

## *Advice to a Lecturer*

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A public lecture is a performance, and it is also an invitation to conversation. A lively conversation—especially when one person does most of the talking—requires that the speaker have something to say. A memorable performance requires assiduous preparation. I touch on a number of important elements: preparing the scene and eliminating barriers between you and the audience ... engaging your listeners with a narrative arc ... the uses of the minute particular ... tension and resolution, surprise and drama ... experiments and demonstrations, specimens and souvenirs ... showing yourself, and your passion.

SHARING THE NUMINOUS ADVENTURE OF DISCOVERY is one of the great rewards of a life in science. We nourish our intellectual lives by exchanging ideas and techniques, discoveries and insights, hopes and frustrations. As speakers or listeners, writers or readers, teachers or students, we play active roles, and for that reason every memorable talk or article or class is both performance and conversation.

In the English-speaking world, we can trace the origins of the modern public lecture to events established at the Royal Institution in London in 1800, leading to the Friday Evening Discourses formalized in 1825 and the celebrated Christmas Lectures (for a juvenile audience) inaugurated in the same year. Michael Faraday, pictured at right, founded both series. He reportedly gave 123 Friday Evening Discourses between 1826 and 1862 and 19 courses of Christmas Lectures between 1827 and 1861. Near the middle of the eighteenth century, the invention of the Leiden jar, which could store large electrical charges, had sparked a wave of demonstrations and electrical entertainments for large audiences and intimate salons alike.

Today, many institutions—universities, laboratories, libraries, and other cultural establishments—organize programs that bring science to a broad public and the public to individual scientists. How is a scientist to prepare to make the most of these opportunities not only to instruct and seek to inspire, but to learn from the audience?

Faraday, a masterly lecturer and demonstrator before both juvenile and adult auditors, compiled a charming and emphatic list of *dos* and *don'ts* for aspiring lecturers, including himself, that remains a classic worth our attention. In this essay, I offer my thoughts, drawn from decades of speaking and listening.



Detail of the £20 note, depicting Michael Faraday at the Royal Institution Christmas Lectures. In the foreground is a magnetoelectric spark apparatus. These notes circulated from 1991 to 2001. See Roger Withington. *The New £20 Note & Michael Faraday*. Bank of England, 1991. ISBN 1-85730-001-7.

The unheard history of the Friday Evening Discourses. URL <http://bit.ly/3l4VWSw>. Royal Institution, London.

History of the Christmas Lectures. URL <http://bit.ly/3H0Bj5P>. Royal Institution, London.

Michael Faraday. *Advice to a Lecturer*. Assembled by the Royal Institution, London, 1960. Available online at URL <http://bit.ly/3wJ74ad>. Natural Philosophy Collection, University of Aberdeen; Raymond J. Seeger. Michael Faraday and the art of lecturing. *Physics Today*, 21(8):30, August, 1968. DOI: 10.1063/1.3035100.

Do not be paralyzed by the legitimate concern that "...science stories never really end. They're all middle. It's a narrative nightmare." Brooke Gladstone and Josh Neufeld (Illustrator). *The Influencing Machine*. W. W. Norton, New York, 2011, 2021.

The constructions of the Dada artist Jean (Hans) Arp, including his *Constellation* series, provide a useful visual metaphor for the varieties of framing. Some are rectilinear and neatly contain all the objects. Others, still rectilinear, cut off some objects, indicating that they lie outside the frame, but not giving a full account of their shape or extent. Others display the objects that extend beyond the frame in full. Then there are the curvilinear frames such as *Relief concret D* (1960) URL <http://bit.ly/3jJEbrA>, which contain—but not entirely—a collection of curvy objects.

Peter Ho Davies. *The Art of Revision*. Graywolf Press, November 2021. ISBN 9781644450390. See page 135.

**START AT THE END.** At some point in preparing or presenting a lecture, you will inevitably ask yourself, "Why am I doing this?" That is reason enough for it to be the first question to ask, and to begin to answer. What will you promise your listeners? Where are you leading them? What is the culmination, the punch line, the end of your narrative arc? At the end of your allotted time, will the story be over, or will it be opening wider?

**WHO WILL BE YOUR AUDIENCE?** What are their backgrounds? What do they know? What do they want? They are likely to be diverse in their prior knowledge and experiences. Do what you can, with the aid of your hosts, to get to know them in advance. Try to put yourself in their place. Ask yourself what you hope to achieve for them, and what you would desire as an audience member. I like to imagine the goal that each audience member might go home feeling like a more interesting person than before.

**FRAME YOUR SUBJECT.** What do you plan to cover? What is left out as inessential? What related material might be of interest to your auditors? You define the number and contours of the topics within your frame, shaped according to your plan, and you control how much you evoke of the world beyond the frame. You are in control, but you are making a compact with your audience to deliver on what you promise.

You owe it to yourself and to your audience to make a plan, but whether you make a formal structured outline depends on how you work best. A sequence of visuals can provide prompts for a smooth presentation. If it will give you needed confidence to prepare a full script, to be presented (nearly) verbatim, do so. Just remember to stay spontaneous, lest you come off as an automaton. Some speakers I admire rehearse their lectures, with or without an audience of coaches. Prepare thoroughly enough in your own way so you don't have to fumble for words. It is not forbidden to have new thoughts while lecturing, provided you don't lose your thread.

Expect to revise. Writing a journal article or preparing a seminar, you generally know in advance what you want to say and how to present it. There will be—must be—revision, but it will mostly take the form of polishing and clarifying. Preparing a public lecture has more in common with research itself: you have to discover along the way what the story is. As Peter Ho Davies puts it, we revise to understand our intent, to understand our own stories.

**ASSIST YOUR SPONSORS.** The organizers of your event may be highly experienced and efficient, or they may be staging a public lecture for

the first time. It is in their interest, as well as yours, that the event be a success. *It's not all about you.* Your appearance can serve to raise the profile of science—or an area of science—and of the sponsoring institution, department, or research group. Ask how you can help to attract an audience, for example by doing brief interviews with local media.

**PREPARE THE SCENE.** The site of your lecture will nearly always be chosen for you. Lecture halls, auditoriums, amphitheaters come in many sizes and configurations. A surprising number appear to have been designed by people who have never given or attended a lecture!

Would any actor step on stage without scoping it out? Examine your performance space well before the lecture begins. Imagine the opportunities the space affords for engaging with your audience, and pay attention to the impediments. Are there fixed or portable blackboards or whiteboards? Will you use them?

Where will visuals be projected, and at what scale? Imagine yourself in the audience. Take time to walk around and to see your slides from various locations. At your position in the front of the room, how readily will you see the images? Will a monitor face you, sparing you from turning away from the audience? Will you point to the images with a hand, a stick, a laser pointer?

Where possible, *eliminate barriers* between you and the audience. Many venues will place you on a stage or raised platform (podium); while this separates you from your auditors, it also makes you visible. Do not hide behind a lectern, but approach your audience. Should you need access to notes, find a solution—a pocket, perhaps—that keeps you in full view. If you are using a laptop to provide visuals, use a presentation remote, instead of poking at a keyboard.

Many a lecture theater dedicated to introductory science courses is fronted by a formidable laboratory bench, equipped with faucets, sinks, gas regulators, power supplies, stopcocks, gas valves, and other fascinating devices. Unless you will be using that daunting fortification for demonstrations and experiments (compare the image of Faraday on the £20 note), place yourself on the audience side of the island.

Will you need a side table to hold props or demonstration equipment? Will you need a power source for equipment other than a laptop? If you wish to record your talk, understand how you will do that gracefully.

In all but the most intimate settings, a microphone is essential to the success of your lecture. Resist a fixed microphone, which would root you in place. A hand-held microphone reduces your freedom

Should circumstance ever place you in a Gothic pulpit, make the best of the situation and enjoy the view.

to move and gesture. A microphone that you wear will probably be tethered to a battery pack and transmitter. Plan your wardrobe so you don't have to carry the transmitter in your hand. A lavalier (clip-on) microphone, sometimes called a lapel mic, and a headworn microphone—a "Madonna mic"—are commonly available.

Do not be misled by the lapel-mic nomenclature. Unless you are wearing a symmetric pair of clip-ons, a microphone on one lapel will be vulnerable to your turning the other way. The ideal placement is on the centerline of your chest, about one hand-width below the collar, with the microphone facing up. A necktie is an ideal place to clip the mic. So is the placket of a shirt, the strip of fabric that carries the buttonholes. There is a complication: men's shirt buttons are on the right, women's on the left. Take care that a microphone clipped to your shirt is pointing up. If you wear a top other than a shirt or blouse, find a solution in which the microphone is properly placed and will not be rubbed by fabric when you move. The backstage team will know how to help.

Plan to shut down your cell phone before the lecture to avoid interference with the wireless microphone and prevent interruptions. Once you have turned it off, there is no reason to carry it with you.

Test all the devices you will use—microphone, remote, pointer. If it will be necessary to adjust the lighting before or during your lecture, work it out in advance with the staff. Whether professionals or student volunteers, the people who work backstage will appreciate being treated as your partners. They will often understand the peculiarities of a setting that you are seeing for the first time.

If you plan for audience participation, how will you bring the volunteer(s) into the picture?

The reason to deal with these considerations in advance is to free your mind to be fully present in the performance, without having to stress over what might go wrong.

**DRESSING THE STAGE.** I've been lucky to have the complicity and enthusiastic assistance of indulgent and imaginative colleagues for lectures at Fermilab. Memorable examples include displaying most of the more than 1400 Ph.D. theses based on Tevatron experiments on the steps leading to the stage in Ramsey Auditorium; placing chairs and an oriental carpet on the stage to signify that we are not in a classroom; distributing artifacts and instruments around the stage for me to show and explain, and for audience members to examine after the performance. Staging is easier to accomplish when you are working with the home team, but think about the possibilities anywhere.

WRITE BEFORE THEIR EYES? The blackboard (or whiteboard or flipchart) has two attributes that can be turned to your advantage: immediacy and persistence. What you write or draw is revealed at a human pace, and it remains visible after you have moved on. If you choose to take advantage of an analogue method, be sure that the writing surface will be visible to your audience, and that the needed tools—chalk (perhaps in colors), markers, erasers—are present and operational. Take care that your creation is legible and at an appropriate scale. The larger the room, the less practical it is for the lecturer to draw or write on a physical surface, except for a very simple drawing, a name or symbol, or a terse equation. [Writing on a tablet computer connected to a projector achieves immediacy, but not necessarily persistence. I haven't yet seen this done with any degree of elegance, but I am sure that masters of the art will soon arrive.]

THE HAZARDS OF AN INTRODUCTION. Nearly all public lectures will be introduced by a representative of the sponsoring organization. The tasks of the presiding officer are to call the gathering to order, to review public-safety and other protocols, to acknowledge the generous support of patrons, to announce future events, and finally to present and welcome the featured speaker. Many presidors are experienced, well-organized, and attuned to the value of brevity. Others, perhaps out of misplaced respect or affection, may feel compelled to rehearse your entire *curriculum vitae* at a level of detail that would cause your grandparents to blush. A mercifully small number will feel obliged to present a digest of what they imagine your talk will contain. You should take the precaution of encouraging a *brief* introduction, but once the droning begins you are practically defenseless. Be aware that the audience's clock is ticking from the call to order, so you may need to trim your presentation to avoid wearing out your welcome or sacrificing Questions and Answers. Keep your composure, and resolve to behave better when *you* make an introduction.

PRESENTING YOURSELF. Dress appropriately. Be yourself. Speak clearly and naturally. Convey your appreciation for the audience by your manner. Find a few individuals with whom you can make eye contact. Their reactions will tell you how the lecture is going and what adjustments you might need to make. The listeners' side of the conversation may be expressed by rapt attention, curiosity, delight, puzzlement, even boredom or narcolepsy! Read the room and respond by elaborating or truncating what you planned to say. By moving about, you remind the audience that you are alive. Appear relaxed yet engaged. Strive to be interesting, enthusiastic, and glad to be there. Pacing like a person possessed is not a good look!

A fine example of episodic / occasional blackboard use is given by Richard P. Feynman. Feynman's Messenger Lectures, 1964. Six lectures presented at Cornell University, URL <https://bit.ly/415baHv>.

Two screens driven from two sources may accomplish persistence, but this requires a lot of preparation, dexterity, and sang-froid.

For technical lectures or classroom teaching, the measured pace of blackboard writing can be highly advantageous. See Patrick Henry Winston. *How to speak*, January 2018. URL <https://youtu.be/Unzc731iCUY>. MIT Lecture; Patrick Henry Winston. *Make It Clear*. MIT Press, Cambridge, Mass., 2020. ISBN 9780262539388.

A celebrated example of an extended introduction is George Bernard Shaw. Oration at the Savoy Hotel fund-raising dinner (1930). In *Albert Einstein: Historic Recordings 1930–1947*. British Library, 2005. ISBN 0-7123-0521-1. Compact Disc, Track 2. Bernard Shaw's ebullience is on display in a video clip posted by the Nobel Foundation, URL <https://bit.ly/3Het1lb>. For a transcript, see URL <https://bit.ly/GBSAE1930>.

It is technically possible, with a wireless microphone and a presentation remote, to move about the audience, either for your presentation or for the discussion. Have a clear reason to attempt this, and be on guard for audio feedback.

Nathan Heller. What We Get Wrong about Joan Didion. *The New Yorker*, 2021. URL <https://bit.ly/3Kj71tu>. February 1 print issue

WHO ARE YOU? Unless you are one of The Immortals, there is a high probability that many audience members will not know what you do, what your background is, and even what your name is. Your name and affiliation will accompany your lecture title on a poster, but you will serve the audience by showing yourself and your perspective. The peerless essayist Joan Didion put it this way: “You had to let readers know who you were and where your camera stood.”

THE GOAL IS TO COMMUNICATE, NOT TO BEDAZZLE! Choose a style that is comfortable for you and appropriate to the setting and the composition of your audience. Rewarding lectures may range from spare in concepts to information-rich. The first will feature a few ideas, simply explained, leaving the audience with easy-to-summarize information. The advantage of this approach is that some (many?) in the audience will emerge saying, “I understood everything!” Others may complain, “The speaker didn’t say anything!” In the denser format, reactions may range from “I learned a lot!” to “It was all a blur, I couldn’t follow!” Your task, once you have chosen what you want to convey, is to carry off your plan in a way that is maximally rewarding for the greatest fraction of your auditors. Whether you present a few concepts or many, don’t neglect the virtues of a few bold-face headlines enriched by engaging detail.

Whatever path you choose, it is good discipline to ask, “How little can I say?” and “What can I leave out?”

HOW TO BEGIN? Give your listeners something to care about, to whet their curiosity, and to engage them in the spirit of conversation. You might begin with a provocative question. (If it concerns something unfamiliar, you may have to explain why it is a question, or an interesting question.) Or you might open with a dramatic assertion, an announcement, a challenge, even a confession. Never underestimate the power of a simple declarative statement. Evoking an authentic personal connection to the place or subject or local heroes can help you to build solidarity with the audience. To my taste, showing an outline clashes with the ideal of a conversation.

When do you intend the audience to apprehend the big picture? Does the reveal come at the beginning, the end, or build throughout the talk? Conceive your opening to serve this intention, and make good on the compact you form with your auditors.

A valuable device in narrative prose, both fiction and nonfiction, is to dive into the middle of the action—*in medias res*—conveying a sense of excitement and urgency. The development can fill in how the characters arrived at that point, how the action proceeds, arriving at the dénouement in which various threads are brought together. Will

your story end neatly, or will it open toward a new adventure?

A powerful technique, much used in fine nature writing, is to begin from a striking observation or puzzle, then zoom out to a broader perspective that entails a new framework for understanding, and finally to see another specific observation through new eyes. This particular–general–particular sequence adapts to many science stories, and may help your listeners to feel that they have gained a new way to see and understand. The similar sonata form—theme–development–restated theme—is especially suited to prosecuting an argument.

**THINK LIKE A STORYTELLER.** Once you have chosen an opening and a scaffolding, tell stories. People like good stories, and they love to retell them. Many memorable stories feature memorable characters. We are schooled to write technical reports drained of personality. Rise above that training! Introduce your listeners to some interesting real people. One of your characters might even be yourself, as long as you steer clear of exaggerated self-promotion. If you can induce your audience to think, “I’d like to know more about that character,” you will engage their interest in a way that even the most amazing bare facts cannot.

Good storytelling involves surprise and drama, tension and resolution. Do not merely rehearse a sequence of events, but try to convey what it was like to be in the middle of the action, whether you were a protagonist, an observer, or a reporter after the fact. Show yourself. Show your passion.

**NEVER TELL A LIE!** Do not tell your audience anything they would have to unlearn. Simplify as appropriate, but do nothing that would lose their trust, either in the moment or in the future.

**VISUALS / IMAGES / SLIDES.** The objective of visuals, whether images or text, is to convey information. Do not waste precious pixels on logos or elaborate watermarks on every page. Acknowledge institutional affiliations and sources of financial support on your title slide or credits page, as appropriate. On succeeding pages, purge any element that smacks of corporate branding or distracts from the essential information.

It can be very effective to show images only, with no words at all. You can provide necessary words as you speak. Use high-resolution images that fill as much of the screen as possible. (Today’s standard format is 16:9 at full resolution.) If an image doesn’t fill the whole screen, place it on a dark background so the important content doesn’t have to compete with a dazzling white halo.

A good starting point is Alla Katsnelson. Colour me better: fixing figures for colour blindness. *Nature*, 598:224–225, 2021. DOI: 10.1038/d41586-021-02696-z.

Alexander von Humboldt. *Political essay on the kingdom of New Spain*, volume I. T. Davison, London, 1811. translated from the original French by John Black; URL <https://bit.ly/41Ihvce>, “Geographical Introduction,” p. ccciii.

Robert Bringhurst. *The Elements of Typography*. Hartley & Marks, 3.1 edition, 2005. ISBN 0-88179-205-5.

Set yourself the challenge of composing a presentation without any text. (You can add back what you determine is absolutely essential.) I predict that you will feel liberated to not have to parrot or paraphrase what is written on the slides.

It is essential to edit and revise images—especially graphs—as meticulously as you do words. Remove information that distracts from what you want to convey. Don’t simply recycle plots from research articles. *Never have to say, “Ignore that.”* While you are at it, take care to adjust colors and textures to make your figures as broadly accessible as you can. Do not display an image quilt of thumbnails merely to show that you have done a lot of work. Pick the most telling image, display it in large format, and discuss it. If you don’t plan to discuss it, leave it out!

Not everyone in your audience will be an everyday user of graphs or columns of numbers. Be selective in what you display; explain carefully what you see (and what you want your listeners to see), without condescension. What you show should “[s]peak to the senses without fatiguing the mind.”

When you employ text, take care that the typography is legible and respectful of the content. It should not call undue attention to itself. Depending on the illumination in a room, it may be beneficial to display white (or light) text on a dark background. If that is your choice, and you want to make a PDF file for distribution, consider making a print-friendly version with a white background.

Always test an audio or video clip under realistic conditions before the performance. It would be humiliating—not merely deflating—to discover while in full rhetorical flight that your magnificent dramatic high-point can’t be seen or heard. If you discover the problem in advance, you can try to devise a seamless workaround.

SPECIMENS, ARTIFACTS, PROPS. From intimate school visits to lectures in large event venues, the people you meet will see you as a visitor from an unfamiliar realm—a returning explorer. Intrepid travelers of the great age of discovery brought home not only their tales of adventure, but also exotic plants, animals, and field notes, which gave immediacy and credibility to their reports. You can do the same.

Share the instruments we use to interrogate nature and documentary evidence of important observations, as well as the conclusions that will find their way into textbooks. Real objects (or authentic representations of real objects) that you can introduce to your audience will make your voyage—metaphorical though it may be—concrete and fascinating. To see, inspect, even to touch authentic devices can be thrilling.



**HANDOUTS.** Master of data visualization Edward Tufte advocates delivering a high-resolution paper document into the hands of your audience members. A handout should be clear, rich in content, and thoughtfully composed. It can elicit the audience's curiosity, serve as a prop for interaction during the lecture, and be a meaningful souvenir to be taken home and shared with others. With access to a laser printer, it is straightforward to produce an appealing handout in standard stationery size (US Letter, 8-1/2 x 11 inches, or A4, 210 x 297 mm). At double size (US Tabloid, 11 x 17 inches, or A3, 297 x 420 mm), you may create a memorable artifact. These may be distributed to people entering the room or left on the seats. Every audience member should receive one.

**CHANGING PACE: ENTERTAINMENT AND COMIC RELIEF.** It can be challenging for an audience to sustain focus without occasional relief. Shakespeare regularly broke the emotional tension of intense drama with humorous characters and witty repartee—comic relief. Faraday himself observed that "... the generality of mankind cannot accompany us one short hour unless the path is strewn with flowers." Take the first stifled cough or two that you hear as an alarm to bring your audience back.

In the early days of lectures at the Royal Institution, entertainment was a central element of a fashionable scientific evening. A famous etching satirizes a demonstration by Thomas Young and Humphry Davy of the effects of laughing gas on a courageous human subject.



That dose of daffiness incorporated the main point of the lecture. Your task is to introduce moments of relaxation or levity without losing the thread of your presentation. You want the audience to refresh and reset, but not to check out.

Edward R. Tufte. *Envisioning Information*. Graphics Press, Cheshire, Connecticut, 1990. ISBN 0-9613921-1-8; *Visual Explanations*. Graphics Press, Cheshire, Connecticut, 1997. ISBN 0-9613921-2-6; *The Visual Display of Quantitative Information*. Graphics Press, Cheshire, Connecticut, 2001. ISBN 0-9613921-4-2; *Beautiful Evidence*. Graphics Press, Cheshire, Connecticut, 2006. ISBN 0-9613921-7-7; *Seeing with Fresh Eyes: Meaning, Space, Data, Truth*. Graphics Press, Cheshire, Connecticut, 2020. ISBN 978-1930824003.

Michael Faraday. Letter to Ben Abbott, June 13, 1813. Quoted in N. Forbes and B. Mahon, *Faraday, Maxwell, and the Electromagnetic Field*, Prometheus Books, Amherst, NY, 2014. ISBN 9781616149420, p. 38.

The twentieth-century English actor Ralph Richardson characterized his profession as "merely the art of keeping a large group of people from coughing." (Widely attributed)

James Gillray, "Scientific researches! New discoveries in pneumaticks!, or, An experimental lecture on the powers of air," London, 1802. URL <http://bit.ly/3ltadZi>.

Experiments and demonstrations can be both entertaining and instructive. Because you may need to advance toward the audience or adjust the lighting dramatically, you can give listeners the accurate impression that you are letting them in on an important idea. Be sure that whatever you exhibit is enlightening, not mystifying. Your chosen apparatus may range from real scientific devices to toys or household items that can be used as analogues of the instruments we use in the laboratory. Make sure that the spectacle will succeed. A misfire or two is acceptable, and may even build suspense or amusement, but *your experiment must not fail*. University demonstrators have a wealth of experience and wisdom. You will win extra points if your listeners can repeat a demonstration at home.

**TIME: MEET YOUR AUDIENCE'S EXPECTATIONS.** It never ceases to astonish me that many physicists, most of whom know how to count, show up for a twenty-minute conference talk prepared to motor through an hour's worth of slides. You owe your public better preparation, lest you find them checking their timepieces. Keep track of time; if you find yourself running late, adapt gracefully. If you keep your composure, only you will know what you have edited out. Do not shortchange the conclusion you have thoughtfully prepared for your talk by truncating abruptly.

**YOUR LAST WORDS.** This is your chance to plant a conclusion in your auditors' minds, to remind them what they have heard, and express why you have been inspired by the opportunity to tell them. As a backdrop, show a compelling (memorable!) image from your presentation. Avoid weak formulas, such as "I hope that I have convinced you . . ." Instead summarize your main points and leave them feeling that they have learned something important—and had a good time. Turn to your advantage the truism that science stories never end by reiterating what should come next. Do not succumb to the temptation to close with the memorable words of An Authority, unless you have used a quotation earlier and can now show it in a new light. Better far to close with memorable words of your own! Here is an opportune moment to roll the credits, before returning to the preceding memorable image for the Q&A.

**CHERISH THE QUESTIONS AND ANSWERS.** A lively post-lecture discussion brings the element of conversation to the fore. *You* may learn something—a novel impression of your subject, something you said that left an inaccurate impression, what is on the mind of audience members. Unless auditors have access to a microphone, summarize the question. Should a question be ill-posed, do your best to turn

it into a brilliant question and give the best answer you can. Be responsive, but don't filibuster! Remember that it takes some courage to pose a question or make a comment before a group of strangers. Always answer respectfully. Take care to recognize a broad demographic. If your host can only see one kind of questioner, intervene and choose the questioners yourself. A question after the presentation may be the first time a person has ever spoken with a scientist. If you have the chance to take a young person seriously, you will make the world a better place and perhaps change a life. Some shy people will approach you one-on-one at a reception following the performance. Make time for them; don't hide among your professional colleagues.

**TOOLS.** Most lecturers today prepare their "slides" to be presented from a computer by a laser projector or a large monitor. A few lecturers with an artistic bent prefer to compose their slides on paper and scan them into a convenient digital format for presentation, but a large majority choose to prepare the slides using computer software. Whatever method you choose, the images you show should be high in resolution and reveal that they were prepared with care. My own tools of choice, depending on the material to be presented, are Apple Keynote and L<sup>A</sup>T<sub>E</sub>X Beamer, both of which create high-resolution images in the PDF standard. Having a PDF version is essential insurance if you are constrained to use a computer other than your own for the presentation. Avoid pixelated images and minimize the use of transitions and other potentially distracting bells and whistles.

Apple Computer. Keynote presentation software. URL <https://bit.ly/3IckwZx>; Till Tantau, Joseph Wright, and Vedran Miletic. BEAMER – A L<sup>A</sup>T<sub>E</sub>X class for producing presentations and slides, 2022. URL <https://bit.ly/3EexGnB>; Portable document format. URL <https://bit.ly/3KlvRci>.

**SINS.** Racing through too many slides, stuffing too many words onto slides, turning your back on the audience, rambling on interminably, lacking energy and enthusiasm. Lapsing into the passive voice and draining all personality from your story.

**MORTAL SINS.** I stand with Faraday: Reading your whole lecture—as opposed to an excerpt from an essential document or a pithy quotation—off the slides does not make for spellbinding oratory. Extra demerits for using a laser pointer as a bouncing ball to indicate every blessed word in turn, as in a pre-karaoke singalong.

The most unforgivable sin is disrespecting your audience. Never let this happen!

From Faraday's *Advice to a Lecturer*—  
 "... although I allow a lecturer to write out his matter, I do not approve of his reading it – at least, not as he would a quotation or extract. He should deliver it in a ready and free manner, referring to his book merely as he would to copious notes, and not confining his tongue to the path there delineated but digress as the circumstances may demand or localities allow."

**LECTURING IN THE TIME OF PANDEMIC . . . AND BEYOND.** The COVID-19 plague severely constrained travel and personal contact. We were fortunate, for both our personal and professional lives, that the lockdown arrived just as robust tools for virtual meetings were

becoming broadly available and highly functional. It is now routine to organize lectures for audiences in widely separated time zones, or even distributed around the globe.

The benefits of virtual lectures are clear: reducing the cost, time-burden, and carbon footprint of travel; broadening the pool of potential lecturers; and building a transnational community. On the other hand, meeting people on-screen is a denatured imitation of meeting them face to face. The peripheral activities that attend a lecture visit are compromised or lost entirely. Virtual lectures will surely persist as one component of intellectual life as the world approaches the status quo ante-COVID, so we must learn to make them as rewarding as we can.

For the lecturer, the greatest deficiency is the absence of audience feedback. Participants are necessarily muted throughout the presentation, and it is a real challenge to pick up any visual cues from audience members.

Many participants will watch your presentation on laptop screens. That fact heightens the importance of using pixels efficiently in the visuals, which begins with choosing a 16:9 format over 4:3. It is possible for a lecturer to write or draw in real time, but it is not as easy as stepping up to a blackboard or flipchart. If you are going to do this, you need to acquire the right equipment and perfect your technique before you go online with an expectant audience.

zoom virtual meetings. URL <https://zoom.us>.

Most of my remote experience is on the zoom platform, which has become a highly reliable and flexible tool. It is prudent to exercise your presentation in advance, in case the organizer's software version is different from yours or has some local quirk. (This advice applies whether you are speaker or organizer!) In current versions of zoom, it is possible to emulate the look of an in-person lecture, with the speaker in the foreground (at adjustable size and position) by using the "Slides as Virtual Background" option for Keynote or PowerPoint visuals. Test in advance!

ADDRESSING AN AUDIENCE WHOSE PRIMARY LANGUAGE IS DIFFERENT FROM YOURS. The organizers should announce the language in which you will present your discourse. If you can give a fluent presentation in the local language, kudos! Bear in mind that, unless you do so regularly, the pace at which you speak is likely to be slower than in your native tongue, so you should prune your presentation accordingly. Translating the words on your visuals to the local language is a nice touch.

Many audiences around the world are comfortable in English, but your accent or cadence or scientific vocabulary may be unfamiliar. Again, presenting the words on your slides in the local language

will reinforce what you are aiming to communicate. If you are not confident in the local language, enlist the aid of a colleague who is a native speaker.

In some situations, you may be speaking in your native tongue (or, more generally in today's world, in English) while some or all of the audience is hearing a simultaneous translation. You can help by providing the translator with a list of technical or unfamiliar terms, ideally in the intended order of their appearance, and by translating any text on your slides into the local idiom. An experienced translator may ask you to pronounce unfamiliar words.

In all of these cases, it is a courtesy to present your handouts in the local language. This enables your auditors to share more readily with their friends and family.

Questions will usually be posed in the local language and translated for you, with your responses translated simultaneously for the audience. Assess how much overhead is involved as you decide how extensive your answers should be.

**CAPTIONING AND INTERPRETATION.** Try to discover in advance whether your presentation will be supplemented by captions superposed on your visuals, or by sign-language interpretation. You will do everyone a favor by providing a list of technical or unfamiliar terms, ideally in the order of their appearance, to the persons enhancing your performance, just as you would do for foreign-language interpreters. It is helpful to know where the captioner or signer will be positioned, should you need to interact. Real-time captioning is an imperfect but evolving art. You can make it less likely that a caption will interfere with your graphics by avoiding slides dense with text.

**FIND YOUR OWN WAY.** You can learn a lot by observing lecturers at work, whether or not they are speaking about science. But you are not bound by formulas, or even by well-intentioned advice; you will have to find your own style, your own rhythm. Courage!

Our fellow citizens have a remarkable faith in the value of exploration. It is a treat for them to meet an explorer. Be that person. Enhance that faith.