methods for simulating the way a person can detect sound from a vibrating structure. The two methods (the exhaustive method and the singular value decomposition (SVD) method) were compared with respect to how many computations were required and
how accurate the simulations were. The use of the balance scales on this conclusion slide made the comparisons more memorable than if the presenter had simply listed the two results. By the way, when this presenter, Aimee Lalime, was ready for questions in this presentation, she had the single word Questions appear at the bottom of this slide. That strategy allowed her to keep projecting the conclusion slide for the duration of the question period rather than to project a throwaway question slide as so many presenters unfortunately do.

For a short presentation, such as at a conference, you should limit yourself to one conclusion slide. Once the audience sees or hears “conclusion,” they assume that they are at the end. As my wife contends, a second conclusion slide tests the audience’s patience, and the unthinkably third conclusion slide exhausts it.

In summary, the SVD method can effectively replace the exhaustive method

<table>
<thead>
<tr>
<th>SVD reduces the number of computations</th>
<th>SVD is close to the accuracy of the exhaustive method</th>
</tr>
</thead>
<tbody>
<tr>
<td>140,000 Exhaustive Method</td>
<td>100% Exhaustive Method</td>
</tr>
<tr>
<td>4,000 SVD Method</td>
<td>97.7% SVD Method</td>
</tr>
</tbody>
</table>

Number of Computations | Accuracy

Figure 4-22. Memorable conclusion slide for presentation that compares two computational methods: the exhaustive method and the singular value decomposition (SVD) method. The methods can be used to simulate the way we hear sound from a vibrating structure.
Critical Error 7
Not Accounting for Murphy’s Law

Today I start my experimental lectures. They are also lectures of anxiety because with the setting up of every experiment comes the feeling: Will it go according to plan? For the best preparations are by no means an absolute safeguard against nature’s perversity.

— Heinrich Hertz

The legend goes that a new physics professor at a Midwest school wanted to impress the undergraduates with his teaching. In his first semester, he requested to teach one of the large sections of freshman physics. Held in a huge lecture hall, each class period consisted of a lecture about a major topic and then a demonstration of a principle associated with that topic. For the class period that discussed motion in a plane, the new professor refused to use the six-foot air table that everyone else used. Instead, he had the technicians build him something twice as large. Likewise, for the class period on Newton’s laws, he refused to use the tabletop spring balance that everyone else used; he had the technicians build him something much larger.

When the time came for him to demonstrate the motion of a pendulum, he put aside the tabletop pendulum that everyone else used and called for a hook to be mounted in the lecture hall’s ceiling. Then he had tethered to the hook a medicine ball; one of those heavy leather balls that athletes in the 1950s tossed around for exercise. The medicine ball was fixed so that it could swing freely from one wall to the other. The day for the pendulum class came, and the new assistant professor
began by saying that he was to perform an experiment that would place himself in physical danger. Although he said that he could be seriously injured in the experiment, he claimed that he had not practiced it because he was so confident that the laws of physics would keep him safe.

So, after preliminary discussion about a pendulum’s trajectory, its period, and its minimum and maximum speeds, the new professor pulled the medicine ball to one wall of the room and climbed on top of a stepladder. With his back against the wall, the professor held the medicine ball to his chin and said that he was going to release the ball with zero velocity and that when it returned to this position, by the laws of physics, the velocity would again be zero. Well, this new professor’s goal had been to engage the students, and as he stood on top of that ladder with the huge ball against his chin, he certainly had them engaged. When the professor let the ball go, it swung through its arc attaining a maximum velocity at the low point of the arc and rising almost to touch the far wall. Then the ball started its return trajectory. Apparently, because the new professor had not practiced this demonstration, he was unprepared for the sight of the huge ball making its way back toward him. According to students in the room, although his eyes grew large, he refused to bail out. Instead, he braced himself, but in so doing, he must have leaned forward ever so slightly. What the new assistant professor ended up demonstrating was not so much the motion of a pendulum, but the conservation of momentum because the students saw that a large mass (the medicine ball) with little velocity struck a small mass (the new assistant professor’s head) and imparted to it a relatively fast velocity. The new assistant professor’s head snapped back and hit the wall, and he fell unconscious to the floor.
For a moment, no one in the class moved. Then a few students rushed down to the new professor's aid. Later, after the smelling salts arrived and the professor returned to consciousness, the class slowly wandered out.

This professor's demonstration followed the Law of Murphy, which was named for Edward A. Murphy, Jr., an engineer who worked on rocket-sled experiments for the US Air Force in 1949. Over the years, Murphy's Law has taken on many forms. With regard to presentations, the most fitting form is, "What can go wrong will go wrong, and at the worst possible time." Examples of Murphy's Law abound in presentations. One example occurred in a demonstration by Microsoft Corporation of its Office XP version of PowerPoint. The presentation occurred before technical professionals and government workers packed into the MCI Center in Washington, D.C. During the demonstration, the program crashed, locking up the computer.

Yet another instance of Murphy's Law reigning during a presentation occurred with an architectural firm that had bid on the design of a new baseball stadium in Milwaukee. The firm, which was based in Milwaukee, had a design similar to the sky dome in Toronto in which the roof could retract on sunny days and close on rainy days. In the presentation of the proposed design, the firm set out to demonstrate the roof's movement on its three-dimensional model of the stadium. This demonstration was planned for the culmination of the presentation and was accompanied by "The Star Spangled Banner." With the music playing loudly and the audience focused on the beautiful model of the stadium, the presenter flipped the switch for the roof to open. Nothing happened. "The Star Spangled Banner" continued to play, and the audience continued to keep its focus on the beautiful model, but the roof did not retract. The presenter tried everything
that he could, but the demonstration failed. As you might expect, in the stiff competition for the contract, this architectural firm did not win the bid.5

Not only does Murphy’s Law wreak havoc during demonstrations, but it also causes mischief while presenters use equipment for projecting overhead slides. Consider, for example, the review meeting in St. Louis in which an engineer began his thirty-minute presentation by placing a transparency on the overhead projector. Unknowingly, the presenter had left the onionskin paper, which was not transparent, on the transparency.6 Because the meeting was a review meeting and because everyone was competing for the same pot of funds, people in the audience were not inclined to help one another. For that reason, no one said anything to the presenter about the fact that nothing was projected onto the screen. The presenter did not help his own cause, because he stood beside the overhead, stared down at the sheet of paper, and never once looked behind him to see what was projected. Using a pointer, the presenter went line by line through a set of equations on the sheet. Nearing the bottom of the sheet, he said, “As you can see…. ” With that remark, chuckles sounded throughout the audience.

The presenter paused, looked up at the audience, chuckled himself, and then proceeded with the second sheet of his talk. Again, the presenter stared at the sheet and never looked behind at the screen. A few more times he said, “As you can see…,” and each time the remark elicited more laughter. So it went for about fifteen minutes. Each time he said, “As you can see,” the audience laughed, and each time he paused, looked up, laughed himself, and then proceeded. Finally, after a dozen sheets, he stopped and asked the audience, “Okay guys, what is so funny?” Someone yelled, “Take a look at the screen.” He turned around, and saw that the screen was projecting a big black shadow.
Had he spent so much as thirty seconds before the presentation trying out his slides on the overhead projector, he would have realized his error. Although the step seems so obvious, the number of presenters who botch the execution of this simple piece of equipment is astounding.

Consider as another example the engineering professor who made a presentation at a Ohio review meeting of industrial sponsors. When the engineering professor placed the first overhead slide onto the projector, the slide was backwards and upside down. This audience, which was more helpful than the previously mentioned St. Louis audience, kindly informed the professor about the error. The professor then picked up the transparency and turned it right side up, but it was still backwards. The audience chuckled. On the third try, the professor placed the slide correctly. With the next transparency, the professor made the exact same mistake, and again it took him two iterations to correctly place the slide. This time, the audience did not chuckle. Although it is difficult to believe, the professor made that same mistake on all twenty of his presentation slides. In the middle of this presentation, one of the sponsors turned to another and said, “I swear, if that idiot makes that same mistake again with the slides, I will make sure that his contract is not renewed.” Well, the professor continued making the same mistake, and the contract was not renewed.

Yet a third and final story (actually, I have many more) occurred at a briefing about a research funding opportunity. Using an overhead projector, but standing directly in its light, the funding agency’s new representative went over each slide, point by point. Because the lists on her transparencies contained a rehearsing of last year’s specifications and because the audience was tired and somewhat jaded, no one told her that the entire projection was displayed in an undecipherable image on the front of her red dress. This representative continued in
this manner for about fifteen minutes, when a latecomer to the briefing shouted out, “You are blocking the projector.” The representative apologized and then moved about 6 inches to the side. She finished her presentation while now blocking about three-fourths of the screen, which the uninterested audience continued to ignore.7

The purpose of relating all of these accounts of presentations being pulled down by failed demonstrations or mishandled equipment is not to dissuade you from incorporating demonstrations or projected slides. Rather, the purpose is to make you sensitive to the hurdles of their incorporation. Your decision as to whether to incorporate demonstrations or slides should account for three factors: (1) the complexity of the demonstration or the difficulty in handling the projection equipment; (2) the gain for the presentation should the demonstration succeed or the slides project; and (3) the loss for the presentation should the demonstration fail or the slides not project. If the demonstration is worth trying or if the slides are worth projecting, you should go forward. In that case, though, you should find ways to minimize the occurrence of Murphy’s Law.

Rehearsing

One of the best ways to minimize the occurrence of Murphy’s Law in your presentation is to rehearse. For each of his spectacular high-voltage demonstrations, Nikola Tesla reportedly rehearsed at least twenty times.8 By rehearsing, you learn the pitfalls that could startle you in the actual performance. For instance, had each of the three presenters who mishandled the overhead projector simply practiced for a couple of minutes, each presenter would have avoided the mistakes that pulled down the presentation. Likewise, if the Midwest professor had practiced with the medicine ball mounted on the pendulum,
he would have realized the problems inherent in that
demonstration (namely, his own fear of the ball) and re-
worked the experiment.

Rehearsing is certainly no guarantee of success. The
architectural firm that was competing for the contract for
the baseball stadium had practiced opening and closing
the roof several times before the big proposal presenta-
tion. Moreover, Microsoft had undoubtedly practiced the
demonstration of its XP software several times before its
presentation in the MCI Center. Nonetheless, while re-
hearsing does not guarantee success, it greatly increases
the odds.

For instance, during one rehearsal with my com-
puter projection system, which has a remote control to
change the visuals, I learned two important lessons. First,
if the laptop computer is moved during the presentation,
the antenna for the remote can become disengaged. Sec-
don, I learned that simply plugging the antenna back in
does not cure the problem — the slides continue to switch,
but do so at a painfully slow rate. To get the system to
work effectively again, I have to stop the slide show of
the presentation program and then remove a hidden com-
puter window that warns about the antenna having been
disconnected. Learning these two lessons has saved me
much grief and embarrassment in my presentations. I
am careful to make sure that the connection between the
laptop and antenna is secure, and on the one odd occa-
sion when someone moved my computer and inadvert-
ently disconnected the antenna, I efficiently took the steps
necessary to get the system back on track.

Arriving Early

Another important step to mitigate the effects of Murphy’s
Law is to arrive early to the presentation. When I taught
at the University of Wisconsin, I had to give a large lec-
ture each semester in an auditorium to about 150 upper-classmen. This room had a projection system that operated from a computer within the room, and each semester I would carry over two computer disks (I brought two in case one failed). For the first four semesters, everything worked well. Although I revised the slides each semester (I continually revise my presentations), all four presentations went smoothly.

For the presentation in the fifth semester, though, I was thrown for a loop. When I loaded my presentation onto the auditorium’s computer and opened the file, I was shocked to see that each letter of my presentation had been replaced by a little box. In other words, the typeface that I had used for this presentation (Arial Narrow) had been removed from the machine. The audience, which was already filtering in, did not know my dark secret, because this wonderful room was equipped such that you did not have to project what was on the computer into view until you wanted to. Because I had arrived ten minutes early, I had the opportunity to highlight all those slides and replace my typeface with one on the machine, Arial. Because Arial is significantly wider than Arial Narrow, I had to finagle some of the text boxes. Although that took a little time, I was ready to go when the bell rang and the audience expected me to deliver.

What saved me from embarrassment in that presentation was my early arrival to the lecture hall (granted, bringing my own laptop or bringing my own fonts on the disk would have circumvented the problem). By the way, in that same lecture hall, I have watched presenters irritate audiences because these presenters arrived just as the bell rang only to find that something unexpected had happened. In some cases, their typefaces had been removed from the computer as mine had been. In other cases, their computer disks did not work. In still other cases, their laptop computers did not have the right con-
Accounting for the Worst

Usually, a few days before a presentation, when I have my structure and projected slides set, I imagine what I would do if the worst were to occur. Often, I imagine this nightmare while I am taking my noontime run or walking my dogs. In imagining the worst, I am not psyching myself out by dwelling on failure; rather, I am trying to devise a plan should the equipment fail. Such thinking is good preparation.

For instance, in one presentation before seventy-five people at one of the national laboratories, I had requested a computer projection system. This presentation occurred when the technology for computer projectors was new. I was skeptical about the equipment working because I had never used such a piece of equipment at this laboratory. For that reason, I had designed the presentation such that I could give it from just my handouts. Sure enough, the unexpected happened: The computer technician went on vacation the day before I arrived to speak, and the backup person did not receive word about my request until five minutes before the presentation. For the seventy-five people crowded in the room, I began the presentation on time using the handouts. Fifteen minutes later, the computer was up and running, but those important minutes, as well as the patience of the audience, had not been lost.
Imagining potential problems is a good exercise, but imagining the worst is even better. I learned this lesson while conducting a six-hour workshop at a different national laboratory. The first problem that occurred was that some handouts I requested to be shipped to the presentation site in California came instead to my home in Virginia. This hurdle was not such a big problem because I could simply pack those handouts in a suitcase. However, because my suitcase was now too large for me to carry onto the plane, I had to check it through. The second problem was that the airline misplaced that bag, and it did not arrive in San Jose, California, with my flight. Because the presentation was the next day, I had to begin the presentation without the handouts. I also had to make the presentation in the clothes that I had worn on the plane; I had arrived late at night when all the clothing stores were closed. Making the presentation in the same clothes that I wore on the plane was not such a problem, because for the plane trip I had worn professional attire. Granted, the clothes did not feel fresh, but that was more my perception than the audience’s.

The second problem that I encountered for this presentation was that the on-site computer projection system had a burned-out bulb. I had never used a projector such as this one, which was in a big black box with a strange cable arrangement. Fortunately, as is my custom, I had arrived thirty minutes before the presentation and had time to change the bulb. Unfortunately, even with a changed bulb, the projector did not project my slides, because it was not receiving a signal from my computer. Apparently, this kind of projector required special software to work with my laptop computer. As luck would have it, the site had a second projector down the hall, this one of a different type. Unfortunately, someone had walked off with the cable that was to connect to my computer. For emergency situations such as this one, I had
brought a few transparencies so that I could begin my presentation. Because the time for the presentation had begun and the room was filled, I began my presentation with these transparencies as my host from the laboratory frantically searched for a cable. I spoke slowly because I had only one hour’s worth of transparencies for a six-hour workshop.

After fifty minutes, when I was down to only a couple of transparencies, my bad luck changed. My host found a third projector, this one with a cable and without the need for special software on my computer. So I was able to switch back to my computer. Moreover, during the lunch break, the airline reported that they had located my bag. With ten minutes to go in the workshop, the airline delivered the bag—just enough time for me to distribute the handouts to the participants before they left.

My assessment at the end of this workshop was that I had been lucky.

Disasters usually do not occur for just one reason but for a series of reasons. Consider a case much more serious than a failed presentation: the sinking of the Titanic and the loss of more than 1500 people. In the Titanic’s case, the reasons for the disaster were numerous: The captain had apparently wanted to set a speed record for the voyage; the sea was unusually calm, so that the lookouts could not see waves lapping against the iceberg; the lookouts had misplaced their binoculars and had to rely on their unaided eyes; the pilot did not hit the iceberg head on (which many believe would have allowed the Titanic to stay afloat for several hours), but hit it with a glancing blow that caused much more damage to the hull; the crew had not practiced filling or lowering the lifeboats; earlier in the evening, the wireless operators of the Titanic had chastised the wireless operator of the California, the nearest ship, for sending them a warning about the ice (the Titanic’s operators were busy sending messages to New...
York); the California’s wireless operator, rebuffed by the Titanic’s operators, went to bed early, less than an hour before the striking of the iceberg. Such a string of events could cause even the best prepared presentation to fail.

Although you might rehearse, arrive early, and anticipate the worst, you will probably encounter in your career at least one set of circumstances in which Murphy’s Law will reign. In such a situation, you should keep your cool and, as Michael Faraday did, keep control of the situation. Michael Faraday performed many experiments in his lectures and therefore took many risks. His skill at experimenting impressed even the best scientists of his day, including Joseph Henry. Still, Faraday’s experiments were not immune to Murphy’s Law. As Faraday’s biographer Geoffrey Canter commented, Faraday was in “apparent total command of himself and therefore of the proceedings. This is not to say that experiments did not sometimes fail to function as expected, but on such occasions he could turn the apparent failure to advantage and not lose control of the situation.”
Chapter 5

Delivery:
You, the Room,
and the Audience

[Feynman] absolutely riveted the attention of everyone in the room for the entire time he was there. His need to do that helps explain some of the racy stories he liked to tell about himself, but it also lies close to the core of what made him a great teacher. For Feynman, the lecture hall was a theater, and the lecturer a performer, responsible for providing drama and fireworks as well as facts and figures. This was true regardless of his audience, whether he was talking to undergraduates or graduate students, to his colleagues or the general public.¹

—David L. Goodstein

Delivery is your interaction with the audience and with the room. Voice, gestures, eye contact, stance, movement—all of these contribute to delivery. How you deliver your presentation affects how intently the audience listens to you and whether your audience even trusts you. According to Michael Faraday, “[Lectures] depend entirely for their value on the manner in which they are given. It is not the matter, not the subject, so much as the man.”² What Faraday meant here was not that the quality of the content was unimportant, but that no matter what the subject is, the audience will be engaged only if the speaker delivers that subject in an engaging way. For in-