CHAPTER

8

Communicating with Public Audiences

8.1 WHY DO SCIENTISTS COMMUNICATE WITH PUBLIC AUDIENCES?

In Chapter 1 we noted that scientific disciplines are not only communities in themselves but also parts of the larger society in which these communities are situated and in which scientists work and live. This relationship between scientists and society is of great interest to the National Academy of Sciences and other national research associations, who together convened the Committee on Assessing Integrity in Research Environments (CAIRE). In a report issued in 2002, CAIRE et al. state:

The pursuit and dissemination of knowledge enjoy a place of distinction in American culture, and the public expects to reap considerable benefit from the creative and innovative contributions of scientists. As science becomes increasingly intertwined with major social, philosophical, economic, and political issues, scientists become more accountable to the larger society of which they are a part. (p 33)

In previous chapters we have explored genres and conventions that professional scientists use to communicate with each other. In this chapter we will explore conventions used to communicate knowledge of science and scientific research to public audiences in the larger society.

The term *public audience* is a rather loose one and is meant here to imply a wide range of listeners and readers with a variety of interests, needs, and educational backgrounds. It may be a group or a professional person (even with a PhD in another field) in need of information about a particular scientific topic, or a general reader or listener simply curious about science. Public audiences for science thus can include, but are not limited to, those who regularly use the results of scientific research in the course of their daily work (such as agricultural producers, fish and game managers, medical professionals); administrators, local government agencies, and other public officials who need scientific information to make decisions about issues such as waste management, industrial and environmental regulations, and road construction; clubs, classes, and other educational or special-interest groups that want to learn about science; private citizens who use natural resources for hiking, hunting, fishing, and other recreational purposes; and members of the public at large, who have a vested interest in science insofar as they support it financially through government funding and must live with its consequences.

Thus, public audiences are not monolithic, but rather quite diverse, and so no single, "rationalistic" formula will suffice to define them or their interests (see Locke 2001). In addition to addressing more general audiences *within* the scientific community (e.g., readers of journals such as *Science* and *Nature*, or the mixed audience of the research proposal), scientists may wish to write articles for the much broader audiences that read science-oriented journals such as *Scientific American* and *Discover*, general-interest publications such as *Time* and *Newsweek*, or the feature section of a newspaper. They also may be called on to make presentations to public audiences, participate in question-and-answer sessions, take part in public policy debates affected by developments in their research areas, and give press releases and radio, television, or online presentations and interviews on important discoveries or issues in their field.

There are three major reasons scientists communicate with the general public: moral, economic, and political. The National Academy of Sciences asserts that scientists have an ethical responsibility to understand and explain the effect of the work that they do on the society in which they live:

The occurrence and consequences of discoveries in basic research are virtually impossible to foresee. Nevertheless, the scientific community must recognize the potential for such discoveries and be prepared to address the questions that they raise. If scientists do find that their discoveries have implications for some important aspect of public affairs, they have a responsibility to call attention to the public issues involved. (NAS 1995, p 20)

Genetic research—including genetically modified foods (GMFs), pharmacogenomics, stem cell research, cloning—are obvious cases in which scientific discoveries are morally controversial or have complicated, long-term implications for society. Other controversial areas of research include global climate change, nuclear power, environmental protection and wildlife preservation, the use of laboratory animals in medical research, the prescribing of psychiatric drugs, the unnecessary overuse of medical technology diagnosis and treatment (see Berenson 2008) and in artificially prolonging life, and biological studies of race and gender.

A second reason scientists communicate with the general public is economic and hinges on the practical question: Who funds science? In addition to private labs, corporations, and universities, it is the government, and therefore the public, that funds science through tax dollars and so indirectly chooses which projects to support. Public financial support of science takes two forms: the funding of governmental agencies that conduct scientific research and the funding of government grant programs that support research by scientists at other institutions. The federal government's proposed budget for 2008 included $6.065 billion for NSF (Mould and Cabbage 2008g), $17.6 billion for NASA (2008e), $95 billion for the USDA (2008), and approximately $28 billion for NIH (2008), with a request of $29.5 billion for year 2009. Increases in some areas of scientific research and education were undoubtedly spurred by the terrorist attack on the United States on September 11, 2001, notably research on biochemical and biological agents. But other government-run programs have either been scaled back because of budget cuts (e.g., NASA's Mars expeditions) or eliminated altogether (the Superconducting Super Collider). "Big science" projects in which the federal government plays a major role (such as the Hubble Telescope, the International Space Station, and the Human Genome Project) require costly equipment and the coordination of efforts of scientists around the world and can be prohibitively expensive. In times of renewed budget deficits and economic belt tightening, scientists must be able to convince not only their peers but also the public and its official representatives in government of the worthiness of scientific projects. Responsibility for garnering public understanding of, enthusiasm for, and goodwill toward science ultimately rests with scientists.

The third reason scientists should learn to communicate with the general public is related to the politics of a democracy. A democratic society requires that its citizens (both electorate and elected) be informed about the issues that confront it. Since science is a major cultural force in our democracy, many of the policy decisions we make are about or based on science. As the National Academy of Sciences states:

[S]cience and technology have become such integral parts of society that scientists can no longer isolate themselves from societal concerns. Nearly half of the bills that come before Congress have a significant scientific or technological component. Scientists are increasingly called upon to contribute to public policy and to the public understanding of science. They play an important role in educating nonscientists about the content and processes of science. (NAS 1995, p 21)

Thus, a democracy such as ours needs a scientifically informed citizenry to arrive at good decisions about what research to support and how to interpret and apply its results (see O'Keefe 2001). In a 1996 survey of the American public, the National Science Foundation found only 25 percent performed well on a basic test in science and economics (Associated Press 1996). That same survey, however, found that 72 percent of the participants considered scientific research valuable. A later study by NSF found that "[M]ost Americans have a positive attitude about science and technology" (CAIRE et al. 2002, p 16), but also argues that scientists themselves have an important role to play in maintaining that positive relationship with the public. Citing a 2005 article by Michael Specter in the *New Yorker*, Donald Samson writes that the United States lags behind other countries in students' and the public's understanding of science. According to Specter, the high school seniors in the United States "'performed below the average of twenty-one countries on a test of general knowledge of mathematics and science—and in advanced courses, the U.S. was close the bottom (p 68)'" (Samson 2006, p 5). Significantly, Samson's article is not (only) an argument for increased education in science and math, but also an analysis of the role of ineffective and even damaging communication of science to students and to the public, and the need for improved reading and writing skills in scientific education. It is also an argument for the need to make science not only accessible and comprehensible to students and public, but more interesting and appealing to them as well. (Farmelo [2000] had made a similar argument but added that scientists also need to battle bungled science that gives scientists bad press.)

Scientists can help citizens understand and continue to appreciate science by becoming aware of the various media and genres through which the public gets its information and by learning to use the technologies of those media and the conventions of those genres to effectively communicate with the public. In 1990, John Wilkes, director of the Science Communication Program at the University of California–Santa Cruz, noted that "U.S. citizens get up to 90% of their information about science from newspapers, magazines, and, to a lesser extent, television. As producers of scientific knowledge, scientists are in the best position to use the media to teach the public what it wants—and needs—to know about developments in medicine, science, and technology" (1990 p 15). In 2006, Samson, a science communication expert, argued that despite the increasing prominence and importance of science via television and the Internet, most Americans still get the bulk of their news from print sources. Samson suggests that while television broadcasts by their very (technological?) nature tend to be superficial, and the credibility of Internet posts is always an issue, general public science journals like *Popular Science* and specialty public science journals like *Scientific American* can cater to specific sets of interests, explore issues in much more depth, and are more reliable. In addition, Samson (2006) states that: "We tend to associate science coverage with the specialty magazines, but far more readers get information about science from daily newspapers and more general weekly and monthly magazines," publications with enormous circulations (p 7).

While most scientists are not professionally trained in speaking or writing to general audiences, many scientists have recognized that the general public is an important audience to reach. As Bazerman demonstrates in *The Languages of Edison's Light* (1999), Thomas Edison was a master of public relations; it would not be far-fetched to say that the adoption of electric power and light was the result of his ability to employ various media (including the light bulb itself in spectacular displays of electric power) to persuasively communicate with a diversity of audiences: investors, businessmen, the U.S. Patent Office, international governments, the press, and the public.[1] Books and articles by such famous scientists as physicist Stephen Hawking, paleontologist Stephen Jay Gould, marine biologist Rachel Carson, research physician Lewis Thomas, and anthropologist Richard Leakey—just to name a few—as well as the current popularity of television programs about science (*National Geographic Explorer, Nature*, and *NOVA*), represent more traditional but effective means for scientists to reach outside their profession to wider audiences.

But earlier studies of the impact of technologies on audiences also suggest that technologies do change "the range of experiences and skills that audiences bring to media" (Nightingale 1986, p 31). Given Edison's achievement, it is perhaps also fitting that the explosion of communication technologies should make communicating with the public easy and more urgent. Popular websites like PubMed Central (www.pubmedcentral.nih.gov), "aims to fill the role of a world class library in the digital age" (PubMed Central 2008). The non- profit Public Library of Science (PLoS) (http://www.publiclibraryofscience.org/), or *SEED Magazine* (http://seedmagazine.com/) allow readers to view, listen to, read, research, and respond to science by blog. YouTube broadcasts and/or iTune podcasts of webcam, video, or 3D animation feature how-to astronomy demonstrations or physical explorations of space specifically designed by amateurs, companies, or agency-scientists themselves. These new forms of communication make use of newer low-cost as well as high-end technologies to appeal to younger viewers and shape the public's understanding and perception of science (see Shida and Gater 2007).

But the availability of powerful communication technology does not in itself guarantee successful communication. In Chapters 3 we explored how new communication technologies, as a potentially democratizing force, have both provided the means but also increased the need for scientists to communicate with the public. We also explored how it is a commonplace that because of the open, rapid, and anonymous sources of the public communication of science online, and the frequent lack of quality control mechanisms, not all the information found on the web is reliable. Given this technology, both the general reader *and the scientist* have the added responsibility to communicate directly and effectively with the public in a variety of media (see Shida and Gater 2007).

[1] Lievrouw (1990) studied the Pons and Fleischmann debate as a modern-day example of the way "scientists strategically use popular media to make knowledge accessible to the public at large and to make themselves known" (p 1).

One solution to the inconsistency of online communication, then, may be the direct interaction of scientists with the public online. The interactive capabilities of the World Wide Web make the Internet a potential meeting place where scientists can interact not only with each other but also with other publics. In fact, the online journal *Issues in Science and Technology Online* (2007), "a forum for discussion of public policy related to science, engineering, and medicine" envisions itself as a public meeting place, focusing on social policy as well as policies designed to enhance specific research fields—and not only the communication of social policy, but also the interactive discussion of it. The journal's editors state their mission on their homepage:

Although *Issues* is published by the scientific and technical communities, it is not just a platform for these communities to present their views to Congress and the public. Rather, it is a place where researchers, government officials, business leaders, and others with a stake in public policy can share ideas and offer specific suggestions. Unlike a popular magazine, in which journalists report on the work of experts, or a professional journal, in which experts communicate with colleagues, *Issues* offers authorities an opportunity to share their insights directly with a broad audience.
And the expertise of the boardroom, the statehouse, and the federal agency is as important as that of the laboratory and the university. (http://www.issues.org/about.html)

All of these developments suggest that rather than heading to ivory-tower labs and leaving the communication of science to journalists, scientists are taking to public pages and airwaves and fiber-optic cables to explain their work. An understanding of the principles and techniques of audience adaptation, and of general audiences themselves, is essential for successfully communicating with the public in any medium.

EXERCISE 8.1

Choose a topic in your field (perhaps derived from a research report you have read), and identify some specific public audiences you might address on this topic. Who outside your field might read or listen to what you as an expert have to say about this topic? Why would they be reading or listening? What media would they likely use? How do the needs and interests of these groups differ from those of experts in your field? What do they want or need from your presentation, and how much would they already know? (Are there any public audiences with whom experts in your field might communicate but currently don't?)

EXERCISE 8.2

On the World Wide Web, search for information on a subject that you are interested in but don't know anything about. After reading the material, speculate on whether the information is reliable—whether you can trust this website. How do you know? List your specific observations about the author(s), the organization(s), the website design and graphics, the content, the terminology and style, and anything else that you are using to assess the validity and truthfulness of the information the site contains. What are some of the ways the public evaluates online information? What questions about the validity and truthfulness of the information remain unanswered for you? What else do you need to know before you can trust this site? How can online communication with the public be improved?

8.2 UNDERSTANDING "GENERAL" AUDIENCES

Some research indicates that human reasoning, even in sciences, is "proverbial"—based on human experience and common sense (e.g., Shapin 2001). But of course, human experience varies. Public audiences can be as diverse as the general population in their knowledge, interests, and needs. Listeners and readers in these audiences will possess varying types and degrees of scientific knowledge. What these general audiences have in common is a presumed lack of knowledge about *your* topic. Just as scientists must understand the conventions governing communication with their peers to be successful professionals, so too must they understand the conventions of communicating with public audiences in order to do so successfully. In this chapter we discuss some general strategies for adapting scientific information to meet the needs and interests of non-scientists in a wide range of situations. These strategies can then be applied to specific audiences, genres, and mediums as the occasion demands.

The basic principle of audience adaptation is that we build a discussion or argument on the knowledge, goals, values, and experience of the audience. This principle is the basis of *all* successful communication and teaching, including that between professional scientists. It is also essential for the scientist communicating with public audiences in any medium. In adapting scientific information for nonspecialists, the writer or speaker introduces new knowledge by trying to relate it to what the audience knows or values; this new knowledge, grounded in what the audience already knows, then becomes the foundation for more new knowledge and so forth.

When you write for other scientists in your area of specialization, such as in the research report, you can assume your readers have some degree of familiarity with the topic to begin with, as well as some degree of interest. When you write for public audiences, however, you need to be more cautious. Instead of assuming knowledge on the part of your readers, you must help them develop that knowledge; instead of assuming interest in the topic, you must generate interest. The way to begin is by assessing your audience's knowledge, needs, and goals.

In *The Rhetorical Act*, Karlyn Kohrs Campbell (1982) gives the following advice on assessing audience (p 149–150). Consider your subject *from the point of view of your readers or listeners*.

- What expectations does your audience have about the subject? About you?
- How is your audience likely to see and/or understand the topic or issue?
- Are there conflicting beliefs or concepts that will have to be dealt with, and how will you deal with them?
- Are familiar explanations trite or boring?
- Does the audience have firsthand experiences that you can draw on to illustrate points in your discussion?

To answer these questions, you will need to find out as much as possible about the background, areas of expertise, probable beliefs, values, and general interests of members of your audience. One way to learn about your audience is to ask the organization sponsoring your talk about who will be in attendance and why. Or read the magazine you are writing for and look at specific text features as described in Exercise 8.3; these features can often provide hints about how to interpret and adapt to a particular audience.

Consider the rhetorical situation in the following scenario.

Jane, a premed student working with lasers, wanted to show her friend, Mike, a zoology major, how a new laser in her lab worked: "Come on over to my lab and I'll give you a demonstration." Mike had never studied or worked with lasers, but from what he had heard, they seemed fascinating; so one day he took Jane up on her offer. When Mike got to the lab, Jane escorted him through a maze of machines to the lab table where her laser was set up, and she proceeded to take the laser apart and explain each major component. Mike quickly lost interest and wandered away to look at the other machines, while Jane continued to discuss at length the technical details she had learned about lasers, oblivious to the fact that Mike was no longer listening. What do you think happened? Using the information given about Mike and your own common sense and empathy (both necessary in audience adaptation), what do you think Mike expected when he walked into Jane's lab? What would Mike like to see and learn about lasers? If Mike were an administrator of the lab—say in charge of personnel and finance—why would he be interested in the laser? What would he want to see and learn? If Mike were a parent whose child's school was about to purchase a laser for use in science classes, what would he want to know about it?

To extend a distinction drawn by Flower (1993), Jane was "speaker-based" rather than "listener-based": She was more concerned with what she as the speaker was interested in and had to say about lasers than in what Mike as the listener was interested in and may have wanted to hear about lasers. The story of Jane and Mike is a microcosm of large- and small-scale breakdowns in communication that occur every day in our society. In fact, communication breakdown has been cited as a major contributing factor in a number of serious technological accidents. In the case of the Three Mile Island nuclear reactor meltdown in 1979, for example, faulty assumptions about how to communicate with the public hampered the efforts of officials to find the best way to inform the public and to control the emergency, which led to widespread panic and social disarray (Farrell and Goodnight 1981). The inability of engineers and managers to understand each others' values has been directly implicated as a major cause of the *Challenger* shuttle explosion (Herndl et al. 1991; Tufte 1996, 2006), and is more than likely an important factor in the *Columbia* accident as well (see *Columbia* Accident Investigation Board 2003, esp. Chapter 7). And the inability of experts and government officials to consider the values and emotions of public audiences has been a factor in unsuccessful attempts to site low- level radioactive waste facilities all around the country (Katz and Miller 1996) and to convince the global public of the safety of biotechnology (Katz 2008).

In all these situations, communicators in one area of expertise seriously misunderstood the audience outside their fields, with dire consequences. Unlike the expert colleague, who has both knowledge of the subject and an intrinsic interest in it, public audiences have different perspectives on and interests in the subject, and thus different expectations and needs that must be appealed to. While experts are interested in theory and technical details, in methods and results, public audiences are generally interested in what things "do" and their effect on public safety, health, and welfare.

In addition to the three general modes of appeal (*logos, pathos, ethos*) discussed in Chapter 7, two special appeals often come into play in the accommodation of scientific knowledge to public audiences (Fahnestock 1986). The first is the *wonder appeal*, which emphasizes the sense of surprise and joy and awe that people (both generalists and specialists!) often feel when confronted with an exciting scientific discovery. The second is the *application appeal*, which emphasizes the practical benefits of a scientific concept or discovery for a particular audience, a society at large, or humankind. This appeal is especially effective with administrators and public officials. The administrator is interested in what things do from the point of view of cost, production, public health, environmental safety, and resource management: How can this new piece of equipment be used in the lab? How much does it cost to purchase and maintain? What products (or discoveries) are likely to arise from it, and will they be profitable for the lab or company? Is the piece of equipment or product cost-effective? Safe? Efficient?

Most of us are fascinated by the accomplishments and spectacle of science, and interested in what things do from the point of view of common experience or daily life. Practical application is also important to the general public. Figure 8.1 contains a blurb by John O'Neil in *The New York Times*, reporting the results of an *H. pylori* breath test in a study published in the *British Medical Journal*. Comparing the blurb to Chiba et al. (2002), contained in Chapter 10 (p xxx–xxx), note the amount of Chiba et al. detail that has been left out of the blurb. Also note the appeals to "wonder" in the title and the graphic that is not included in the Chiba et al. article in *BMJ*, and the two direct appeals to "application," quoted from the BMJ article, in the last paragraph of the blurb: the breath test (which is as good as endoscopy) is less invasive than endoscopy and is cheaper than endoscopy.

Copyrighted material removed. See References for full citation.

FIGURE 8.1 Blurb on *H. pylori* breath test (O'Neil 2002, p D6).

Both the wonder appeal and the application appeal work well with general audiences. In the scenario described earlier, Mike may have secretly wanted to ask: "Can we see the laser burn a hole in something?" (wonder). "How can lasers be used to shoot down missiles in outer space and also perform delicate eye surgery?" (wonder and application). "How could I use lasers in my zoology major?" (application). He never got a chance.

In the remainder of this chapter, we will explore several principles and specific strategies writers can use to adapt scientific and technical discussions for general audiences.

EXERCISE 8.3

In Figure 8.2 we have reproduced the introductions to five different articles on the same topic. You'll see that they are clearly intended for different audiences. As you read, think about what kind of publication these pieces would have appeared in. (This exercise has been adapted from Bradford and Whitburn [1982].)

A. Read the five introductions and categorize them according to the level of specialized knowledge assumed on the part of the audience. Use a scale of 1 (general audience) to 5 (most specialized audience). Speculate about where each piece might have been published.

B. After you've categorized the texts, reflect on what criteria you used to do so. In what ways do these introductions vary? What made you decide that one article is intended for a more general audience than another? Be sure to consider all dimensions of the text, including such features as content and organization, terminology and phrasing, formatting and visual presentation, tone and point of view. List the many ways in which these texts vary. Illustrate each of these features with a pair of contrasting examples from the passages.

C. Your instructor may ask you to work in small groups to develop a consensus ordering of the five texts, a consensus list of the features on which they vary, and a set of contrasting examples to illustrate each feature.

Copyrighted material removed. See References for full citation.

FIGURE 8.2 Five introductions. Bradford and Whitburn. "Analysis of the same subject in diverse periodicals." *Technical Writing Teacher* 9 (Winter 1982).[2]

[2] Original formatting and typeface are reproduced as closely as possible. Sources for these introductions are listed in the Works Cited list and identified in the Instructor's Manual.

EXERCISE 8.4

Assume you're a member of Stephen Reynolds's research team. You've been invited to speak to a local amateur astronomy club about the origin of the Kepler supernova remnant. Using Campbell's audience analysis questions on page xxx as your starting point, write a paragraph describing your audience. Write a second paragraph describing what kinds of appeals you would use to discuss the topic with this audience. What would you talk about with them?

8.3 ADAPTING THROUGH NARRATION

Narration is a powerful means of audience adaptation. Research has shown that stories are basic to the formation of human identity and knowledge—even scientific knowledge (Fisher 1987; Polkinghorne 1988). By creating a human story through which an audience can identify with a scientific subject, narration can make science accessible and acceptable to general audiences (Katz 1992a). Jorgensen-Earp and Jorgensen (2002) have examined the way Alexander Fleming, unlike his less remembered rival, Howard Florey, used narratives from the British wartime press to make his penicillin research salient to a victorious World War II public. Unlike the research report—with its hypothesis, methods, results, and conclusion sections—science, when presented to the general public, often takes the form of a dramatic story, with characters, plot, conflict, and resolution.[3] When the *New Yorker* reported the discovery of *H. pylori*, for example, its story was titled "Marshall's Hunch" (Monmaney 1993) and focused on Marshall himself, tracking his rise to prominence from relative obscurity and emphasizing his iconoclastic style. Marshall the rebel, not *H. pylori*, was the hero of this story for a general audience. (Haller [1998] analyzes a similar characterization of researchers studying chronic fatigue syndrome.)

Parts of the "story of science" often take the form of a *history*, a brief chronology of events. It may be a recounting of steps leading to a discovery or the development of a phenomenon, concept, project, or field. Historical narrative can be especially effective if the story can be accommodated to the audience's interest and/or general (cultural) experience. Such narratives are usually given dramatic flair, as in the following "scene" in Huyghe's description of the discovery of the killer algae (contained in Chapter 10): "The story properly begins one night early in 1988, with a massacre in Edward Noga's laboratory at North Carolina State University in Raleigh" (1993, p 72).

These principles of narration apply equally to communicating with the public in electronic media, whether television or online. In Chapter 6 we discussed the use of body and voice in conference presentations. In narratives broadcast via electronic media, both principles of narration and oral presentations are brought together. Dr. Sanjay Gupta, a well-known physician who regularly appears on major network television as a host of primetime specials or as a medical consultant on the evening news, combines scripted narratives with a more informal delivery that, combined with some of the audience adaptation techniques to be

[3] As you will see in this chapter, the application of what appears to be "literary technique"—not only narrative, but also metaphor, analogy, and even imagery—can be very effective in making abstract or complex science tangible and accessible to the public (see Arroliga [2002]). Because of this ability to make abstractions palpable, literary technique is increasingly being used to develop and teach empathy in medical education: Martin Blaser, who in 2000 became Chairman of the Department of Medicine and Professor of Microbiology at New York University and whose work is represented in Chapter 9, believes so much in the value of the study of writing and literature for scientific and medical education (www.blreview.org/staff.htm) that he co-founded the *Bellevue Literary Review*, a prestigious literary journal published by Bellevue Hospital that features poetry and fiction "that touch upon relationships to the human body, illness, health and healing" (http://www.blreview.org/index.htm).

described below, including graphics, creates an informative but persuasive ethos that will appeal to a general audience (see Dinolfo 2008); in a sense, in these television appearances the narrator becomes a character in her or his own presentation. As NASA hurricane specialist Jeffrey Halverson (NASA 2008a) demonstrates, online, sophisticated animation and satellite imagery can be combined with narration to create a compelling as well as informative educational series of podcast seminars (see Additional Resources #2, contained in Chapter 13).

EXERCISE 8.5

Read the Huyghe (1993) article (Chapter 10, p xxx–xxx) from *Discover* magazine about the Burkholder team's research on toxic dinoflagellates. Look for instances of narrative storytelling and character development. What parts of this project are dramatized in this article written for a general audience? Who are the main "characters"? What is the "plot"? What is the "conflict"? How is it "resolved"?

EXERCISE 8.6

Watch an episode of a science program such as *Nature* or *NOVA* on television. As in Exercise 8.5, is the scientific information adapted to a general viewing audience through the use of narrative storytelling? What parts of the science are being dramatized? Who are the main "characters"? What is the "plot"? What is the "conflict"? How is it "resolved," and how does the resolution support scientific research?

8.4 ADAPTING THROUGH EXAMPLES

Examples play a prominent role in audience adaptation and are essential for comprehension. As shown in Figure 8.3, specific examples provide increasingly more particular instances of a general class or concept to which the examples belong. As we move down "the ladder of abstraction," the more specific example of the class or concept under discussion tends to make the class or concept easier to grasp. The trick in every instance is to pick the right level of specificity and language for your topic and purpose. For instance, a pet care booklet for cat owners might feature a particular housecat (Golden Boy) with Feline Immunodeficiency Virus (FIV) to help illustrate the symptoms of this disease; but while an article about effects of global climate change on animal health might include the category of diseased mammals again, it also could include different categories (e.g., starving mammals), and both of these might be illustrated with other specific examples from those categories (sickened cattle, endangered polar bears, etc.).

Examples also can provide an effective way to relate unfamiliar concepts to what readers or listeners already know, value, and are interested in—if they are drawn from the reader's or listener's experience. Red tide, which many coastal visitors have seen firsthand, might be a more effective example of the class of biological phenomena called *algal blooms* than *Pfiesteria* if you were addressing coastal visitors. As you discovered in the Mike and Jane story above, different audiences will be interested in different issues—in this case, different aspects of lasers. In speaking to or writing, you would want to draw examples from that particular audience's area of interest.

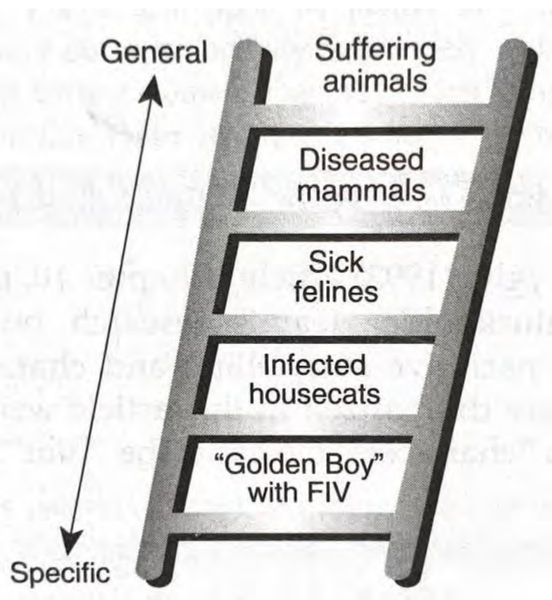

FIGURE 8.3 The use of examples: Movement from general classes to particular instances.

In this book we have used examples to illustrate our discussion of various genres and conventions. Imagine this book without them!

8.5 ADAPTING THROUGH DEFINITION

Several definitional strategies can be used to "unpack," or "translate," scientific terms for a general audience. Before you consider any of these strategies, you will want to ask yourself whether the particular term is needed by the audience at all. Think about the knowledge, needs, and interests of your audience. Is the term absolutely essential for the audience to learn?

If you decide it will bog down the reader, omit the term. For example, when you read our descriptions of the appeals to wonder and application in Section 8.2, did you need to know that the technical term for the appeal to application is the *teleological appeal* and that the appeal to wonder is the *deontological appeal* (Fahnestock 1986)? What good does it do you to know this information now? What would have been the effect if we had used these terms instead of the general terms in the earlier discussion? Are there circumstances in which this technical terminology might be appropriate?

If you decide a term is important enough to take the time to explain it to your audience, then you can use one of the following definitional strategies to define it. These strategies are not just different ways of explaining terms but also different ways of thinking about concepts. Each definitional strategy gives you (and thus the audience) a different "angle" on a term, a different perspective on a concept. Thus, your choice of definitional strategy will depend on (1) the term or concept; (2) the audience's knowledge, values, interests, and needs; and (3) what you want to say to this audience (your purpose).

When you define using the *classical* (*Aristotelian*) *definition*, you place a term or concept in a general class of things to which it is similar and then delineate how the term or concept is different from other members of this class. This genus-differentia definition is the one we find most often in dictionaries. It depends on classification as the primary intellectual strategy to explain a concept. For example, in *Sky & Telescope's* coverage of the Reynolds team's Kepler analysis, "type 1A supernova" is the term to be defined, "thermonuclear explosion" is the genus, and "of a white dwarf" is the differential (Naeye 2007; reproduced in Chapter 12).

The definitional strategy *etymology* explains a term by examining the history of the word(s). Notice how in the following etymological definition Huyghe (1993) employs the narration strategy to enhance audience appeal as well:

They have proposed calling [the dinoflagellate] *Pfiesteria piscimorte* (the genus name was picked to honor the late dino specialist Lois Pfiester of the University of Oklahoma and also because Burkholder liked the name's echo of both *feast* and *cafeteria*; the species name means 'fish killer'). (p 75)

8.6 ADAPTING THROUGH ANALYSIS

Analysis breaks a whole into constituent elements. Thus, in analysis, division, not classification, is the primary strategy used to unpack a concept. Analysis can be used to discuss the structure of a molecule or the stages of a supernova. Huyghe (1993) uses analysis to divide the life cycle of dinoflagellates into stages to emphasize the scientific oddity of these creatures and their devastating effect:

[The new dinoflagellate's] life cycle consists of more than 15 stages The dino lives most of its life as an amoeba; in one toxic "giant" amoeboid stage it grows to be nearly 20 times the size of the flagellated toxic cells. The stage when the dino leaves its cyst to attack fish is actually quite ephemeral, appearing only when fish are present. The researchers also found that this stage is the only time the creature sexually reproduces. (p 75)

8.7 ADAPTING THROUGH COMPARISON

Comparison is a particularly useful method for explaining concepts to non-specialists. Using this strategy, the scientist indicates how a phenomenon is similar to or different from other phenomena the audience is more familiar with: "Dinoflagellates are twilight-zone creatures: half-plant, half-animal. They produce chlorophyll, but they also move about, using their two flagella, or whiplike tails, to swim rapidly through the water" (Huyghe 1993, p 72).

The use of synonyms is one type of comparison strategy. *Synonym*, substituting one or more words for another, can be used to define a term in a context the audience is more familiar with, as in the example above: "flagella, or whiplike tails." This sort of definition in context is also known as *parenthetical explanation* (if in parentheses), and *apposition*, if inserted between commas without parentheses.

It is because no two words have exactly the same meaning or connotation that synonym falls under the category of comparison: for the writer or speaker, the use of synonyms really involves a comparison of terms and concepts rather than exact substitution—a search for a similar word that the audience will be more likely to understand and be able to relate to. Given that technical terms are part of a precise vocabulary of a field, the scientist using synonym usually has to trade off some accuracy for the sake of gaining the audience's comprehension.

You've all learned that *simile* is a comparison that uses *like* or *as*. Simile can be used to drive home a point figuratively, as in the following example: "Efforts to describe [the dinoflagellate] have evoked the strangest comparisons: like grass feeding on sheep, said one scientist. And that's not stretching things much" (Huyghe 1993, p 72). Unlike simile, *metaphor* does not use *like* or *as*. It is thus a less obvious, but a much more pervasive, method of comparison than we might think. By omitting *like* or *as*, metaphors not only conceal the comparison but also imply an identification of the things compared, as in the following example: "The creature is in fact a tiny plant with a Jekyll and Hyde personality, one that preys on animal life a million times its size" (Huyghe 1993, p 72). Notice that the attribution of a specific behavior to the alga through the personality metaphor of "Jekyll and Hyde" is grounded in the audience's cultural knowledge.

Some researchers believe that metaphors actually structure, and to some extent determine, the way we conceptualize the world (e.g., Lakoff and Johnson 1980). It has been argued that metaphors are implicit in scientific models and thought (Turbayne 1970; Kuhn 1979; Leary 1990; Boyd 1993; Spraggins 1999; Shea 2008); Neils Bohr's early model of the atom as a solar system immediately comes to mind, but there are many others. In any case, common sense tells us that the metaphors we choose both color and reflect the way we think about phenomena. Metaphors are used not only in communicating with general audiences (e.g., "biological clock" [Brown 1959]; "killer algae" [Huyghe 1993]), but also by scientists themselves in exploring new phenomena (e.g., "genetic code" [Watson and Crick 1953]; "phantom dinoflagellate" [Burkholder et al. 1992]) the "ears" of the Kepler supernova remnant [Reynolds et al. 2005. p 1]).[4]

In creating metaphors for nonexpert audiences, it is important to remember two things:

(1) Find the metaphors in the language, knowledge, and experience of your audience; do not merely switch to other technical metaphors embedded in your field that the audience will not understand. (2) Use metaphors consistently; mixing metaphors confuses readers and may introduce inconsistencies into your discussion.

EXERCISE 8.7

An excerpt from Monmaney's (1993) profile of Barry Marshall in the *New Yorker* is presented in Figure 8.4. Identify and circle the metaphors Monmaney uses to discuss the *H. pylori* bacteria. What are the bacteria being compared to? Why? Are the metaphors related to each other (i.e., consistent)? What do the metaphors communicate? Compare the description of this bacterium in *The New Yorker* with its description in the Marshall and Warren letters (1983) in Chapter 9. Are there any metaphors in the technical letters? What conclusions can you draw about the use of metaphors for scientific and non-scientific audiences? What is the scientific basis for the metaphors in *The New Yorker* excerpt? What is the popular basis of the metaphor?

See next page (175A).

FIGURE 8.4 Metaphor identification: From "Marshall's Hunch," by Terence Monmaney, originally published in *The New Yorker*. Copyright © 1993 by Terence Monmaney. Excerpted by permission of the author.

[4] Quotation marks are often used around "popular" terminology by scientists writing to general and specialist audiences to distance themselves from it, reflecting an abiding concern for their professional credibility.

It takes a kind of cunning for *Helicobacter pylori* to fill its niche, for the adult human stomach is one of nature's most hostile habitats. Each day, the stomach normally produces about half a gallon of gastric juice, whose strong hydrochloric acid and digestive enzymes readily tear meat and microbes apart. Gastric juice is like a binary chemical weapon—so destructive that it's constituted only on the way to the target. As cells in the stomach lining secrete the raw ingredients of gastric juice into the mucus that coats the stomach lining, the ingredients mix into an even more caustic brew, which then oozes into the cavity. There the gastric juice breaks pabulum down chemically while muscles in the stomach wall act to crush it. The viscoelastic mucus, as thick as axle grease, keeps the stomach from digesting itself.

Once *Helicobacter* reaches the stomach, it probably does not linger out in the open cavity— a tossing sea of toxic chemicals. It heads for cover. The bacterium's helical shape seems to have been designed for speedy travel in a dense medium. *Helicobacter* is living torque; a microscopic Roto-Rooter, it corkscrews through the mucus. Then, instead of penetrating the cells of the stomach lining, it settles in the mucus just beyond the lining. More often than not, it settles in the pylorus. No one knows why. Under the microscope, a *Helicobacter* infection looks like a satellite image of an armada gathered off a ragged shore. At one end of the bacterium is a cluster of long, wispy, curving flagella, which may serve as anchors. It's a graceful menace.

Helicobacter possesses a vital defense against stomach acid, and this adaptation, too, is a marvel of evolutionary design. Its coat is studded with enzymes that convert urea—a waste product, virtually unlimited supplies of which can be found in the stomach—directly into carbon dioxide and also into ammonia, a strong alkali. Thus *Helicobacter* ensconces itself in an acid- neutralizing mist. In like fashion, it generates another antacid— bicarbonate, as in Alka-Seltzer.

A *Helicobacter* infection that establishes itself succeeds largely because the immune system can't reach it. In response to a *Helicobacter* invasion, immune-system cells in the bone marrow produce white blood cells, killer cells, and other microbe destroyers, and those float through the bloodstream to the very edge of the stomach lining—and go no farther, because the lining holds them back. The *Helicobacter,* hovering in the mucus, are out of range. And yet the immune system sends reinforcements. Killer cells pile up, gorging the stomach lining; permanently alerted, seldom engaged, the killers become trigger-happy. Some die, fall apart, and spill their microbe-fighting compounds into the host tissue. Friendly fire begets friendly fire. Metabolic hell breaks loose. The lining is now inflamed: acute gastritis. Micronutrients are pumped from the bloodstream to the front lines, to feed the killers, but loads of them seep out of the stomach lining and into the mucus. Offshore, the *Helicobacter* feast; having drawn the immune system into battle, the bacteria now loot the provisions. "I propose that inflammation is good for *Helicobacter,*" Blaser says. "That's what it wants."

Chronic gastritis, a standoff between the bacteria and the host's immune system, may persist for years—decades, according to some estimates. As it happens, whatever serious damage is done to stomach or intestinal tissue is apparently done not by the bacteria themselves but by the inflammatory response they provoke. That the host plays such a large role in his own pathology may help explain why *Helicobacter* infection affects different people differently. (Also, scientists recently discovered that there are at least two strains of *Helicobacter pylori,* and that one of them is far more likely to cause a peptic ulcer than any other.) Inevitably, though, for *Helicobacter* to be really successful it has to meet a parasite's final challenge: to start another colony before the host dies.

FIGURE 8.4 Metaphor identification: From "Marshall's Hunch," by Terence Monmaney, originally published in *The New Yorker*. Copyright © 1993 by Terence Monmaney. Excerpted by permission of the author.

Analogy is an extended comparison that may include similes and metaphors. In fact, an analogy might comprise a series of related metaphors running throughout a text. Like other methods of comparison, the advantage of an analogy is that the writer can begin with what the audience knows and then move back and forth between the known and the unknown as the concept is explained or new terms are further defined. For example, in the Huyghe piece, the metaphor "killer algae," announced in the title of the article, "surfaces" throughout the text. In a series of multimedia segments for students and teachers, Halverson (NASA 2008a) uses the extended analogy of the car engine to explain how hurricanes form (see segments 20–22 of this resource: http://www.nasa.gov/mission_pages/hurricanes/multimedia/AtlanticHurricanesWithJeff.html). Halverson uses this analogy both verbally and visually to describe the "fuel" (water vapor), "flywheel" (rotating winds), "combustion" (condensation), "exhaust" (rain and clouds), and other components of the "natural heat engine" of the hurricane. Halverson wisely observes that this analogy will become less effective over time: as the hybrid car's electric motor replaces the gas-powered engine, students are less likely to be familiar with the workings of the internal combustion engine that forms the base of this analogy.

You should note that *analogy* **is not** *example*. While examples are drawn from the general class of concepts they are a part of, the "examples" in analogies are drawn from similar or parallel classes of concepts; that is, they are based on comparison. As Ziman (2000) might indicate, scientists can draw on intellectual and political contexts outside science in comparing unfamiliar concepts with concepts more familiar to their general audiences.

EXERCISE 8.8

In the Huyghe (1993) piece, look at definitions, similes, metaphors, and other places where the metaphor "killer algae" is extended in the discussion through analogy. Are there places where the analogy breaks down or is violated? Why? What is the effect? Do you see any similiarity between the analogy in the Huyghe piece on dinoflagellates and the analogy in the excerpt from Monmaney's piece on *H. pylori?* What do these analogies tell you about common attitudes toward microorganisms?

8.8 ADAPTING THROUGH GRAPHICS

Graphics are visual representations of phenomena. Like metaphor, they also have the power to persuasively portray abstract *concepts* as physical phenomena and relations (see Gilbert and Mulkay 1984; Tufte 2006). As discussed in previous chapters, visual aids such as tables, line graphs, diagrams, and site maps are conventionally used to present information to scientific audiences in research reports and conference presentations. But graphics can also be used to explain concepts to general audiences, whether in material that is printed, broadcast, or accessed digitally. Note the use of Figure 8.3 to illustrate audience adaptation strategies in this chapter, or Halverson's extensive use of graphics in the NASA educational segments mentioned above. Like verbal examples, visual examples should be based on your audience's knowledge, interests, and values.

For general audiences, photographs, slides, maps, drawings, bar graphs, pie charts, and simple diagrams serve to make the verbally abstract visually concrete. One advantage of these types of pictorial representation is that they can be made colorful, attractive, and thus very appealing. They also can be discussed at any level of generality that is appropriate. A striking photograph can even be used to introduce a topic. For example, the opening page spread of the "Killer Algae" article (Huyghe 1993) catches readers' attention by juxtaposing a "supersized" image of the toxic dinoflagellate with smaller pictures of the fish that become its victims, effectively dramatizing the magnitude of the threat posed by the microscopic algae. The Kepler image in *Sky & Telescope's* description of Reynolds et al.'s finding serves as a dramatic introduction to this research (see p xxx in Chapter 12). More prominent than the text itself, this visual plays a significant role in conveying the nature of this discovery.

The medium, size, shape, and color of a visual representation also can be used to communicate symbolically. Line graphs use colors (e.g., black and red) as well as the direction of the line (up and down) to symbolically (and dramatically) show increase and decrease *visually*. Thus, a pie chart showing percentages of food consumed by Americans during the day versus the night, for instance, might color the day part of the graph yellow and the night part blue, communicating basic information at a glance through color as well as labels. A graph showing annual deforestation by fire might have bars colored red or orange (known as "hot colors," as opposed to blue or green, known as "cool colors") or even shaped like flames! The use of size, shape, and color in graphics is especially important for nonexpert audiences when knowledge of the appearance of phenomena cannot be assumed but can be communicated quickly through the visual medium, or when dramatic effect is desired to make a point.

When using graphics to communicate to a general audience, consider all the possibilities the visual medium has to offer you. Recall from Chapter 6, though, that one of the dangers of pictorial representation is that the visual aid (whether print or pixel) may contain too much detail, especially if it is not designed specifically for the purposes of your presentation (see Figure 6.3). Visual aids, like text, should be focused and uncluttered when communicating with non-specialists.

EXERCISE 8.9

The public announcements of the Reynolds team's discovery of the Kepler supernova remnant (Roy and Watzke 2007; Cowden 2007; contained in Chapter 12, p xxx, and xxx) use many of the audience adaptation techniques discussed above. Turn to those pieces and see if you can identify the various techniques. In what ways do these techniques make the science more accessible and relevant to a general audience? Are any techniques used together in the same sentence to unpack concepts? In what ways do these techniques "change" the scientific information? What do you learn about using audience adaptation techniques by looking at how they are used in these two articles?

EXERCISE 8.10

Imagine that you are an editor working for *Discover* or *Scientific American*. You have assigned one of your staff writers to write an article describing the Reynolds team's research on the Kepler supernova remnant. While your writer reviews the research and flies to North Carolina State University to conduct an interview, you call in your design staff to start planning the visual presentation. You notice that all the popular coverage features the image from Chandra as the only visual. After reviewing this research (see Chapter 12), think about what other visual effects you'd like to create. Describe (or better yet, sketch) the first page spread for the article. Think of an effective title for the piece, and incorporate it into your design.

EXERCISE 8.11

Burkholder and Rublee diagram the life cycle of the toxic dinoflagellate in Figure 2 of their 1994 Sea Grant Proposal (see p 290). Patrick Huyghe presents a brief verbal description of the life cycle on the last page of his *Discover* piece (1993, p 277). Assume that you are working with Huyghe on a revision of this piece. Your task is to adapt Burkholder and Rublee's technical diagram for the general readership of *Discover*. Redesign this diagram, using both the original diagram and Huyghe's verbal description as your guide. You may add to or revise Huyghe's verbal description to accommodate your graphic if you wish.

8.9 LOGIC AND ORGANIZATION IN WRITING FOR PUBLIC AUDIENCES

Unlike the research report and proposal, there is no standard structure for articles written for general audiences. Thus, you will want to consult the publication you are writing for to get a sense of stylistic and formatting options. Major topics or points are often indicated by headings, as in Blaser's (2005) *Scientific American* article on *H. pylori*, contained in Chapter 9. When headings are used, they are topical rather than functional; that is, they provide clues to the content rather than the structure of the text. Functional headings (such as "Introduction," "Methods," "Results," "Discussion") are useful in genres governed by a standard structure, for they enable readers familiar with that structure to quickly locate the types of information they're most interested in. But such headings are of no use when no particular pattern of organization is expected by readers.

Topical headings help readers see at a glance what major topics or issues will be raised in each section of an article. Thus, this type of heading serves to introduce the unique pattern of organization used in a given essay. To do so, they must be clearly comprehensible to the general reader. Topical headings also provide an opportunity to catch readers' attention and pique their interest. Thus, authors writing for general audiences aim to create titles and headings that are not only informative but also intriguing.

Articles in general-reader publications may end with a list of suggested readings but usually do not include a formal reference list. These articles rarely report the results of individual experiments, focusing instead on the general outcomes of a body of research. They therefore do not typically include citations of individual research reports. Such reports are occasionally included in a list of further readings (see Blaser [2005], Chapter 9), but it is not common practice to include sources written for research journal audiences when writing for newspapers or general-interest magazines. For those readers, it is more helpful to list resources that are specifically designed for general readers and are readily available in local bookstores or public libraries.

Instead of drawing on prior research reports to support their claims, authors often use interview data when writing for general audiences. Direct quotations are rarely used in other genres of scientific discourse (see Chapter 5), but they are legitimate and popular forms of evidence in general-reader publications such as newspapers and magazines. In fact, *quoting* can be understood to constitute another major strategy for adapting science to a general audience.

Quotations from "characters" in a scientific story can enliven it, and thus are frequently used when the narrative strategy is employed. The Huyghe (1993) article in *Discover* and the popular coverage of Chambers and Hurtt's research on the effects of Hurricane Katrina include numerous examples of this strategy (see the pieces by Cook-Anderson and Kaufman in Chapter 13). Another common use for quotations is to provide support for or elaboration of a claim made in an essay, as when the author quotes a prominent authority's opinion of a new finding or its implications. In classical argumentation terms, quotations thus represent either *appeals to experience* (testimonials) or *appeals to authority*. For general readers or listeners, both types of testimony enhance the credibility and authenticity of the scientific story being told.

EXERCISE 8.12

Compare the headings in Blaser's (2005) *Scientific American* piece (p xxx–xxx) with those of a standard research report, such as those by Marshall and Warren (1984) or Graham et al. (1992). Then compare the title and headings of the *Scientific American* piece with the review article that Blaser (1987) wrote for *Gastroenterology* (p xxx–xxx). (These readings are all contained in Chapter 9.) Write a brief (two-page) analysis in which you use these sample articles to illustrate the differences between topical and functional headings and the differences between specialized and general audiences.

EXERCISE 8.13

Blaser (2005) does not include direct quotations in his *Scientific American* piece (Chapter 9), most likely because he himself is one of the researchers involved in this research and thus provides the authenticity that quotations would contribute. However, if you were to write on his topic for a general readership, what kinds of quotations would you want to obtain to supplement your article? In a paragraph or two, choose a target publication and audience for your piece, and explain whom you would like to interview, what kind of information you'd hope to obtain from those interviewed, and how you would use this material in your article.

EXERCISE 8.14

Chapter 10 (p xxx–xxx) includes a piece on *Pfiesteria* from *Environmental Science and Technology Online*, published by the American Chemical Society (Engelhaupt 2008). This document utilizes a range of strategies for communicating complex scientific knowledge to non-specialists. Analyze this text, describing the adaptation strategies it employs and speculating on the effectiveness of each. Don't limit your analysis to the strategies discussed in this chapter. Overall, does this seem an effective article? What is the assumed audience like? What public needs, interests, or concerns does it seem intended to address?

Activities and Assignments

1. Watch a local weather forecast on television or online. In a two- or three-page paper, identify and describe the audience adaptation strategies being used, and assess their effect on you as a member of the audience.
2. A. Choose a paragraph from an expert text in your field (e.g., from a textbook or journal). Select and analyze a general audience for which this topic might be appropriate and a preferred medium of communication. Adapt the paragraph for that audience using the audience adaptation strategies you have studied in this chapter. Be sure to specify the intended audience (by publication/medium, age, education, background, interests, goals, etc.). Compare your adaptation with the original, and explain the similarities and differences.

B. Now select and analyze an appropriate administrative audience and medium, and adapt the same piece for this audience (e.g., suppose you are working in a lab and need to explain a piece of equipment or an experiment to the lab administrators so that they will continue funding your project). Note what changes you had to make in content and strategy from the piece written for a general audience. Compare this piece written for an administrative audience with the original text written for an expert audience; explain any similarities and differences between these texts.

3. Jeffrey Chambers' research on Gulf Coast forest damage after Hurricane Katrina was described for public audiences in a number of venues. Read the feature story that NASA posted on November 15, 2007 and the *Washington Post*'s report the following day (see p xxx–xxx in Chapter 13), both of which are based on the brevia article published by Chambers et al. in Science (also in Chapter 13). Analyze and compare the adaptation strategies used in these two articles. For example, who is the "hero" in each of these stories? Also, who has been interviewed for each story, and why were they chosen? What is the overall message conveyed by each article? What purpose does each serve?
4. Write a scientific essay for a popular magazine or newspaper in print or online that traditionally covers science (*Time, National Geographic, Scientific American, Discover, The New York Times*, etc.). Choose an essay from that publication or website as a model. Analyze the audience for the magazine using the questions in Exercise 8.3B as a guide, and examine your model for the audience adaptation strategies we have discussed. Use these strategies where necessary and appropriate in your

essay. Create visuals designed for this journal and audience to include with your text. Be sure to include your model with your assignment.

5. Choose a particular public audience and occasion for an oral presentation on a topic in your field. For example, you might address a club, a junior high classroom, a congressional committee, the press. (If you have the equipment and the technical expertise, you also might decide to prepare this presentation as if for television broadcast or streaming online.) Give an oral presentation appropriate to this audience. The talk may be based on a previous topic you wrote about in this or other classes for an expert audience, or for Activity 4, but be sure to adapt it fully for an oral presentation to your new audience, using the principles and strategies in this chapter. Remember to eliminate any terms, concepts, and details that don't fit your general audience's needs and interests; make sure other terms are appropriately explained. Design visuals for this audience. Before you present this talk in class, inform your listeners of the intended purpose, audience, and occasion for the presentation—who and where they are supposed to be as they role-play the target audience. Because they most likely represent a diverse public audience for your topic, they will be able to give you direct feedback about what they understood.

6. Write an online "fact sheet" for the public on an issue in your field. EPA's *Pfiesteria* fact sheet, which provides a useful model, can be viewed online at http://www.medhelp.org/NIHlib/GF- 394.html. Consider where your fact sheet should be posted: Where would interested publics look for it or be likely to come across it? What government agency or private organization should provide such a fact sheet? Design a fact sheet that is clearly adapted to the needs of the general public and that uses the Internet medium to full advantage. What text features does the Internet enable you to include that would not be available in a hard copy text?

7. Reporter Andrew Revkin described a range of positions in the climate change debate in a 2007 *New York Times* article titled "New Middle Stance Emerges in Debate over Climate." Read this article, the final item in Chapter 13, paying special attention to the stances taken by the scientists interviewed, as well as their comments about scientists' roles or potential roles in this public debate. Consider the roles that scientists play in public discussion of this and other science-related issues. Write an essay in which you reflect on scientists' responsibilities in such discussions, and conversely, on the public's responsibility in interpreting science. How do, or should, non-specialists make decisions when the experts disagree?