CHAPTER 7

Countering Skepticism, Denial, and Despair

The alarming prospect of not only a hotter world, higher sea levels, more intense storm events, and flooding, but also increased disease, fresh water and food shortages, supply chain disruptions, and other national and global security stresses may, understandably, trigger a variety of reactions, from denial and despair to fear and sadness.

For some, there's an understandable tendency to look the other way and focus on more immediate concerns. One natural response to being confronted with climate change bad news is to doubt the science or question the scientists. Can it really be as bad as all of that? Are the scientists mistaken? Could they be missing something? Such skepticism is natural and important. Educators often struggle to encourage healthy skepticism and critical thinking among their learners, so when introducing climate and energy topics, finding out what naïve ideas, misconceptions, or doubts they have is an important starting point.

Knowing that skepticism is the lifeblood of science, John Cook, an Australian scientist long interested in climate change, started his website Skeptical Science in 2007 as a response to comments by U.S. politicians that climate change was a hoax. Over the years, Cook (2014) and his team have assembled a collection of over 170 arguments against the hoax charge. Their site (http://www.skepticalscience.com) is used by educators and even scientists not familiar with all the current research and is especially helpful in being able to counter common statements that arise in discussing climate and energy issues.

Taking a layered approach by first presenting the myth, then providing a basic as well as more intermediate understanding of the current science countering the myth, the Skeptical Science team analyzed the merit of the arguments in detail. Many of the myths originate from legitimate questions asked by skeptical novices and experts alike who are trying to wrap their minds around and inquire about a topic that is immense in scope and complexity. Responses to twelve of the more common arguments against human-induced climate change that Cook's team deconstruct and respond to on their website are captured in the table below.

	SKEPTIC ARGUMENT	VS.	WHAT THE SCIENCE SAYS
1	Climate has changed before.		Climate reacts to whatever forces it to change at the time; humans are now the dominant force.
2	It's the sun.		In the last 35 years of global warming, sun and climate have been going in opposite directions.
3	It's not bad.		Negative impacts of global warming on agriculture, health, and environment far outweigh any positives.
4	There is no consensus.		Ninety-seven percent of climate experts agree humans are causing global warming.
5	It's cooling.		The last decade, 2000–2009, was the hottest on record.
6	Models are unreliable.		Models have successfully reproduced temperatures since 1900 globally, by land, in the air, and in the ocean.
7	Temperature record is unreliable.		The warming trend is the same in rural and urban areas, measured by thermometers and satellites.
8	Animals and plants can adapt.		Global warming will cause mass extinctions of species that cannot adapt on short-time scales.
9	It hasn't warmed since 1998.		For global records, 2010 is the hottest year on record, tied with 2005.
10	Antarctica is gaining ice.		Satellites measure Antarctica losing land ice at an accelerating rate.
11	An Ice Age was predicted in the '70s.		The vast majority of climate papers in the 1970s predicted warming.
12	Carbon dioxide lags temperature.		Carbon dixoide didn't initiate warming from past ice ages, but it did amplify the warming.

NOTE: For more, visit: http://www.skepticalscience.com/argument.php

Cook and his team relied on peer-reviewed literature in their rebuttals of the arguments against the science. If there are new insights or findings from scientific research in the literature, Cook and his team update their commentary.

Many educators and others interested in climate change have found Skeptical Science and a similar, somewhat more technically oriented website called Real Climate (http://www.realclimate.org), started in 2004 by nine climate scientists, to be invaluable. The sites help rebut arguments purporting climate change to be a hoax or that human activities couldn't possibly be the cause of the heating of the atmosphere and ocean. They also help users in their own skeptical inquiries into how scientists know what they know.

Cook's original theory of change was based on the notion that countering confusion or misinformation, whether legitimate skepticism or manufactured doubt motivated by a political or cultural bias, could be achieved by a logical, reasoned approach: Explain the myth, then analyze it in light of the scientific literature, and as a result, light bulbs of understanding will go off. Mission accomplished. As experienced teachers or parents will attest: If only it were so easy! Climate and energy issues are not only complex but also replete with psychological, social, cultural, political, global, and individual predilections. As we will see in a moment, Cook has rethought the challenges of countering climate confusion, but first, let's look at an overview of the spectrum of climate confusion.

Denial, Doubt, and More

In 2008 a series of studies was initiated that have become known as the Six Americas studies. Conducted by the Yale Project on Climate Change and the George Mason University Center for Climate Change Communication, these surveys have measured the beliefs, attitudes, values, and more of American adults regarding climate change. The study's report identifies Global Warming's Six Americas: six unique audiences within the American public that each responds to the issue in their own distinct way. The reports define the audience segments as the Alarmed (16% as of the January 2014 report of a survey conducted in November 2013), who are fully convinced of the reality and seriousness of climate change and are already taking action to address it. The Concerned (27%)—the largest of the six Americas—are also convinced that global warming is happening and is a serious problem, but they have not yet engaged the issue personally. Three other Americas—the Cautious (23%), the Disengaged (5%), and the Doubtful (12%)—represent different stages of understanding and acceptance of the problem, and none are actively involved. The final America—the Dismissive (15%)—are very sure it is not happening and are actively involved as opponents of a national effort to reduce greenhouse gas emissions.

Significantly, three in four of the Alarmed "often" or "occasionally" talk with family and friends about the topic. By contrast, only one in four of the Concerned do so, and 90% of the other groups indicate they discuss the subject only "rarely" or "never" (Leiserowitz, Maibach, Roser-Renouf et al., 2014). Improved literacy will inevitably increase the frequency and depth of such conversations, not only in classrooms but also around the kitchen table and the conference table.

The Six Americas reports are treasure-troves of information about people's attitudes and opinions, and we will examine how they can be applied in learning environments later in this chapter. As mentioned previously, the research team has also looked at the knowledge of adults and teenagers as they relate to the audience segments they fall into. Among the sobering statistics, the survey from November 2013 revealed the fact that only 5% of Americans feels that humans are going to successfully reduce global warming, while 40% or more, depending on when the survey was conducted, think that it is unclear whether or not we will. Another large segment—between one in four and one in five—are deeply pessimistic, feeling we could reduce global warming but that we won't because we aren't willing to change. Needless to say, such attitudes can't help but affect learning about these issues in school.

Other surveys, such as the 2013 study conducted by Stanford's Jon Krosnick, which conducted interviews with random Americans, found strong (75% or more) acceptance that climate change was being caused by human activities, with two-thirds calling for the United States to take action to limit greenhouse gas emissions (Nagel, 2014). Nevertheless, a dedicated and vocal minority can—and has for years—disrupt discussion and discourse, much the way one or two unruly students can derail a classroom and hamper learning. Labeling students (or adults) who doubt or dismiss climate science as deniers may be counterproductive, even though the term may indeed ring true for those who are deeply and aggressively obstinate.

In reality, denial is complicated, nuanced, and multilayered. In her article in *Time*, "We Are All Climate Change Deniers," Mary Pipher (2013) suggests that even if we do accept that climate change is occurring—and most Americans do—we tend

to "minimize or normalize our enormous global problems." She writes: "Our denial is understandable. Our species is not equipped to respond to the threats posed by global warming."

In another article in *Time*—"The Battle Over Global Warming Is All in Your Head"—author Paramaguru (2013) reviews some of the psychological research that has begun to identify our mental barriers and the issues that obstruct our ability to confront the threat. Broadly defined, denial is a natural way of coping with or denying despair, a normal psychological response to cope with the angst, overwhelming feelings, or horror of a particular situation: a way to tamp down the deep despair and sense of hopelessness that may arise in contemplating catastrophe or injustice.

Pipher and sociologists like Kari Norgaard, author of *Living In Denial: Climate Change, Emotions, and Everyday Life* (2011), cite the research of Stanley Cohen, who has researched how people remain willfully ignorant about an issue out of a "need to be innocent of a troubling recognition" (p. 25). His 2001 book *States of Denial* details three primary forms of denial, all of which may come into play inside and around classrooms and other educational settings: literal (it's not happening), interpretive (it's not what you think), and implicatory (accepting the reality but denying responsibility) for what is occurring, which Pipher suggests is widespread.

While Cohen's book is about atrocities and suffering, such as genocide, and not climate change per se, his insights into how denial plays out for individuals and society also applies to human impacts on the environment in general and climate in particular. Roughly speaking, within the lens of the Six Americas segments, literal denial, though increasingly rare, is mostly often found among the Dismissive, Doubtful, and Disengaged. Interpretive denial (the planet is warming but it is because of natural cycles, not human activities) is common among these same audience segments. Implicatory denial (shirking responsibility or ignoring the implications) is arguably the most widespread, except among the most motivated of the Alarmed and Concerned.

In part because of deliberate efforts to encourage doubt and denial over the years, climate change science and potential policy solutions have become increasingly politically polarized. People who consider climate change to be overblown or a hoax derisively refer to the Alarmed group as *warmists* or *alarmists* but often take offense when they are described as *deniers*. The Heartland Institute, which has a long history of casting doubt on the health hazards of tobacco and climate science, went so far to as equate those who take the implications of climate science seriously with mass murderers and terrorists. Assailing the other side with such epithets escalates the polarization and can be counter productive if the goal is open-minded discussion and meaningful discourse. But often in the public arena, the goal has been to "win" the argument or perpetuate polarization rather than have meaningful discourse. Such polarization complicates efforts to educate people about the essential issues, leading some teachers to teach the controversy rather than the consensus science.

Efforts to offer alternative curriculum or provide cover for teaching both sides of a phony controversy often make the same three points, the three pillars of denial identified by the National Center for Science Education (http://ncse.com/climate/denial/pillars), which are the following: (1) claiming the science is bad, controversial, and/or fatally flawed; (2) suggesting that accepting the science will lead to undesirable

consequences for society; and (3) insisting that therefore, for the sake of fairness and balance, both sides of the alleged controversy should be taught.

In May of 2014, a variation of this played out in the state of Wyoming when a footnote on the state's budget bill prevented implementation of the Next Generation Science Standards. The bill's author specifically called out the inclusion of climate change as the reason for preventing adoption of the standards. The reasoning? The science was bad and teaching students about climate change would destroy the state's fossil-fuel-based economy (McCaffrey, 2014). In this instance, the goal was to prevent the topic from being taught at all rather than encourage "both sides" be taught. Such political efforts to derail the teaching of climate and related energy sciences are not unique to Wyoming, and fortunately teachers and school districts are finding ways to work around political obstruction by implementing NGSS-like standards and curriculum on their own.

Denial and political polarization have had and will continue to impact whether and how climate change is taught in classrooms. The bottom line for educators is that true skepticism has a vital role in cultivating critical thinking skills in learners, but deliberate efforts to prevent teaching the topic or nit-picking designed to perpetuate endless debate and doubt need to be confronted in order to avoid furthering confusion and delay.

Why Teaching "Both Sides" Is a Problem

A first glance the idea of teaching both sides of a politically controversial topic like climate change may make sense. Many teachers, according to informal surveys conducted by the National Science Teachers Association, the Alliance for Climate Education, and the National Earth Science Teacher Association, pride themselves on teaching both sides of global warming. The reasons may vary—there may or may not be overt pressure to present the other side—but Americans' sense of fairness and balance is likely a contributing factor to the phenomenon in which educators feel that if they show a pro-climate change video, like *An Inconvenient Truth*, they are required for the sake of balance to show a video challenging climate change, like the *Great Global Warming Swindle* or *Unstoppable Solar Cycles*. In some cases well-meaning teachers will have students debate whether climate change is happening or not.

Presenting a false balance is unfair to learners because it distracts from teaching current science and can backfire, generating more confusion rather than clarity, however well intended the effort. As we observed in Chapter 2, within the context of using argumentation as a tool for delving into scientific thinking and process, good pedagogy requires argumentation only focus on genuine, contemporary scientific controversies presented at an age- and grade-appropriate level and in a reasonable scope and context.

"Both sides" false balance may also backfire by embedding a myth or misconception more deeply into someone's consciousness. When John Cook first learned from his colleague Stephan Lewandowsky about research showing how efforts to replace faulty information with correct information can backfire by over-emphasizing the myth one is trying to get rid of, he became concerned that Skeptical Science's approach to addressing climate myths was perhaps doing more harm than good.

Cook and Lewandowsky decided to pull together the relevant research into the eight-page *Debunking Handbook* (2011) that can perhaps be summed up as this: "Replace sticky thoughts with even stickier thoughts." Some of the take-home messages from the handbook include the following:

- How people think matters more than what people think.
- Complex cognitive processes are involved when refuting misinformation; it is not simply a matter of replacing a bad concept with the correct one.
- Since not mentioning a familiar myth is not always feasible, it is vital to strongly emphasize the facts you want to communicate.
- Less can be more; a long, complex explanation, even if correct, is less appealing than a simple but incorrect myth.

When individuals have a strongly held opinion or worldview, counter-arguments to correct their view may actually reinforce it. Techniques to overcome this bias include self-affirmation—expressing why a value they cherish makes them feel good—and framing—presenting the information in a way that resonates with their worldview. Finally, when a myth is effectively debunked, it is important to fill the gap with an alternative explanation. Graphics conveying core facts can be invaluable to myth busting and replacement.

There are times when repeating a sticky myth is unavoidable, but recognizing the pitfalls in calling attention to them and avoiding using debate or argumentation about faux scientific controversies can minimize the potential for doing more harm than good.

Contemplating Inequities

For adults and youth in the developed world, one of the factors contributing to the varying states of denial relates to the ethical conundrum of reconciling how we, enjoying the fruits of energy-intensive lives fueled primarily by relatively abundant and inexpensive fossil fuels, are impacting everyone on the planet, especially those who did nothing to contribute to the problem. Kevin Anderson of the Tyndall Centre in the United Kingdom, one of the leading climate research institutions in the world, estimates that 20% of the world's population—primarily the developed world—are responsible for some 80% of the world's greenhouse gas emissions, and that perhaps as little as 1% of the world's population is responsible for half the emissions (2011).

But many classrooms in the U.S. may have their own energy inequities. In classes with a mix of affluent students and students in poverty, having them compare their carbon footprints may reveal wide discrepancies in energy consumption among them, which then presents a delicate and awkward teachable moment that requires sensitivity on the part of the educator.

In their article "Making Energy Access Meaningful" in *Issues in Science and Technology*, Bazilian and Pielke (2013), describing the enormous imbalance of energy consumption in the world, write "Our distinctly uncomfortable starting place is that the poorest three-quarters of the global population still only use about ten percent of global energy—a clear indicator of deep and persistent global inequity" (p.74). A question that

people in the United States must ask is that, as the nation with the largest historic contributions to carbon emissions, do we have an added responsibility to prepare ourselves and the world for global changes already well underway? If so, how do we do that?

Clearly, examining economic and energy inequities and associated responsibilities are difficult and often avoided. Such topics are in many respects more appropriate in a social studies class than a science class, which is another compelling reason why climate and energy topics should be taught across the curriculum through team teaching or with teachers from various disciplines coordinating their lessons and learning goals if possible.

The Six Americas in the Learning Environment

The spectrum of the Six Americas segments discussed previously offers a continuum of the relativity of acceptance, doubt, and denial. Many or all six groups will, in some form, show up in most learning environments, whether in a formal classroom, in a public outreach event, or on websites. Here are a few suggestions on how to identify and address denial and despair in these different segments.

Alarmed. Young learners in particular may feel overwhelmed by what they have learned or heard about climate change. Susie Strife, in research toward her PhD (2009), found that anger about the destruction of nature and fear of the future of the environment are common emotions felt by the ten- to twelve-year-olds she interviewed. Some had learned about environmental issues in school, but television and the Internet were the primary media that shaped their views and concerns about global warming and related topics. Video games and films of post-apocalyptic futures are common and contribute to the pessimistic and in some cases cynical attitude of some young people. Grim scenarios of an energy-constrained, substantially warmed world can indeed be alarming.

While in general people who fall into this segment are relatively more knowledgeable and willing to take action than other groups, there still may be wide variance in literacy in this segment. Some who are alarmed may be less informed on the science and more motivated by what they consider the moral or ethical imperatives of the issue than others. That said, most climate scientists who are current on the latest findings fall into this category.

Many scientists and energy experts have been trying to serve as modern-day Paul Reveres, warning of the consequences of human impacts on climate and the environment, but they have not always been effective or successful in their attempts to sound the alarm. We are now at the point where alarm and worry need to be transformed into a can-do confidence, moving beyond inaction, finger pointing, and blame. Transforming alarm into proactive action requires calmly, methodically assessing the situation and coming up with short-term and long-term strategies to apply appropriate responses: just the type of skills the Next Generation Science Standards are designed to foster.

Concerned and Cautious. These two segments, which between them account for about half of the general population, are made up of people who generally have heard of climate change, likely take it somewhat seriously, but have not made it a priority in their lives as many of the Alarmed have, feeling it isn't an immediate or pressing threat to them personally. A learning community, such as a classroom or a group of collaborating faculty, is likely to include many Concerned and Cautious. Finding ways to make climate- and

energy-related issues engaging and relevant to these willing but uninvolved individuals without going overboard and pushing them into despair is the ticket.

Disengaged. While making up a small percentage of the Six Americas studies—5% in an updated, April 2013 study—in many middle and high school classrooms the percentage may be considerably higher because of apathy and/or peer pressure. The disengagement may be because of outside social factors that an educator may not be aware of or, if aware, unable to address. The disengagement, if manifested as apathy, may be in part because of the real existential quandry that climate change and related challenges pose. To reach learners who are disengaged, it is important to understand why in order to determine whether or how to move forward toward engagement.

Doubtful. Everyone has moments of doubt, but this segment, which among adults in the United States tends to be politically and/or religiously conservative, may resist attributing climate change to human activities on the grounds that humans aren't capable of altering the planet in such a way. In a science classroom, it may be possible to avoid confronting a learner's cultural background by simply saying "we're here to learn about what scientific evidence says about the planet," and if religion comes into the equation, point out that there isn't generally a conflict between religion and climate change. The National Center for Science Education's Clergy Climate Project is collecting signatures and statements from a wide range of religious leaders stating their support for the findings of climate science research and addressing the moral and ethical issues of climate change. In the case of individuals whose cultural upbringing conflicts with current climate science, encouraging an attitude of open-mindedness and inquiry may also open eyes and opportunities.

Dismissive. Determining whether someone is genuinely skeptical, in the best sense of the word, and open to learning from an individual who is locked into his or her opinion is important when dealing with those who appear to dismiss climate science. Rather than immediately jumping to the conclusion that someone is a full-fledged climate-change dissenter, it is worthwhile to reserve judgment, especially in an educational setting, to determine whether or not the person is open to learning or already has their mind made up. In some instances, the concern may be more about the danger of scaring children with alarming projections—a legitimate concern, especially with younger children, which is why age and developmentally appropriate pedagogy should always be applied.

Although a relatively small segment of society, the Dismissives have left their mark on climate education by cultivating doubt, sometimes under the guise of promoting critical thinking, using cherry-picked data points or pseudoscience. While a small minority of white males (McCright & Dunlap, 2011) may make up the core of this group, they can exert oversized influence on educators and learners by encouraging a climate of confusion and controversy.

Addressing Doubt and Denial in the Educational Environment

In conversation, determining whether someone is earnestly trying to understand the science or is actually locked into their opinion is often very straightforward. What is the tone of the question or remark? What's your first thought on where they might fit

in the Six Americas spectrum? If they are genuinely open-minded, then a thoughtful dialogue may be possible, and both parties may learn something, if not about the science involved, at least about the others' insights and perspectives.

In a science classroom of course the situation is different. While classroom management requires the educator to be firmly in the driver's seat to avoid disruptive students from hijacking the class, being sensitive to the cultural and ideological backgrounds of students is obviously vital. What about students who have family members that are convinced that climate change is a United Nations' plot to take away Americans' freedom? As many seasoned educators will attest, encouraging open-mindedness and an attitude of "let's investigate for ourselves" without directly debating conspiracy theories or criticizing students' cultural backgrounds will pay dividends. Assuming climate-related topics are in the standards or curriculum, it can also be appropriate to mention that "By the way, you may be quizzed on this down the line, and besides, it's information that will come in handy for future jobs and decisions you may have to make."

Occasionally, other teachers may undermine efforts to teach solid climate science. This may take the form of a teacher, perhaps not even a science teacher, who disparages climate scientists or Al Gore, encouraging students to be skeptical about climate change. In such instances, the best policy is to bring up the concern with someone in the school administration or, if appropriate, a union representative. If climate change is included in the official school district curriculum, teachers who have signed a contract to teach the curriculum may be in hot water if they don't teach the curriculum as laid out.

On Consensus and Uncertainty

For many years, there has been a significant disconnect between the public's view that climate scientists don't agree as to whether climate change is happening or not and the reality that there is strong agreement in the climate science community that climate is indeed changing because of human activities. Part of the confusion likely lies in the fact that there are two definitions of consensus. One is total, unanimous agreement, and the other that there is strong but not necessarily 100% agreement.

John Cook's Consensus Project (2013), similar to several other studies, has found that 97% of the papers published on climate change that take a stand on human-caused global warming agree that it is happening and humans are the cause. Therefore, those who define consensus as 100% agreement or unanimity may deny or dismiss that climate change is happening and that it is caused by human activity. Those who define consensus as strong agreement would believe the opposite, since there clearly is very robust agreement among the vast majority of peer-reviewed science papers. All major research universities, national academies, and by virtue of their ratifying the UN Framework Convention on Climate Change, 195 nations in the world agree that human activities are the driving force of climate and related global change.

Similarly, the term *uncertainty* conveys doubt and confusion among members of the public. Scientists have typically been taught to lead with their uncertainties, as a way of providing context for the evidence that follows. Often, in scientific parlance, uncertainty relates specifically to measurements and possible range of error or inaccuracy. This is

similar to polling predictions where a margin of error is cited. Thus, the IPCC Fifth Assessment versus the Fourth Assessment raises the likelihood that human activities are responsible for changes in climate from 90% to 95%, meaning that scientists have gone from a 10% chance that humans aren't responsible to a 5% chance, in effect doubling the confidence. The only level higher is a 99% probability, which translates in the conservative voice of science as virtually certain. Doubting that climate change is happening or is as bad as some project can be a way to distance oneself from the ramifications and ultimately the responsibility of taking action.

Philosophic Conundrums and Pedagogical Practices

Philosopher Stephan Gardiner, author of *A Perfect Moral Storm: The Ethical Tragedy of Climate Change*, identifies in his paper "Ethics and Climate Change: An Introduction" (2010) key areas for discussion for climate policy, which also relate to handling denial and despair, the treatment of scientific uncertainty, responsibility for past emissions, the setting of mitigation targets, and the places of adaptation and geoengineering.

In a K–12 science classroom in particular, where the focus should be on mastering the science, assigning responsibility for past emissions or discussing specific mitigation targets may be beyond the scope of the curriculum and more appropriate for other courses. But clarifying scientific uncertainty and examining adaptation and geoengineering are relevant if taught in a grade- and class-appropriate way.

The NSF-funded POLAR project at Barnard College, Columbia University—where climate change has been taught to undergraduate students for over twenty years—has developed a variety of interactive games and role-playing educational programs, including Arctic SMARTIC and Future Coast, that allow learners to think through the complex scientific and social dynamics of polar regions altered by changing climate. Dr. Stephanie Pfirman, who is the overall project lead, found that including adaptation and scenario planning for climate change up front rather than tacked on at the end of the semester resulted in more engaged students who felt inspired and empowered by the focus on things that can be done to minimize climate impacts other than reducing carbon dioxide emissions. For many years there was a concern that opening the door to adaptation planning would distract from reducing emissions, but at least in some educational settings, the proactive, anticipatory planning for impacts can be an important way to overcome despair by offering tangible things to do beyond saving energy.

Indeed, since many climate impacts take the form of natural disasters, including extreme storm events, floods, heat waves, and drought, thinking through ways of preparing for such events, doing the math on risks and probabilities, coming up with contingency plans, and engineering responses is a no-risk way of building community capacity. Such approaches also tie in strongly with the Next Generation Science Standards. The National Climate Assessment, available through http://globalchange.gov, was designed to be accessible on mobile devices, thereby taking advantage of the revolution in mobile learning, and it offers a wealth of information relating to climate adaptation throughout the United States.

Geoengineering is also a topic that many have avoided discussing or teaching as a realistic option, but given that we are currently engaged in a massive if unintended geoengineering experiment on the Earth's climate and environmental systems, the range of strategies that are being proposed to offset and counter the effect of carbon emissions on the climate system do have a place in the overall equation. Examining these strategies may also provide opportunities for learners to delve into cutting-edge science, technology, engineering, and mathematics to weigh their practical—and ethical—pros and cons. The majority of the proposals are fraught with ethical, political, and practical issues, particularly the potential for unintended consequences. The two primary strategies are

- Solar radiation management schemes, including cloud modification and altering albedo and land-cover on the Earth's surface or building a sunshade in space to reduce incoming solar energy; and
- Greenhouse gas remediation other than reducing emissions, including carbon capture and sequestration, air-capture through chemical processes, ocean fertilization with iron or urea, and biochar—a form of charcoal that, when buried, sequesters carbon in the ground, improves soil fertility, and acts as a carbon filter for groundwater recharge.

Because geoengineering covers such a range of options, some far-fetched, some inherently low-tech and practical, it cannot be immediately written off. That said, in an educational setting, such as a science classroom, the topic should be introduced in a grade- or course-appropriate way, since learners should understand the basic climate system and how humans are impacting the system before they tackle an analysis of possible solutions.

Klaus Lackner, Director of the Lenfest Center for Sustainable Energy at Columbia University, works on carbon capture and sequestration strategies but was inspired by his daughter's eighth-grade science fair project that extracted carbon dioxide from the air using a fish pump and sodium hydroxide. See the PBS video of Dr. Lackner's project, which is included in the CLEAN collection: http://cleanet.org/resources/43035.html. Other projects, such as Global Thermostat—http://globalthermostat.com—which uses thermal processes to capture carbon dioxide, and New Sky Energy—http://www.newskyenergy.com—which extracts it from wastewater, offer examples of emerging entrepreneurial opportunities that take advantage of cutting-edge science.

Dealing With Despair

In his comments about "where to go from here," Jorg Friedrichs, author of *The Future Is Not What It Used to Be* (2013), suggests that we may well be heading for a hard landing when even well-informed people are unable or unwilling to confront what he describes as "the transitory nature of industrial society." His solution is for the moral individual to live "in the truth" because:

> Life is tragic and sometimes there are no solutions . . . Insofar as climate change and energy scarcity are part of the human predicament, even the most

> accurate diagnosis is unlikely to suggest an easy cure. And yet, my mission as a scholar is to get to the bottom of things regardless of whether or not there is a solution. This does not mean that, as a citizen and consumer, I am better than anyone else. My task as a scholar is not to save the planet or pose as an ecological do-gooder. It is plain old-fashioned intellectual honesty. (p. 170)

He acknowledges that many readers will find his conclusions depressing, especially those who believe the problems can easily remedied simply through politics or local activism. Hoping he is ultimately proven wrong, he suggests two tools—resilience thinking and preventing loss of self-identity—that may prove helpful. The first will require rethinking how we harness energy and in a sense reinventing the goodness of our humanity through our values. He is convinced, however, that sustaining the status quo, just making the current system more resilient won't work: More needs to be done.

Friedrich suggests that emergency measures need to be taken to prevent loss of self-identity, which is vital for individuals to have in order to successfully engage in society and help transform it. Loss of identity occurs on every level of society, and young people, who are in the process of forming their self-identify, are vulnerable to becoming alienated from others and from their environment unless they are given the knowledge to both know themselves and know the challenges facing the future. Arguably, many people numb themselves with video games, substances, and consuming because the pain of facing the world as it is is too much to bear. Overcoming apathy, doubt, and denial in order to make the topic come alive as interesting and relevant is vitally important.

Not all learners will necessarily be troubled by negative emotions or despair. Individuals can be remarkably resilient even in the most challenging circumstances, accepting the "facts of life" and then asking, "What do I do about it?" This opens the door to taking action, however small or tentative that first step might be.

In a sense, data about climate and energy are neutral—just numbers. The context and implications are not: Humanity faces massive challenges on every level, and pessimism is a natural response for many of us. Confronting the despair, cutting through the denial, recognizing that there are options, and focusing on interdisciplinary education and lifelong learning—inherently optimistic enterprises if ever there were ones—gives us practical tools and visionary strategies for the future. Taking action is an important part of that future, and potentially part of the fun, as we'll see in Chapter 8.

Additional Resources

Biochar, International. (n.d.). International Biochar Initiative website. Retrieved from http://www.biochar-international.org

This organization offers an interdisciplinary and integrating theme that allows learners to explore many facets of the carbon cycle. The International Biochar Initiative has begun to collect examples of student projects.