

北京师范大学  
研究生英语

《学术英语读译》课程材料

2021~2022 学年秋季学期

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## Unit 1

### TEXT A

#### Why Study Humanities? What I Tell Engineering Freshmen

John Horgan

1. What's the point of the humanities? Of studying philosophy, history, literature and "soft" sciences like psychology and poly sci? The Commission on the Humanities and Social Sciences, consisting of academic, corporate, political and entertainment big shots, tries to answer this question in a big new report to Congress. The report is intended to counter plunging enrollment in and support for the humanities, which are increasingly viewed as "luxuries that employment-minded students can ill afford," as *The New York Times* put it.
2. Titled "The Heart of the Matter," the report states: "As we strive to create a more civil public discourse, a more adaptable and creative workforce, and a more secure nation, the humanities and social sciences are the heart of the matter, the keeper of the republic—a source of national memory and civic vigor, cultural understanding and communication, individual fulfillment and the ideals we hold in common. They are critical to a democratic society and they require our support."
3. I find this a bit grandiose, and obscure. I have my own humble defense of the humanities, which I came up with a couple of years ago, when I started teaching a new course required for all freshmen at Stevens Institute of Technology. The syllabus includes Sophocles, Plato, Thucydides, Shakespeare, Descartes, Hobbes, Locke, Kant, Mill, Marx, Nietzsche, William James, Freud, Keynes, Eliot—you know, Greatest Hits of Western Civilization.
4. I love teaching the class, but I don't assume that students love taking it. So on the first day of class I ask my wary-looking students, "How many of you would skip this class if it wasn't required?" After I assure them that they won't hurt my feelings, almost all raise their hands.
5. When I ask what the problem is, they say they came to Stevens for engineering, computer science, physics, pre-med, finance, digital music production, etc. They don't see the point of reading all this old impractical stuff that has nothing to do with their careers. When I ask them to guess why Stevens inflicts this course on them, someone usually says, smirking, "To make us well-rounded."
6. Whenever I get the "well-rounded" response, I want to reply, "Does 'well-rounded' mean, like, chubby?" But I don't want to offend overweight students. Instead I say, "I don't really know what 'well-rounded' means. Does it mean being able chitchat about Shakespeare at cocktail parties? I don't care about that." Then I give them my pitch for the course, which goes something like this:
7. We live in a world increasingly dominated by science. And that's fine. I became a science writer because I think science is the most exciting, dynamic, consequential part of human culture, and I wanted to be a part of that. Also, I have two college-age kids, and I'd be thrilled if they pursued careers in science, engineering or medicine. I certainly want them to learn as much science and math as they can, because those skills can help you get a great job. But it is precisely because science is so powerful that we need the humanities now more than ever. In your science, mathematics and engineering classes, you're given facts, answers, knowledge, and truth.

Your professors say, “This is how things are.” They give you certainty. The humanities, at least the way I teach them, give you uncertainty, doubt and skepticism.

8. The humanities are subversive. They undermine the claims of all authorities, whether political, religious or scientific. This skepticism is especially important when it comes to claims about humanity, about what we are, where we came from, and even what we can be and should be. Science has replaced religion as our main source of answers to these questions. Science has told us a lot about ourselves, and we’re learning more every day.

9. But the humanities remind us that we have an enormous capacity for deluding ourselves. They also tell us that every single human is unique, different than every other human, and each of us keeps changing in unpredictable ways. The societies we live in also keep changing—in part because of science and technology! So in certain important ways, humans resist the kind of explanations that science gives us.

10. The humanities are more about questions than answers, and we’re going to wrestle with some ridiculously big questions in this class. Like, what is truth anyway? How do we know something is true? Or rather, why do we believe certain things are true and other things aren’t? Also, how do we decide whether something is wrong or right to do, for us personally or for society as a whole?

11. Also, what is the meaning of life? What is the point of life? Should happiness be our goal? Well, what on earth is happiness? And should happiness be an end in itself or just a side effect of some other more important goal? Like gaining knowledge, or reducing suffering? Each of you has to find your own answer to these questions. Socrates, one of the philosophers we’re going to read, said wisdom means knowing how little you know. Socrates was a pompous, but there is wisdom in what he says about wisdom.

12. If I do my job, by the end of this course you’ll question all authorities, including me. You’ll question what you’ve been told about the nature of reality, about the purpose of life, about what it means to be a good person. Because that, for me, is the point of the humanities: they keep us from being trapped by our own desire for certainty.

13. Postscript: My Stevens colleague Garry Dobbins, a philosopher, likes to give me a hard time, and I him, but I’m always provoked by his take on things, like this response to my post: “As to the Humanities being to teach us a healthy skepticism, we might all agree that this is indeed one of the consequences of such an education; but if this is necessary, as you make it out, because learning science alone we do not learn the importance, or necessity of ‘uncertainty, doubt and skepticism,’ something strange and even perverse has befallen the study of science! Those taking seriously the study of the history of science, for instance, will know that there was a time when science assumed the cultural pre-eminence it still occupies among us precisely because it did not teach dogmas, or as you put it, ‘certainty.’ On the contrary; scientific studies from the early modern period down to the early twentieth century, anyway, were liberal studies. Surely the justification of study of the Humanities, history, literature, philosophy and the rest, is not fundamentally different than the justification for the study of science. There are forces at work in human life, whether material or spiritual, which we seek to master, so far as possible. The language in which we express our knowledge of physical forces obeys somewhat different logical rules to that in which we express our knowledge of economics for example: but this doesn’t mean that the one is less knowledge, or logical, or important, than the other, surely! That you speak of the kind of knowledge to be gained by close study of Shakespeare, Thucydides, or Plato, as ‘impractical’

surely goes to show a misunderstanding as to what is practical in a human life. Unless you can show good reason to believe Socrates mistaken in thinking that self-knowledge is only reliable foundation for a good life.”

14. I responded: “Garry, you’re right that science if properly taught should incorporate skepticism. But science is becoming increasingly dogmatic and arrogant in our era, which is why we need the humanities to foster a healthy anti-dogmatism.”

## TEXT B

### Why A Liberal Arts Education Matters?

Susan M. Di Biase

1. Most college students, and parents of college students, believe the goal of college is to secure a practical education that will lead to a first real job. They know that today’s job market is competitive and uncertain. Their investment of money and time and effort to gain an education needs to pay off.

2. Of course, most people do need to earn a living for themselves and their families. But isn’t getting a college education about more than just survival? Those of us who support the liberal arts and sciences say it is. We urge students to ask themselves two questions:

Am I preparing myself for my first job or for my whole career?

Am I educating myself only for work or also for life?

Those students who aspire to higher goals may be interested in learning more about why the liberal arts education matters. First of all, what are the liberal arts?

#### **What is liberal arts education?**

3. The term “liberal education” was first used in classical Greek and Roman times. It was chosen to emphasize the fact that education was not available for the many people in those societies who were held in slavery, but only for those who were free. The reference to liberty was included in the term because people who were educated started out free, and became more free as their education progressed. The Greeks and Romans recognized that education arms a person to confront the influence of others critically. Such a person is less easily manipulated and deceived. Still today, in order to form a more perfect union, we need citizens who are informed, discerning, and morally courageous. (Liberal) education forms the basis of every democratic society.

4. In *The Republic*, the Greek philosopher Plato explained how a well-rounded education should include the study of astronomy, mathematics, music and poetry. Of course our fields of knowledge have grown “astronomically” since his day, but his basic message underlies the tradition of liberal arts education. Plato taught his students to appreciate logic and order, ideals and beauty. Later teachers included the study of the growing fields of science and the burgeoning wealth of literature. They broadened the study of societies, governments, and history. But the main purpose of traditional liberal education stayed the same. It was designed to develop one’s critical faculty, so necessary to the pursuit of wisdom and virtue. Isn’t this aim still relevant today?

### **Relevance of liberal education in today's world**

5. Some people argue that wisdom and virtue are much less important than job training. They are not sure it benefits young people in this world to have ideals they feel passionately about, to have broad interests that excite and consume them, and to have an awareness of the joys and sorrows of people who live far away, or next door. This may be too much to ask, they argue, of the ordinary person struggling to make a living. Better to focus on learning some specific set of skills, because then at least one has a chance of getting a job.

6. Does a broad, idealistic, liberating education also prepare a person to be valuable to a company? Many business leaders say it does. They argue that the job market has changed. Workers no longer stay at one company doing the same job until retirement. Technology drives change at such a pace that in less than five years, most facts college students learn are out of date. Business recruiters are looking for graduates who are inventive and flexible enough to learn new skills. Many students and parents worry about the short-term: preparing for the first real job. Most corporate executives, however, value an education that prepares one for a lifetime of imaginative and productive work. Indeed, business leaders know that survival in today's unstable job market depends upon the intellectual discipline that only a liberal education can offer.

### **Strengths for employment**

7. Education in the arts, sciences, and humanities develops in students three types of skills that employers prize above all others. These are reasoning skills, communication skills, and social skills.

#### *Reasoning skills*

8. Educators know that graduates must have strong reasoning and problem-solving abilities to succeed in today's workplace. Graduates must be able to think logically and critically to solve problems on the job. They must also be imaginative. Employers appreciate graduates who have learned to be enthusiastic about learning, who are willing to develop new skills and try new methods and technologies. A liberal arts education is valuable because it teaches students to ask questions that matter, to weigh conflicting evidence, to appreciate the complexity of situations, and to develop logical, convincing arguments for solutions.

9. A student who studies the liberal arts chooses to learn something about a lot of different fields: the arts, the sciences, the humanities. This develops the ability to see connections among very different ideas and very different approaches to studying the world. Study in the liberal arts trains the brain to be flexible: to think logically, yes, but metaphorically as well. Scientists now know that new linkages in the brain (called synapses) are actually formed when the brain is being used in new ways. The student develops the ability to analyze, or break ideas into parts, and to synthesize, to bring parts together to make a whole. These are considered the most difficult intellectual skills, and the person who has developed them gains a wider perspective and greater mental agility.

#### *Communication skills*

10. Such intellectual agility also develops the student's ability to organize and communicate

thoughts. Employers search for graduates who are able to communicate ideas clearly and coherently, who can be articulate and persuasive in proposing new ideas. Communication skills divide those who move up the career ladder from those who stagnate. Although many people can master the technical skills of a job, very few have the communication skills needed to present a truly professional image in speech and writing.

#### *Social skills*

11. Finally, employers want to hire people who have strong social skills, people who cooperate well with others. Having studied literature, history, and the social sciences, such people appreciate the variety of humanity. They treat people who are unlike them with respect and understanding. They are sensitive to cultural and economic differences. People with strong social skills are idealistic enough to strive for cooperation and fairness. They can inspire a team with enthusiasm. They make better leaders, and better citizens.

#### **Strengths for living**

12. These broad skills in reasoning and communication form the basis for success in one's personal aspirations as well. Emphasizing the utility of education for job training creates a false dichotomy between work and the rest of life. Our capitalistic society overemphasizes people's roles as producers and consumers of material goods. Overlooked are our roles as citizens and voters, spouses and parents, Girl Scout troop leaders, soccer coaches, church choir members, and neighbors. Liberal education encourages students to consider their eventual roles in working for the good of individuals and of the community. It encourages students to consider which values they would like to express through a good and decent life. It encourages students to view their experiences in the larger context of history and social change. This gives young people a greater sense of purpose in life. This sense, often missing from the lives of young people today, is that of feeling involved in the great effort at civilization and moral progress, which began before we were born and will continue long after we die.

13. One of the saddest results of narrowing the goal of education is that it causes students to overlook the lifelong rewards of a broad education in the arts, sciences, and humanities. Chief among these is the joy of learning. Learning something about a lot of subjects leads to a greater curiosity about the natural world and how it is represented and understood. It infuses it with greater meaning and joy. Watching children play on a bright spring day calls to mind a poem by William Blake. Seeing a magnificent bridge spanning an ancient river leads to a reflection on the years it took the waters to carve the streambed, and the years it took human beings to learn enough to build the bridge. Education is like a Fountain of Youth: it allows people to see the world with the wisdom of the ages, but with minds that are forever curious, forever young.

14. The best thing about a broad, thorough, liberal education is that it can never be taken away. Students sometimes ask, "Why do we have to study chemistry (or history, or foreign languages) when we will never use this stuff again?" The answer is very simple. One may never use chemical formulas again, but studying chemical formulas makes one's brain work better. One sees connections more quickly. One's thoughts are organized more clearly. It's like sweeping the cobwebs out of your head. Teachers have known for centuries that studying different subjects trains



the mind to work in different ways: analytically, synthetically, creatively, logically, metaphorically. And now, scientists know that studying different subjects actually change the biochemical structure of the brain, forming new connections that make it more limber and agile. One is changed forever, and this is the greatest gift. Liberal arts education enriches life in ways that can't be measured in terms of money, and that beg to be handed down.

## Unit 2

### TEXT A

#### Can a “Triple Package” of Personality Traits Explain Success? The “tiger mother” thesis is refuted by science

Daisy Grewal

1. In 2011, Yale law professor Amy Chua became a household name after publishing her book *Battle Hymn of the Tiger Mother*, a memoir documenting her draconian parenting style. Chua generated lots of publicity for her shock value anecdotes, like the time she threatened to burn all her daughter's stuffed animals as consequence for playing poorly on the piano. Chua claims that her parenting techniques were not only typical of Chinese immigrants, but explained why Chinese Americans, on average, have educationally outperformed other ethnic groups.
2. Three years later, Chua collaborated with her husband and fellow Yale law professor, Jed Rubenfeld, to write a book that makes even bolder claims about how cultural differences explain group disparities in success. In *The Triple Package: How Three Unlikely Traits Explain the Rise and Fall of Cultural Groups in America*, Chua and Rubenfeld argue that a unique combination of three personality traits are the magic formula behind achievement. The three traits are: a belief in the superiority of one's own group, a tendency towards feelings of insecurity, and the ability to control one's impulses. According to the book, individuals who belong to cultures that emphasize these three traits tend to do better. As examples of their theory at work, Chua and Rubenfeld point out the greater success of Mormons, Nigerians, Persians, Cubans, Indians, East Asians, Lebanese, and Jews.
3. Chua and Rubenfeld's book was met with harsh opposition, particularly from Asian Americans who objected to what they saw as the perpetuation of the “model minority” stereotype—the idea that Asian Americans tend to do well because of a cultural emphasis on work ethic, family values, and conformity. (Chua is Chinese.) Like all stereotypes, the model minority stereotype ignores the vast diversity within the Asian American population as well as the challenges faced by many people within that group.
4. The book also received praise from critics who lauded its frank discussion of an important question: why do some groups in America, on average, tend to do better than others? If one examines Chua and Rubenfeld's theory closely, it becomes apparent that it is ultimately psychological rather than cultural: they propose that a specific combination of psychological traits can explain success, and they believe that people from certain groups are more likely to possess

them. Joshua Hart and Christopher Chabris, both psychology professors at Union College, decided to empirically test the “triple package” hypothesis, using two studies with a combined online sample of over 1200 adults of various ethnic backgrounds.

5. The researchers deliberately chose to study a sample of representative Americans, rather than members of the successful groups mentioned by Chua and Rubenfeld, since this would offer a stronger test of the theory. If the presence of these three traits predict success, regardless of one’s ethnic or cultural group, then one might more confidently conclude that it is the combination of traits—rather than some other reason—that leads to greater success.

6. The triple package’s first trait, a belief in the superiority of one’s own group, was measured with a scale that asked respondents how much they agree with statements such as, “Most other cultures are backward compared to my culture.” Measuring insecurity, the second trait, proved a bit more complex because Chua and Rubenfeld argue in their book that insecurity can take many forms including low self-esteem, feelings of danger, or fear of losing what one already has. Therefore, the researchers measured insecurity using multiple scales. They combined their participants’ scores on these scales and identified the following three factors of insecurity: personal insecurity, contingent self-worth, and family insecurity. For “control,” the third trait, they used scales of impulsiveness, conscientiousness, and grit.

7. The researchers also measured their participants’ cognitive abilities through vocabulary and mathematical reasoning tests. Although Chua and Rubenfeld’s theory does not emphasize intelligence, past research has shown that general cognitive abilities are one of the strongest predictors of achievement and success. Finally, to measure life success, Hart and Chabris had their participants report on their annual income, level of education, and honors and awards they have received. All of these measures of success were combined to create a single, combined “success” variable.

8. The researchers used regression analysis to determine the strength of the relationship between the personality traits and self-reported success. The findings did not support Chua and Rubenfeld’s triple package theory of traits. The participants reporting the most success were not the ones who scored highly on all three traits. Instead, the biggest predictors of success were cognitive ability and parental education. Also, in direct contradiction to Chua and Rubenfeld’s theory, greater personal insecurity was related to less success in life.

9. There were, however, a couple of isolated findings that did support elements of the triple package hypothesis. Participants who scored higher on contingent self-worth reported greater success. People with high contingent self-worth tend to rely more on outer circumstances, such as the praise of other people, in order to feel good about themselves. It makes sense that people who have a high need for external approval would work harder to achieve outward success. In addition, there was a small but significant correlation between feelings of group superiority and attaining a higher income. In other words, the more hubris that participants expressed about their own ethnic group, the more money they reported making. Despite these individual findings in support of the theory, Hart and Chabris found no consistent evidence that it is the unique combination of the three traits—group superiority, personal insecurity, and impulse control—that leads to greater success.

10. If Chua and Rubenfeld’s theory can’t explain the success of certain groups, then what might? Hart and Chabris point out that, although it seems appealing to think that we can identify a group

of learnable traits that determine success, there is scant evidence for such a formula. The idea of a “triple package” may seem compelling because it seems to fit with our own personal observations and common stereotypes about immigrants. In addition, the theory meshes well with the belief that success depends on one’s hard work and personal qualities, rather than one’s circumstances. But, as best we know, success is best explained by such unsurprising factors as being smart, being conscientious, and having the good fortune of growing up in a financially stable environment.

## TEXT B

### What Drives Success? (excerpt)

Amy Chua & Jed Rubenfeld

1. A seemingly un-American fact about America today is that for some groups, much more than others, upward mobility and the American dream are alive and well. It may be taboo to say it, but certain ethnic, religious and national-origin groups are doing strikingly better than Americans overall. Indian-Americans earn almost double the national figure (roughly \$90,000 per year in median household income versus \$50,000). Iranian-, Lebanese- and Chinese-Americans are also top-earners. In the last 30 years, Mormons have become leaders of corporate America, holding top positions in many of America’s most recognizable companies. These facts don’t make some groups “better” than others, and material success cannot be equated with a well-lived life. But willful blindness to facts is never a good policy. Jewish success is the most historically fraught and the most broad-based. Although Jews make up only about 2 percent of the United States’ adult population, they account for a third of the current Supreme Court; over two-thirds of Tony Award-winning lyricists and composers; and about a third of American Nobel laureates.

2. The most comforting explanation of these facts is that they are mere artifacts of class—rich parents passing on advantages to their children—or of immigrants arriving in this country with high skill and education levels. Important as these factors are, they explain only a small part of the picture. Today’s wealthy Mormon businessmen often started from humble origins. Although India and China send the most immigrants to the United States through employment-based channels, almost half of all Indian immigrants and over half of Chinese immigrants do not enter the country under those criteria. Many are poor and poorly educated. Comprehensive data published by the Russell Sage Foundation in 2013 showed that the children of Chinese, Korean and Vietnamese immigrants experienced exceptional upward mobility regardless of their parents’ socioeconomic or educational background.[...]

3. It turns out that for all their diversity, the strikingly successful groups in America today share three traits that, together, propel success. The first is a superiority complex—a deep-seated belief in their exceptionality. The second appears to be the opposite—insecurity, a feeling that you or what you’ve done is not good enough. The third is impulse control. Any individual, from any background, can have what we call this Triple Package of traits. But research shows that some groups are instilling them more frequently than others, and that they are enjoying greater

success.

4. It's odd to think of people feeling simultaneously superior and insecure. Yet it's precisely this unstable combination that generates drive: a chip on the shoulder, a goading need to prove oneself. Add impulse control—the ability to resist temptation—and the result is people who systematically sacrifice present gratification in pursuit of future attainment. Ironically, each element of the Triple Package violates a core tenet of contemporary American thinking.

5. We know that group superiority claims are specious and dangerous, yet every one of America's most successful groups tells itself that it's exceptional in a deep sense. Mormons see themselves, in the historian Claudia L. Bushman's words, as "an island of morality in a sea of moral decay." Middle East experts and many Iranians explicitly refer to a Persian "superiority complex." At their first Passover Seders, most Jewish children hear that Jews are the "chosen" people; later they may be taught that Jews are a moral people, a people of law and intellect, a people of survivors.

6. That insecurity should be a lever of success is another anathema in American culture. Feelings of inadequacy are cause for concern or even therapy; parents deliberately instilling insecurity in their children is almost unthinkable. Yet insecurity runs deep in every one of America's rising groups; and consciously or unconsciously, they tend to instill it in their children. A central finding in a study of more than 5,000 immigrants' children led by the sociologist Rubén G. Rumbaut was how frequently the kids felt "motivated to achieve" because of an acute sense of obligation to redeem their parents' sacrifices. Numerous studies, including in-depth field work conducted by the Harvard sociologist Vivian S. Louie, reveal Chinese immigrant parents frequently imposing exorbitant academic expectations on their children ("Why only a 99?"), making them feel that "family honor" depends on their success.

7. By contrast, white American parents have been found to be more focused on building children's social skills and self-esteem. There's an ocean of difference between "You're amazing. Mommy and Daddy never want you to worry about a thing" and "If you don't do well at school, you'll let down the family and end up a bum on the streets." In a study of thousands of high school students, Asian-American students reported the lowest self-esteem of any racial group, even as they racked up the highest grades.

8. Moreover, being an outsider in a society—and America's most successful groups are all outsiders in one way or another—is a source of insecurity in itself. Immigrants worry about whether they can survive in a strange land, often communicating a sense of life's precariousness to their children. Hence the common credo: They can take away your home or business, but never your education, so study harder. In combination with a superiority complex, the feeling of being underestimated or scorned can be a powerful motivator.

9. Finally, impulse control runs against the grain of contemporary culture as well. Countless books and feel-good movies extol the virtue of living in the here and now, and people who control their impulses don't live in the moment. The dominant culture is fearful of spoiling children's happiness with excessive restraints or demands. By contrast, every one of America's most successful groups takes a very different view of childhood, inculcating habits of discipline from a very early age—or at least they did so when they were on the rise.

10. In isolation, each of these three qualities would be insufficient. Alone, a superiority complex is a recipe for complacency; mere insecurity could be crippling; impulse control can produce asceticism. Only in combination do these qualities generate drive and what Tocqueville called the “longing to rise.” Needless to say, high-achieving groups don’t instill these qualities in all their members. They don’t have to. A culture producing, say, four high achievers out of 10 would attain wildly disproportionate success if the surrounding average was one out of 20.

## Unit 3

### TEXT A

#### Can Emotional Intelligence Be Taught?

Jennifer Kahn

1. One day last spring, James Wade sat cross-legged on the carpet and called his kindergarten class to order. Lanky and soft-spoken, Wade has a gentle charisma well suited to his role as a teacher of small children: steady, rather than exuberant. When a child performs a requested task, like closing the door after recess, he will often acknowledge the moment by murmuring, “Thank you, sweet pea,” in a mild Texas drawl.

2. As the children formed a circle, Wade asked the 5-year-olds to think about “anything happening at home, or at school, that’s a problem, that you want to share.” He repeated his invitation twice, in a lulling voice, until a small, round-faced boy in a white shirt and blue cardigan raised his hand. Blinking back tears, he whispered, “My mom does not like me.” The problem, he said, was that he played too much on his mother’s iPhone. “She screams me out every day,” he added, sounding wretched.

3. Wade let that sink in, then turned to the class and asked, “Have any of your mommies or daddies ever yelled at you?” When half the children raised their hands, Wade nodded encouragingly. “Then maybe we can help.” Turning to a tiny girl in a pink T-shirt, he asked what she felt like when she was yelled at.

“Sad,” the girl said, looking down.

“And what did you do? What words did you use?”

“I said, ‘Mommy, I don’t like to hear you scream at me.’”

4. Wade nodded slowly, then looked around the room. “What do you think? Does that sound like a good thing to say?” When the kids nodded vigorously, Wade clapped his hands once. “O.K., let’s practice. Play like I’m your mommy.” Scooting into the center of the circle, he gave the boy, Reedhom, a small toy bear to stand in for the iPhone, then began to berate him in a ridiculous booming voice. “Lalalala!” Wade hollered, looming overhead in a goofy parody of parental frustration. “Why are you doing that, Reedhom? Reedhom, why?” In the circle, the other kids rocked back and forth in delight. One or two impulsively begin to crawl in Reedhom’s direction, as if joining a game.

5. Still slightly teary, Reedhom began to giggle. Abruptly, Wade held up a finger. “Now, we talked about this. What can Reedhom do?” Recollecting himself, Reedhom sat up straight. “Mommy, I don’t like it when you scream at me,” he announced firmly.

“Good,” Wade said. “And maybe your mommy will say: ‘I’m sorry, Reedhom. I had to go somewhere in a hurry, and I got a little mad. I’m sorry.’” Reedhom solemnly accepted the apology—then beamed as he shook Wade’s hand.

6. **Wade’s approach**—used schoolwide at Garfield Elementary, in Oakland, Calif.—is part of a strategy known as **social-emotional learning**, which is based on the idea that emotional skills are crucial to academic performance.

7. “Something we now know, from doing dozens of studies, is that emotions can either enhance or hinder your ability to learn,” Marc Brackett, a senior research scientist in psychology at Yale University, told a crowd of educators at a conference last June. “They affect our attention and our memory. If you’re very anxious about something, or agitated, how well can you focus on what’s being taught?”

8. Once a small corner of education theory, S.E.L. has gained traction in recent years, driven in part by concerns over school violence, bullying and teen suicide. But while prevention programs tend to focus on a single problem, the goal of social-emotional learning is grander: to instill a deep psychological intelligence that will help children regulate their emotions.

9. For children, Brackett notes, school is an emotional caldron: a constant stream of academic and social challenges that can generate feelings ranging from loneliness to euphoria. Educators and parents have long assumed that a child’s ability to cope with such stresses is either innate—a matter of temperament—or else acquired “along the way,” in the rough and tumble of ordinary interaction. But in practice, Brackett says, many children never develop those crucial skills. “It’s like saying that a child doesn’t need to study English because she talks with her parents at home,” Brackett told me last spring. “Emotional skills are the same. A teacher might say, “Calm down!”—but how exactly do you calm down when you’re feeling anxious? Where do you learn the skills to manage those feelings?”

10. A growing number of educators and psychologists now believe that the answer to that question is in school. George Lucas’s Edutopia foundation has lobbied for the teaching of social and emotional skills for the past decade; the State of Illinois passed a bill in 2003 making “social and emotional learning” a part of school curricula. Thousands of schools now use one of the several dozen programs, including Brackett’s own, that have been approved as “evidence-based” by the Collaborative for Academic, Social and Emotional Learning, a Chicago-based nonprofit. All told, there are now tens of thousands of emotional-literacy programs running in cities nationwide.

11. The theory that kids need to learn to manage their emotions in order to reach their potential grew out of the research of a pair of psychology professors—John Mayer, at the University of New Hampshire, and Peter Salovey, at Yale. In the 1980s, Mayer and Salovey became curious about the ways in which emotions communicate information, and why some people seem more able to take advantage of those messages than others. While outlining the set of skills that defined this “emotional intelligence,” Salovey realized that it might be even more influential than he had originally suspected, affecting everything from problem solving to job satisfaction: “It was like, this is predictive!”

12. In the years since, a number of studies have supported this view. So-called non-cognitive skills—attributes like self-restraint, persistence and self-awareness—might actually be better predictors of a person’s life trajectory than standard academic measures. A 2011 study using data collected on 17,000 British infants followed over 50 years found that a child’s level of mental well-being correlated strongly with future success. Similar studies have found that kids who develop these skills are not only more likely to do well at work but also to have longer marriages and to suffer less from depression and anxiety. Some evidence even shows that they will be physically healthier.

13. This was startling news. “Everybody said, Oh, it’s how kids achieve academically that will predict their adult employment, and health, and everything else,” recalls Mark Greenberg, a Penn State University psychologist. “And then it turned out that for both employment and health outcomes, academic achievement actually predicted less than these other factors.”

14. Should social-emotional learning prove successful, in other words, it could generate a string of benefits that far exceeds a mere bump in test scores. This prospect has led to some giddiness among researchers. Maurice Elias, a psychology professor at Rutgers University and the director of the Rutgers Social-Emotional Learning Lab, has lauded emotional literacy as “the missing piece” in American education.

15. But finding ways to measure emotional awareness—never mind its effects—is tricky. It’s also still unclear whether S.E.L. programs create the kind of deep and lasting change they aspire to. The history of education reform is rife with failures: promising programs that succeed in studies, only to falter in the real world. The phenomenon is so common that researchers even have a name for it: the Hawthorne effect—the fact that simply focusing attention on something, like a school, is enough to cause a temporary uptick in performance.

16. The problem of evaluating S.E.L. is compounded both by the variety of “prosocial” programs on offer and by the ways in which they end up being used in the classroom. Some of them—including one of the most popular, Second Step—are heavily scripted: teachers receive grade-appropriate “kits” with detailed lesson plans, exercises and accompanying videos. Others, like *Facing History and Ourselves*—in which children debate personal ethics after reading the fictionalized letters of a Nazi colonel and a member of the French Resistance—are more free-form: closer to a college philosophy seminar than to a junior-high civics class. “‘Mindful eating’ is social-emotional learning, according to some people,” Brackett told me. “It’s a mess. Everybody wants to jump on the bandwagon.”

17. David Caruso, a psychologist who does consulting and training in emotional intelligence, has called the current boom in social-emotional programs “promising,” but he worries that the field might be getting ahead of itself. “There are people who want to write this into the Common Core right now,” Caruso told me. “But before we institutionalize this, we’d better be sure that it makes a difference in the long run.”

18. Leataata Floyd Elementary, a school in a low-income part of Sacramento, has few problems with gangs or guns but a long history of dysfunction. Until recently, the staff attrition rate was more than 20 percent a year, and student test scores were regularly among the lowest in the state. Before the current principal, Billy Aydlett, was hired in 2010, there were six separate principals in five years.

19. Not long after he arrived, Aydlett created a detailed plan to boost the school's academic performance. He recruited a roster of highly regarded teachers and developed an aggressive new curriculum full of rich and invigorating lessons. Once the school year started, however, it became clear that the new strategy was a bust. "Literally within the first month of school, we realized that we hadn't planned for the right thing," Aydlett recalled when I visited the school last spring. "What we discovered was that these kids weren't going to be able to make progress on the academics until they'd gotten help with their social and emotional issues."

20. With the district's support, Aydlett attended social-emotional learning training. The program was an unlikely choice for Aydlett—a socially awkward man who confesses to being "awful" at ordinary human encounters. But since beginning the emotional-literacy work, Aydlett said, he had become more aware of interpersonal dynamics, and even made going on a vacation with his wife a priority—something he never bothered to do before. ("I didn't see the point in that kind of connectedness," he admitted. "But I've learned that it's important.") On the morning I visited, he stood greeting children at the gate with high-fives, then led me to the classroom of Jennifer Garcia, who teaches second grade.

21. As Aydlett and I watched, Garcia walked her class through an exercise in nonverbal cues, asking the children to imagine times when they felt sad or angry or frustrated, and then to freeze in those expressions and postures. As the kids slumped forward in exaggerated positions of woe, Garcia complimented them on small details: a bowed head or hangdog expression. Afterward, Garcia turned to the class. "This is the thinking part of your brain," she said, holding up her thumb. She pointed to her fingers. "And this is the feeling part of your brain." Folding her thumb into the center of her palm, she closed her fingers around it. "When we have strong emotions, the thinking part of our brain can't always control them," Garcia explained, wagging her fist. "What do we do in those moments?" As the kids called out answers—counting to five, "self-talk," "dragon breaths" (a kind of deep-breathing exercise)—Garcia nodded.

22. Such strategies may seem simplistic, but researchers say they can have a profound effect. When I spoke with Mark Greenberg, who developed a social-emotional curriculum known as Paths (Promoting Alternative Thinking Strategies), he noted that repeatedly practicing these skills means they gradually become automatic. "The ability to stop and calm down is foundational in those moments."

23. The value of such skills was evident later that day, when I sat in on a fourth-grade class meeting, in which students worked through interpersonal conflicts as a group. Sitting in a circle on the carpet, Anthony, a small boy in a red shirt, began by recounting how he cried during a class exercise and was laughed at by some of the other students. Asked whether he thought the kids were giggling to be mean, or just giggling because they were uncomfortable, Anthony paused. "I think that some people didn't know what to do, and so they giggled," he admitted finally — though he was also adamant that a few of the kids were actually laughing at him. "I was really sad about that," he added.

24. Though Anthony was still upset, his acknowledgment that not all the kids were snickering — that some may just have been laughing nervously—felt like a surprisingly nuanced insight for a 9-year-old. In the adult world, this kind of reappraisal is known as "reframing." It's a valuable skill, coloring how we interpret events and handle their emotional content. Does a casual remark from an acquaintance get cataloged as a criticism and obsessed over? Or is it reconsidered and dismissed as



unintentional?

25. Depending on our personalities, and how we're raised, the ability to reframe may or may not come easily. Richard Davidson, a neuroscientist at the University of Wisconsin-Madison, notes that while one child may stay rattled by an event for days or weeks, another child may rebound within hours. (Neurotic people tend to recover more slowly.) In theory, at least, social-emotional training can establish neurological pathways that make a child less vulnerable to anxiety and quicker to recover from unhappy experiences. One study found that preschoolers who had even a single year of a social-emotional learning program continued to perform better two years after they left the program; they weren't as physically aggressive, and they internalized less anxiety and stress than children who hadn't participated in the program.

26. It may also make children smarter. Davidson notes that because social-emotional training develops the prefrontal cortex, it can also enhance academically important skills like impulse control, abstract reasoning, long-term planning and working memory. Though it's not clear how significant this effect is, a 2011 meta-analysis found that K-12 students who received social-emotional instruction scored an average of 11 percentile points higher on standardized achievement tests. A similar study found a nearly 20 percent decrease in violent or delinquent behavior.

27. When I spoke with teachers at Leataata Floyd, they reported seeing similar results. One teacher remembered the pre-S.E.L. school as being out of control, with kids throwing food and angrily upending their desks in class. Now, she says, "they may still blow up, but they take responsibility. That's a new thing: they always used to blame somebody else. For them to take responsibility—it's huge."

## TEXT B

### The Complexity Choir Discovering the Harmony of Health

Daniel J. Siegel

1. What is a healthy mind? Is it simply the absence of symptoms and dysfunctions, or is there something more to a life well lived? How can we embrace the diversity of behavior, temperament, values, and orientation across a wide range of cultures and still come up with a coherent definition of health? Just as some scientists are reluctant to define the mind, some people say that we shouldn't define mental health at all, because it is authoritarian to do so—we shouldn't tell others how to be healthy. But how do we account for the universal striving for happiness? How do we understand the cross-culturally recognizable ease of well-being? Positive psychology has offered an important corrective to the disease model by identifying the characteristics of happy people, such as gratitude, compassion, open-mindedness, and curiosity, but is there some unnamed quality that underlies all of these individual strengths?

2. Over the last twenty years, I've come to believe that integration is the key mechanism

beneath both the absence of illness and the presence of well-being. Integration—the linkage of differentiated elements of a system—illuminates a direct pathway toward health. It's the way we avoid a life of dull, boring rigidity on the one hand, or explosive chaos on the other. We can learn to detect when integration is absent or insufficient and develop effective strategies to promote differentiation and then linkage. The key to this transformation is cultivating the capacity for mindsight.

3. In new interventions based on the approach of interpersonal neurobiology, mindsight has helped many people shift the flow of energy and information in their lives toward integration. But why is integration such a powerful tool for transformation? My search for an answer to this question has led to some surprising and practical realizations.

#### The Choir Sings

4. These days, before I define mental well-being in my lectures, I often ask for volunteers to sing in a “complexity choir.” Experienced singers usually break the ice and come bounding up to the front of the room, while others, initially more reticent, slowly find their way to join in. Whether my audience is parents or teachers, therapists or scientists, I know that the best way to help them grasp the power of integration is through immersion in direct experience.

5. My first request is that the newly assembled choir members all sing the same note at the same time, simply humming along in unison. Someone comes up with a mid-range pitch and they quickly settle into a uniform sound. After about half a minute, I hold up my hand to stop them and then make another request. This time I ask them to cover their ears so they can't hear one another, and then, at my signal, launch individually into whatever song with whatever words they'd like to sing. The audience usually laughs when the singers begin, but they quickly get restive, so I hold up my hand again.

6. Finally I ask the singers to choose a song most of them are likely to know and then to sing it together, harmonizing freely as the spirit moves them. This may be the ultimate pickup ensemble, but it's remarkable to hear what happens as a group of teachers or psychotherapists sail into “Oh! Susanna” or “Row-Row-Row Your Boat.” Once the melody is established, individual voices begin to emerge, weaving their harmonies above and below, playing off one another, moving intuitively toward a crescendo before the final notes. Faces light up in choir and audience alike; we are all swept into the flow of the singers' energy and aliveness. At these times, people have said—and I've experienced this as well—there is a palpable sense of vitality that fills the room.

7. At that moment we are experiencing integration at its acoustic best. Each member of the choir has his or her unique voice, while at the same time they are linked together in a complex and harmonious whole. One is never quite certain where the choir will take the song, but the surprises simply highlight the pleasure of a familiar, shared melody. This balance between differentiated voices on the one hand and their linkage on the other is the embodiment of integration.

8. And what about the first two exercises? As you surely could predict, the single-note humming is unchanging, rigid—and after a while, dull and boring. The initial excitement and risk of volunteering gives way to the monotony of the task. The singers may be linked, but they cannot express their uniqueness, their individuality. When differentiation is blocked, integration cannot occur. Without the movement toward integration, the entire system moves away from complexity—away from harmony—and into rigidity.

9. On the other hand, when the singers close their ears and sing whatever they want, what

emerges is cacophony, a chaotic outpouring of sound that often creates a sense of anxiety and distress in the listeners. Now there is no linkage—only differentiation. When integration is blocked in this way, we also move away from complexity, away from harmony. But this time we move toward chaos, not rigidity.

10. As the singers settle into their seats again, I sum up the point of the exercise: It is the middle way between chaos and rigidity—the flow of independent voices linked together in harmony—that maximizes both complexity and vitality. This is the essence of integration.

#### In Search of Integration

11. When I first began to explore the idea of integration, it intuitively felt right that integration would be important to our individual and relational well-being. But I knew of no scientific explanation for why this might be the case. Integration is mentioned, almost as an aside, in numerous disciplines, from the study of emotion and social functions to research into the brain itself. Yet none of these fields seem to give integration a central role, nor do they clarify why integration would be a good thing in life. Take for example the various scientific fields that study emotion. You might be surprised that there is no universal definition of emotion, even among emotion researchers. When I was reviewing the science of emotion for my first book, I discovered formulations like these: Emotion is a fundamental part of a person across the lifespan. Emotion connects body to brain. Emotion links one person to another. Each of these perspectives described an integrative process—yet integration itself was not discussed directly. Perhaps it was being an outsider to emotion research that helped me to see the common feature underlying their quite distinct definitions of what emotion is, what it does, and how it manifests itself in our lives across time.

12. What role could integration and emotion play in our definition of the mind as an embodied and relational process? Why do people use terms such as *emotional well-being* or *emotionally healthy* or *emotionally close* to label mentally healthy states? And what about such expressions as *emotional breakdown* or *emotionally upset*.

13. As a psychotherapist, I'd worked closely with many people in states of distress, states that to me seemed to be characterized as either rigidity or chaos—or both. Individuals might be stuck in depression or paralyzed by fear. They'd find themselves swept into manic rages or flooded with traumatic memories. Sometimes they'd fluctuate between these extremes, stuck in a whirlwind of energy and information, terrified by minds out of control. But why rigidity or chaos? Why would dysfunction fall into these two categories, or some combination of the two? And why did these patterns keep recurring?

14. There was something about these states that seemed the antithesis of the harmony of a more integrated flow. Could these emotional shifts in our lives reflect changes in our states of integration? Perhaps the term *emotions* itself might be defined as “a shift in our state of integration.” If so, emotion researchers—whatever their approach—might be able to agree that impairments to emotional well-being are movements of the mind away from integration. And perhaps—looking even deeper—integration might be the principle underlying health at all levels of our experience, from the microcosm of our inner world to our interpersonal relationships and life in our communities.

#### A Healthy Mind: Complexity and Self-Organization

15. Diving again into the scientific literature, I finally came across an unlikely discipline that could be relevant to our exploration of the mind: a branch of mathematics that focuses on complex systems. Here is a plausible scientific foundation for the benefits of integration—a reason integration is a good thing in our lives.

16. In brief, complexity theory examines systems that are capable of becoming chaotic and are open to receiving input from outside themselves. Thinking in systems terms requires that we focus on the relationships among the elements that interact to compose the “system.” One classic example of a complex system is a cloud—a collection of water molecules capable of random distribution (it can be chaotic), and which receives light and energy such as wind and heat from outside itself (it is open). Complexity theory explores the natural movements of this open and chaos-susceptible system across time—explaining, for example, why clouds emerge, change shape, and dissipate. It seemed to me that human lives also meet these criteria—we are open systems capable of chaotic behavior—so I read on.

17. A complex system is said to regulate its own emergence. This means that the system itself has certain properties that determine how it unfolds over time. This self-organizational process, the way the system shapes its own unfolding, is built from the mathematics of complex systems. There is no programmer, no program, no outside force governing how the system will flow across time. Self-organization emerges from the interactions among the basic elements that comprise the system. Again, if self-organization applies to clouds, it likely applies to other open systems capable of chaos. We are certainly capable—sometimes too much—of becoming chaotic. And we are quite open to influences outside of ourselves—from people we meet, experiences we have in the world, books we read. If these ideas were relevant and true, then perhaps this was an argument for the idea that we too are capable of self-organization. It seemed to me that our triangle of well-being, the system of mind, brain, and relationships, might be more fully understood in these terms, and we might apply the principles of complexity and integration to creating health across each of these three aspects of our lives.

## Unit 4

### TEXT A

#### We Need a Paris Agreement for Plastics

*They're flowing into the natural environment every day at an unprecedented rate*

Dave Ford

1. My entry into the ocean plastics crisis began when our organization, SoulBuffalo, ran the first ever activist-to-industry ocean plastics summit in May of 2019. To imagine the summit, picture 165 senior leaders from Coca-Cola, Dow, Greenpeace, the American Chemistry Council, the World Bank, World Wildlife Fund (WWF) and representatives of some of the world's 15 million

informal waste pickers all stuck on a boat together in the middle of the Atlantic Garbage Patch for four days.

2. These stakeholders have wildly different strategies, visions and objectives. Our mission was to bring them together in the heart of the crisis to ignite new relationships and accelerate action. We snorkeled together in a sea of plastics and hosted boundary-pushing conversations between leaders that don't usually sit in the same room.

3. We saw up close the paradox of plastic, part wonder material, part environmental scourge. Lightweight and strong, plastic preserves food like no other material. Yet it breaks down into microplastics and nanoplastics, which can now be found everywhere in the world—from the deepest oceans to our very own bodies. Every day plastic is flowing into our natural environment at an unprecedented rate—a dump truck's worth every minute into our oceans alone. As I wrote in *Scientific American* in August, the pandemic has made it worse. Enough masks are being made per year to cover the entire country of Switzerland.

4. Confronting this reality together in the Atlantic Garbage Patch built bridges between the plastic industry and environmental NGOs. Five of the ideas workshopped during the summit are funded and up and running today (including the Plastic Pickers Operational Working Group). The summit made a powerful impact, but the crisis is far from resolved. The need for a complete overhaul of our broken system for managing waste is clear. The growing consensus is that the most effective way to do this is through a U.N. Global Treaty on Plastics. In 14 months at United Nations Environmental Assembly's Fifth Session (UNEA-5), the U.N. will decide on whether to move a treaty forward.

5. The 70-plus-member Ocean Plastics Leadership Network, the activist-to-industry network dedicated to the plastics crisis that was born on that ship in the middle of the Atlantic, is committed to accelerating the work towards a "Paris Agreement" for plastics. We are currently at work on a yearlong series of virtual dialogues during the 14-month groundwork period leading up to the UNEA5 decision in February 2022 on whether to develop a global plastics treaty. Our role is to help map consensus amongst major stakeholders to accelerate a plastics treaty. Traditionally, negotiations on global treaties are incredibly hard, and the vast number of stakeholders in the global plastics crisis only adds to the complexity of the task.

6. Among the stakeholders for a new global agreement on plastic pollution are 193 U.N.-recognized governments; thousands of companies dependent on plastic; trade and advocacy groups; activists and industry-facing nonprofits; waste pickers in the developing world who are responsible for picking plastic out of landfills and off beaches; and seven billion consumers who recycle on average 14 percent of the total amount of plastic they consume.

7. We're under no illusion about the scope of this challenge. We must create a safe forum for tough conversations to take place among this vast and varied group in advance of the February 2022 decision to inform negotiators at the U.N. and help advance the treaty. In the words of Costa Rican diplomat Christiana Figueres, who was central to the realization of the Paris Agreement, we must employ "relentless optimism," coupled with "radical collaboration."

8. Despite this complexity, we believe a meaningful global agreement can be reached and that we must make it happen faster than any treaty before. There are good reasons for optimism. In 1988, the International Maritime Organization ratified a global agreement titled MARPOL Annex V making it illegal for ships to dump plastic in the ocean anywhere in the world. It is still in effect

today, proving there's precedent for global agreements to preserve our oceans. All of the Caribbean nations, the Nordic countries and the Pacific Island states have called for a new global agreement. Sixty-eight countries have publicly expressed interest in a plastics treaty, as have a broad coalition of African countries, and the European Union. While the U.S. has been notably silent on the topic, the groundswell of worldwide support is encouraging.

9. In November, the U.K.'s environmental minister declared the time to start negotiating a plastics treaty is now. "We have a chance now to tackle plastic pollution in the way that the Paris agreement has done for climate change," said Lord Zac Goldsmith. There is also hope across the environmental community that the recently elected Biden administration will be a meaningful force on the plastics treaty, as the Obama administration was for climate.

10. Major reports released in 2020 from industry, NGOs and government also provide a useful blueprint to ground discussions. WWF, Ellen MacArthur Foundation and Boston Consulting Group laid out the business case for a global treaty, and 30 major companies have signed onto a "Business Call for a U.N. Treaty on Plastic Pollution." They urged others to join them in advocating for an international response that aligns businesses and governments and offers a clear approach to addressing the plastic crisis.

11. Environmental NGO groups also voiced their support for a plastics treaty in a report from the Center for International Environmental Law, the Environment Investigation Agency and GAIA (Global Alliance for Incinerator Alternatives). The report has the backing of the Break Free from Plastic movement and Greenpeace. Finally, just a few weeks ago, the Nordic Council of Ministers rolled out a 148-page report that provides a suggested framework and positioning for a future treaty.

12. These reports reveal that there is already alignment on some fundamental points. First, they all call for harmonized reporting on plastics throughout their life cycle, making it possible to account for everything that is being made and how it is handled. This requires a standardization of terms for all things plastic, so regions and stakeholders all speak the same language.

13. Second, all the reports recommend national action plans, where each country sets up its own plans to manage waste based on minimum requirements, much as nations do with greenhouse gas emissions under the Paris accord. Finally, the reports agree that scientific panels should monitor progress globally, and a financial mechanism must support developing countries and distribute funds internationally.

14. While environmental organizations (like OPLN member Greenpeace) and industry groups (like OPLN member American Chemistry Council) may agree on some of the basic structures of a global agreement there are still challenging issues to address.

15. Environmental groups call for mandatory plastic reduction goals and enforceable mechanisms in the treaty, as well as limits on new fossil fuel-derived virgin plastic production.

16. Meanwhile, many industry groups believe a treaty can be successful without mandatory reduction goals and heavily emphasize the expansion of advanced recycling or chemical recycling technologies. Many environmental activist groups see the advanced recycling models as a license to continue with the status quo on consumption.

17. A landmark report from the Pew Charitable Trusts, SYSTEMIQ and various academic partners, titled "Breaking the Plastic Wave," points toward a way to help bridge this divide: we need to dramatically ramp up *both* upstream solutions such as reduction goals championed by

environmental groups *and* downstream solutions championed by industry, including fixing our broken mechanical recycling system and investing in new technologies.

18. How long will bridging this divide take? The road to the Paris Agreement actually began in 1991 with the U.N. Framework Convention on Climate Change, and continued with the Kyoto Protocol in 1997, and the failed meetings in Copenhagen in 2009. The Paris Agreement was finally signed in 2016, 25 years after the first framework was agreed upon.

19. The Montreal Protocol, which has been instrumental in repairing our ozone layer, was signed in 1987, 14 years after CFCs were posited to pose a danger—speedy by U.N. standards. A high seas treaty to conserve marine biological diversity in international waters has been under discussion for 12 years now.

20. However, there is a precedent for greater speed when the issue is plastic. The Basel plastic amendments included plastic waste in a legally binding framework to make global trade in plastic waste more transparent and better regulated. This was a major accomplishment, and the time between the first proposal and unanimous adoption by governments was just eight months, previously an unheard-of time frame in which to negotiate an international agreement.

21. Reports such as “Breaking the Plastic Wave” tell us we’re running out of time. We must rapidly accelerate both upstream and downstream solutions to have any chance of solving this crisis. If we delay dramatic action by just five years and maintain current government and industry commitments, an additional 80 million metric tons of plastic will end up in the ocean by 2040 (or about half of all the plastic that has accumulated from the start of the plastics era up to now).

22. Preventing this disaster for ocean ecosystems and human health and well-being requires creating safe spaces for discussion between environmental and industry groups now. The only way forward is to approach the obstacles head-on in the belief that tension equals progress, and that all parties, regardless of their perspective and approach, should have a seat at the table.

23. If we are brave enough to have those conversations, we have reason to be relentlessly optimistic that an ambitious plastics treaty matching the scale and urgency of the problem can be realized in record time.

## TEXT B

### The Climate Emergency: 2020 in Review

*Despite some promising developments, the need for action has grown even more urgent*

William J. Ripple, Christopher Wolf, Thomas M. Newsome, Phoebe Barnard, William R.

Moomaw

1. The climate emergency has arrived and is accelerating more rapidly than most scientists anticipated, and many of them are deeply concerned. The adverse effects of climate change are much more severe than expected, and now threaten both the biosphere and humanity. There is mounting evidence linking increases in extreme weather frequency and intensity to climate change. The year 2020, one of the hottest years on record, also saw extraordinary wildfire activity in the

Western United States and Australia, a Siberian heat wave with record high temperatures exceeding 38 degrees C (100.4 degrees Fahrenheit) within the Arctic circle, a record low for October Arctic sea ice extent of 2.04 million square miles, an Atlantic hurricane season resulting in more than \$46 billion in damage, and deadly floods and landslides in South Asia that displaced more than 12 million people.

2. Every effort must be made to reduce emissions and increase removals of atmospheric carbon in order to restore the melting Arctic and end the deadly cycle of damage that the current climate is delivering. Scientists now find that catastrophic climate change could render a significant portion of the Earth uninhabitable consequent to continued high emissions, self-reinforcing climate feedback loops and looming tipping points. To date, 1,859 jurisdictions in 33 countries have issued climate emergency declarations covering more than 820 million people.

3. In January 2020, we warned of untold human suffering in a report titled World Scientists' Warning of a Climate Emergency with more than 11,000 scientist signatories from 153 countries at time of publication. As an Alliance of World Scientists, we continue to collect signatures from scientists, with now more than 13,700 signatories. In our paper, we presented graphs showing vital signs of very troubling climate change trends with little progress by humanity. Based on these trends and scientists' moral obligation to "clearly warn humanity of any catastrophic threat" and to "tell it like it is," we declared a climate emergency and proposed policy suggestions. We called for transformative change with six steps involving energy, short-lived air pollutants, nature, food, economy and population.

4. Here, we investigate progress for these six steps during 2020. We have seen a few promising developments on energy, nature and food. Impressively, the European Union is on track to meet its emissions reduction goal for 2020 and become zero net carbon by 2050; however, this goal will still increase temperatures from the damaging levels of today. We are also encouraged by the recent trend of governments committing to zero net carbon, including China by 2060 and Japan by 2050. Similar pledges have been made by the United Kingdom, many subnational governments and some corporations, although there is mounting evidence that a 2050 or later target may be inadequate and net zero carbon should be reached much earlier, for example, by 2030.

5. U.S. President-elect Joe Biden has pledged that the U.S. will rejoin the Paris agreement and proposed a \$2 trillion climate plan to phase down fossil fuels by expanding renewable energy capacity while creating jobs, reducing pollution and investing in historically disadvantaged communities. It is critically important to significantly reduce CO<sub>2</sub> emissions while simultaneously increasing carbon accumulation by forests, mangroves, wetlands and other ecosystems. Progress for nature came in the form of the Bonn Challenge to restore forest and other ecosystems, but much more investment is needed in natural climate solutions. Global meat consumption, which must be reduced for climate mitigation, is expected to decline 3 percent this year, largely as a result of COVID-19. While likely a temporary decline, this coincides with increasingly popular meat substitutes; annual U.S. sales are projected to reach \$1 billion in 2020.

6. Although lockdowns associated with the COVID-19 pandemic resulted in a decrease in CO<sub>2</sub> emissions of 7 percent in 2020, this reduction is unlikely to be long-lived because there has been no major concurrent shift in the way we produce energy. This drop in emissions was a tiny blip compared to the cumulative buildup of greenhouse gases, which has led to all five of the hottest years on record occurring since 2015. In fact, atmospheric concentrations of CO<sub>2</sub> continued to rise rapidly in 2020 reaching a record high in September. COVID-19 also led to a one year



postponement of the COP26 United Nations climate change conference, after the 2019 failure of the COP25 conference to make meaningful progress. We are concerned that no major industrialized country is on track to limit warming to 1.5 degrees C, the target of the Paris Agreement. Instead, the actions of many wealthy countries—including the U.S.—are consistent with greater than three degrees C warming. Unfortunately, progress in 2020 has also been limited in the areas of short-lived air pollutants, the economy and population.

7. As we move into 2021 and beyond, we need a massive-scale mobilization to address the climate crisis, including much more progress on the six steps of climate change mitigation. Key actions for each step include the following:

**Energy.** Swiftly phasing out fossil fuels is a top priority. This can be achieved through a multipronged strategy based on rapidly transitioning to low-carbon renewables such as solar and wind power, implementing massive conservation practices, and imposing carbon fees high enough to curtail the use of fossil fuels.

**Short-lived pollutants.** Quickly cutting emissions of methane, black carbon (soot), hydrofluorocarbons and other short-lived climate pollutants is vital. It can dramatically reduce the short-term rate of warming, which may otherwise be difficult to affect. Specific actions to address short-lived pollutants include reducing methane emissions from landfills and the energy sector (methane), promoting improved clean cookstoves (soot) and developing better refrigerant options and management (hydrofluorocarbons).

**Nature.** We must restore and protect natural ecosystems such as forests, mangroves, wetlands and grasslands, allowing these ecosystems to reach their ecological potential for sequestering carbon dioxide. The logging of the Amazon, tropical forests in Southeast Asia, and other rainforests including the proposed cutting in the Tongass National Forest of Alaska is especially devastating to the climate. Creation of new protected areas, including strategic forest carbon reserves, should be a top priority. Payment for ecosystem services programs offer an equitable way for wealthier nations to help protect natural ecosystems.

**Food.** A dietary shift toward eating more plant-based foods and consuming fewer animal products, especially beef, would significantly reduce emissions of methane and other greenhouse gases. It would also free up agricultural lands for growing human food and, potentially, reforestation (“Nature” step). Relevant policy actions include minimizing tillage to maximize soil carbon, cutting livestock subsidies and supporting research and development of environmentally friendly meat substitutes. Reducing food waste is also critical, given that at least one third of all food produced is wasted.

**Economy.** We must transition to a carbon-free economy that reflects our dependence on the biosphere. Exploitation of ecosystems for profit absolutely must be halted for long-term sustainability. While this is a broad, holistic step involving ecological economics, there are specific actions that support this transition. Examples include cutting subsidies to and divesting from the fossil fuel industry.

**Population.** The global human population, growing by more than 200,000 people per day, must be stabilized and gradually reduced using approaches that ensure social and economic justice such as supporting education for all girls and women, and increasing the availability of voluntary family planning services.

8. These steps synergize with each other and together ensure a sustainable future. They also have many co-benefits beyond climate mitigation. For example, stabilizing human population size can improve climate adaptation capacity in the event of declining crop yields. Similarly, plant-rich diets offer significant benefits for human health.

9. In December 2020, U.N. Secretary-General Antonio Guterres pleaded for every nation to declare a “climate emergency.” Thus, we call for the U.S. government to proclaim a climate emergency with either Joe Biden declaring a national climate emergency through an executive order or Congress passing major climate mitigation funding and a declaration of a climate emergency (H.Con.Res.52, S.Con.Res.22) that has been buried in a Congressional committee throughout 2020. One year ago, we were troubled about poor progress on mitigating climate change. We are now alarmed by the failure of sufficient progress during 2020.

10. However, there are glimmers of hope. Young people in more than 3,500 locations continued global climate strikes calling for urgent action. The Black Lives Matter movement has brought deep social injustice and inequality to the surface of our social and economic systems. Rapid progress in each of the six steps can be achieved when they are framed from the start in the context of climate justice, as climate change is a deeply moral issue. But this is only possible when those who face the greatest climate risks help shape the response, including Indigenous peoples, women, youth, people of color and low-income people. Aggressive transformative change, if framed holistically and equitably, will accelerate broad-based restorative action and avert the worst of the climate emergency. The survival of our society as we know it depends upon this unprecedented change.

## Unit 5

### TEXT A

#### On Running After One's Hat

G. K. Chesterton

1. I feel an almost savage envy on hearing that London has been flooded in my absence, while I am in the mere country. My own Battersea has been, I understand, particularly favored as a meeting of the waters. Battersea was already, as I need hardly say, the most beautiful of human localities. Now that it has the additional splendor of great sheets of water, there must be something quite incomparable in the landscape (or waterscape) of my own romantic town. Battersea must be a vision of Venice. The boat that brought the meat from the butcher's must have shot along those lanes of rippling silver with the strange smoothness of the gondola. The greengrocer who brought cabbages to the corner of the Latchmere Road must have leant upon the oar with the unearthly grace of the gondolier. There is nothing so perfectly poetical as an island; and when a district is flooded it becomes an archipelago.

2. Some consider such romantic views of flood or fire slightly lacking in reality. But really this romantic view of such inconveniences is quite as practical as the other. The true optimist who sees in such things an opportunity for enjoyment is quite as logical and much more sensible than the

ordinary “Indignant Ratepayer” who sees in them an opportunity for grumbling. Real pain, as in the case of being burnt at Smithfield or having a toothache, is a positive thing; it can be supported, but scarcely enjoyed. But, after all, our toothaches are the exception, and as for being burnt at Smithfield, it only happens to us at the very longest intervals. And most of the inconveniences that make men swear or women cry are really sentimental or imaginative inconveniences—things altogether of the mind. For instance, we often hear grown-up people complaining of having to hang about a railway station and wait for a train. Did you ever hear a small boy complain of having to hang about a railway station and wait for a train? No; for to him to be inside a railway station is to be inside a cavern of wonder and a palace of poetical pleasures. Because to him the red light and the green light on the signal are like a new sun and a new moon. Because to him when the wooden arm of the signal falls down suddenly, it is as if a great king had thrown down his staff as a signal and started a shrieking tournament of trains. I myself am of little boys’ habit in this matter. They also serve who only stand and wait for the two fifteen. Their meditations may be full of rich and fruitful things. Many of the most purple hours of my life have been passed at Clapham Junction, which is now, I suppose, under water. I have been there in many moods so fixed and mystical that the water might well have come up to my waist before I noticed it particularly. But in the case of all such annoyances, as I have said, everything depends upon the emotional point of view. You can safely apply the test to almost every one of the things that are currently talked of as the typical nuisance of daily life.

3. For instance, there is a current impression that it is unpleasant to have to run after one’s hat. Why should it be unpleasant to the well-ordered and pious mind? Not merely because it is running, and running exhausts one. The same people run much faster in games and sports. The same people run much more eagerly after an uninteresting, little leather ball than they will after a nice silk hat. There is an idea that it is humiliating to run after one’s hat; and when people say it is humiliating they mean that it is comic. It certainly is comic; but man is a very comic creature, and most of the things he does are comic—eating, for instance. And the most comic things of all are exactly the things that are most worth doing. A man running after a hat is not half so ridiculous as a man running after a wife.

4. Now a man could, if he felt rightly in the matter, run after his hat with the manliest ardor and the most sacred joy. He might regard himself as a jolly huntsman pursuing a wild animal, for certainly no animal could be wilder. In fact, I am inclined to believe that hat-hunting on windy days will be the sport of the upper classes in the future. There will be a meet of ladies and gentlemen on some high ground on a gusty morning. They will be told that the professional attendants have started a hat in such-and-such a thicket, or whatever be the technical term. Notice that this employment will in the fullest degree combine sport with humanitarianism. The hunters would feel that they were not inflicting pain. Nay, they would feel that they were inflicting pleasure, rich, almost riotous pleasure, upon the people who were looking on. When last I saw an old gentleman running after his hat in Hyde Park, I told him that a heart so benevolent as his ought to be filled with peace and thanks at the thought of how much unaffected pleasure his every gesture and bodily attitude were at that moment giving to the crowd.

5. The same principle can be applied to every other typical domestic worry. A gentleman trying to get a fly out of the milk or a piece of cork out of his glass of wine often imagines himself to be irritated. Let him think for a moment of the patience of anglers sitting by dark pools, and let his soul be immediately irradiated with gratification and repose. Again, I have known some people of

very modern views driven by their distress to the use of theological terms to which they attached no doctrinal significance, merely because a drawer was jammed tight and they could not pull it out. A friend of mine was particularly afflicted in this way. Every day his drawer was jammed, and every day in consequence it was something else that rhymes to it. But I pointed out to him that this sense of wrong was really subjective and relative; it rested entirely upon the assumption that the drawer could, should, and would come out easily. “But if,” I said, “you picture to yourself that you are pulling against some powerful and oppressive enemy, the struggle will become merely exciting and not exasperating. Imagine that you are tugging up a lifeboat out of the sea. Imagine that you are roping up a fellow-creature out of an Alpine crevasse. Imagine even that you are a boy again and engaged in a tug-of-war between French and English.” Shortly after saying this I left him; but I have no doubt at all that my words bore the best possible fruit. I have no doubt that every day of his life he hangs on to the handle of that drawer with a flushed face and eyes bright with battle, uttering encouraging shouts to himself, and seeming to hear all round him the roar of an applauding ring.

6. So I do not think that it is altogether fanciful or incredible to suppose that even the floods in London may be accepted and enjoyed poetically. Nothing beyond inconvenience seems really to have been caused by them; and inconvenience, as I have said, is only one aspect, and that the most unimaginative and accidental aspect of a really romantic situation. An adventure is only an inconvenience rightly considered. An inconvenience is only an adventure wrongly considered. The water that girdled the houses and shops of London must, if anything, have only increased their previous witchery and wonder. For as the Roman Catholic priest in the story said: “Wine is good with everything except water,” and on a similar principle, water is good with everything except wine.

## TEXT B

### Happiness in the Workplace

Tal Ben-Shahar

1. Ten years ago I met a young man, a corporate lawyer, who was working in a prestigious New York firm and was about to make partner. He owned a luxury apartment overlooking Central Park and had just bought a new BMW, for cash.
2. He worked extremely hard, spending at least sixty hours each week in the office. Every morning he had to drag himself out of bed to get there, for he felt that he had very little to which he could look forward—the meetings with clients and colleagues and the legal briefs and contracts that filled his days were nothing more to him than a series of chores to be gotten through.
3. When I asked him what he would do for a living in an ideal world, he said that he would work in an art gallery. Were no jobs available in art galleries? No, no, he told me, there were jobs. Was he not qualified to find work? He was. But working in an art gallery, he said, would entail a steep loss of income and lowered standard of living. He hated the law firm but saw no way out.
4. Here was a man who was unhappy because he felt enslaved to a job he disliked. And he's not alone in his unhappiness; in the United States, only 50 percent of employees say that they are

satisfied with their work. Yet my conversation with the lawyer, and with many others who were dissatisfied at work, made clear to me that they were enslaved not because they had no choice but because they had made a choice that made them unhappy.

#### The Meaning, Pleasure, Strengths (MPS) Process

5. Finding the right work—work that corresponds to both our passions and our strengths—can be challenging. We can begin the process by asking these three crucial questions—“What gives me *meaning*?” “What gives me *pleasure*?” “What are my *strengths*?”—and noting the trends that emerge. Looking at the answers and identifying areas of overlap can help us determine what kind of work would make us happiest.

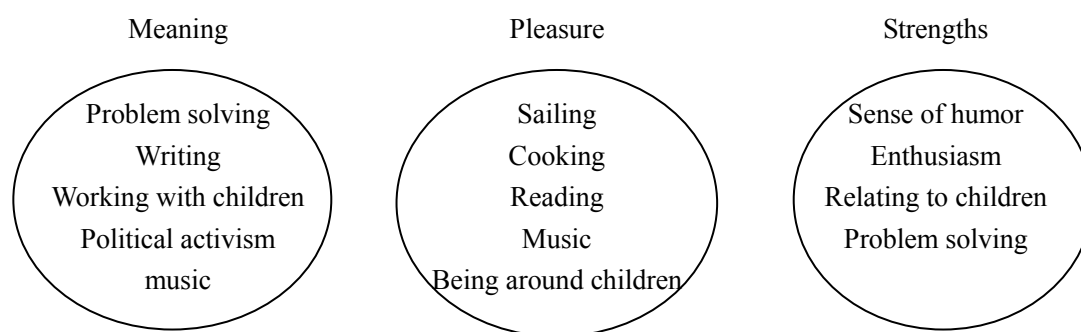
6. Generating accurate answers to these questions requires more effort than simply jotting down whatever leaps to mind when, for instance, we try to think about what we find meaningful. Most of us have more or less ready-made answers to such questions; these answers are usually true but may stop short of representing the full range of experiences that we have found meaningful. We may need to spend time reflecting, thinking deeply to recall those moments in our lives when we felt a sense of true purpose.

7. We may also need to spend some time considering the answers to the three questions. The lists we generate may be long, and the way in which we phrase our answers may not make the areas of overlap immediately apparent.

#### Using the MPS Process

8. Our lists will probably be messier and less straightforward than the following example, which is meant to show how the process works in its most basic form—how thinking about meaning, pleasure, and our strengths can lead us to more happiness and success.

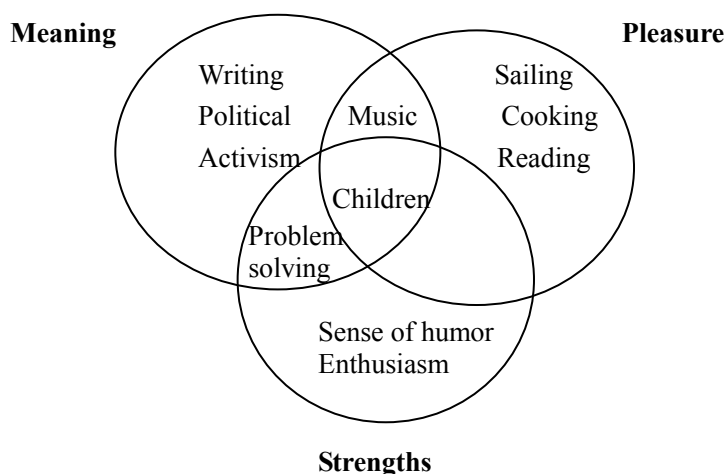
9. Let’s say I derive meaning from solving problems, writing, working with children, engaging in political activism, and music. I enjoy sailing, cooking, reading, music, and being around children. My strengths are my sense of humor, my enthusiasm, my ability to relate to children, and my problem-solving skills.



Which of the answers overlap?

10. In looking at the second diagram, I can see that working with children would give me meaning and pleasure, and I would be good at it. To figure out what specific jobs would be best for me, I would now take into consideration some other aspects of my personality and my life. For example, I am highly organized and like to plan my week’s work in advance—therefore, I prefer to have a more structured daily schedule. I like to travel, and it would therefore be important for

me to have a job that allows long breaks.



11. So what kind of work with children would provide a structured daily schedule and long breaks? What kind of work might involve or make the best use of my other passions and skills, such as my enthusiasm, my sense of humor, and my love of reading and problem solving? Taking all of these factors into account, I might consider becoming an English teacher. While the process may not have led me to the most financially remunerative job, it may have helped me to identify the work that is most profitable to me in the ultimate currency—happiness.

12. The MPS process can also help us make important decisions in other areas of our lives. When choosing a class in school, for example, we can look for an overlap between courses that would be meaningful for our future career, that we would enjoy, and that we would be good at.

13. A manager, too, can use the MPS process for the benefit of her staff and organization. Helping her employees identify and perform activities that they enjoy, find meaningful, and are good at will yield more commitment and better overall performance. The MPS process might even be useful for a manager selecting new employees. Not every workplace can satisfy the needs and tap the strengths of every person. It is important for the manager to create, from the outset, a fit between those she hires and what the workplace has to offer.

#### Crafting Our Calling

14. The implicit assumption in the MPS process is that a person has a choice about where he works. But what if he has no choice or little choice? What if, because of external constraints, he cannot leave his current position or find work that meets the three criteria of meaning, pleasure, and strengths? Moreover, certain occupations or positions are more likely to draw out people's strengths and afford both meaning and pleasure. Working as a medical doctor, one could argue, lends itself more to meaning than work as a secondhand car dealer; similarly, Wrzesniewski's research that employees who are higher in the organizational hierarchy are more likely to experience their work as a calling.

15. But regardless of whether one is the CEO or a clerk, a physician or a salesperson, there is still much that a person can do to craft his work in a way that will maximize the yield in the ultimate currency—so that is experienced more as a calling than as a job. In the words of Amy

Wrzesniewski and Jane Dutton, “Even in the most restricted and routine jobs, employees can exert some influence on what is the essence of their work.”

16. In research of Wrzesniewski and Dutton conducted on hospital cleaners, one group of employees experienced their work as a job—as boring and meaningless—while the other group perceived the same work as engaging and meaningful. The second group of hospital cleaners crafted their work in creative ways. They engaged in more interactions with nurses, patients, and their visitors, taking it upon themselves to make the patients and hospital staff feel better. Generally, they saw their work in its broader context and actively imbued it with meaning: they were not merely removing the garbage and washing dirty linen but were contributing to patients’ well-being and the smooth functioning of the hospital.

17. When it comes to generating the ultimate currency, how we *perceive* the work can matter more than the work itself. Hospital cleaners who recognize a simple truth, which is that their work makes a difference, are happier than doctors who don’t experience their work as meaningful.

18. The researchers saw a similar trend among hairdressers, information technicians, nurses, and restaurant kitchen employees who created meaningful relationships with customers or with others in their organization. They found the same was true among engineers: those who saw themselves as teachers, team creators, and relationship builders felt they were contributing significantly to their companies’ success, and thus related to their work more as a calling than as a job.

#### Focusing on Happiness

19. In *Zen and the Art of Motorcycle Maintenance*, Robert M. Pirsig writes, “The truth knocks on the door and you say, ‘Go away, I’m looking for the truth’ and so it goes away.” We very often fail to recognize the rich sources of pleasure and meaning that are right in front of us in our work. The potential for happiness may be all around us, but if it goes unnoticed—if our focus is elsewhere and we fail to perceive it—we risk losing it. To turn a possibility into a *reality*, we first need to *realize* that the possibility exists.

20. Happiness is not merely contingent on what we do or where we are but on what we choose to perceive. There are people who are unhappy regardless of the work they do or the relationship they are in, and yet they continuously fool themselves into thinking that an external makeover will affect them internally.

21. Ralph Waldo Emerson was right: “To different minds, the same world is a hell, and a heaven.” The exact same event can be perceived, and hence experienced, in very different ways by different people; what we choose to focus on largely determines whether or not we enjoy what we do—within a relationship, at school, and in the workplace. For example, an unhappy investment banker may learn to derive meaning and pleasure from her work if she chooses to focus on those aspects that are personally meaningful and pleasurable. If, however, like many people, she focuses primarily on the material rewards, she is less likely to sustain happiness. A change in perception can make a significant difference; as numerous hairdressers, hospital workers, and engineers so clearly demonstrate, we can find the treasure by focusing on it.

22. Hamlet’s claim that “there is nothing either good or bad but thinking makes it so” is largely, but not entirely, accurate. The fact that what we choose to focus on—our perception—matters so much does not mean that just anybody can find happiness in any situation. For example, there are people who, regardless of their focus, will not derive meaning and pleasure from investment

banking or from teaching. Of course there are also certain circumstances people find themselves in that make the possibility of finding happiness extremely difficult. Happiness is a product of the external as well as of the internal, of what we choose to pursue as well as of what we choose to perceive.

23. Most of us can, and often do, find a job or a career in which we are relatively satisfied. But we can usually do better. To help us find our calling, we need to take the advice of my wise student Ebony Carter, who said, “Instead of focusing on what we can ‘live with,’ we should be thinking about what we can’t live without.” Finding a calling is about heeding the call of our inner voice. That call leads to our calling; that voice guides us to our vocation.

## Unit 6

### TEXT A

#### Mother Tongue

Amy Tan

1. I am not a scholar of English or literature. I cannot give you much more than personal opinions on the English language and its variations in this country or others. I am a writer. And by that definition, I am someone who has always loved language. I am fascinated by language in daily life. I spend a great deal of my time thinking about the power of language—the way it can evoke an emotion, a visual image, a complex idea, or a simple truth. Language is the tool of my trade. And I use them all—all the Englishes I grew up with.

2. Recently, I was made keenly aware of the different Englishes I do use. I was giving a talk to a large group of people, the same talk I had already given to half a dozen other groups. The nature of the talk was about my writing, my life, and my book, *The Joy Luck Club*. The talk was going along well enough, until I remembered one major difference that made the whole talk sound wrong. My mother was in the room. And it was perhaps the first time she had heard me give a lengthy speech, using the kind of English I have never used with her. I was saying things like, “The intersection of memory upon imagination” and “There is an aspect of my fiction that relates to thus-and-thus”—a speech filled with carefully wrought grammatical phrases, burdened, it suddenly seemed to me, with nominalized forms, past perfect tenses, conditional phrases, all the forms of standard English that I had learned in school and through books, the forms of English I did not use at home with my mother.

3. Just last week, I was walking down the street with my mother, and I again found myself conscious of the English I was using, the English I do use with her. We were talking about the price of new and used furniture and I heard myself saying this: “Not waste money that way.” My husband was with us as well, and he didn’t notice any switch in my English. And then I realized why. It’s because over the twenty years we’ve been together I’ve often used that same kind of English with him, and sometimes he even uses it with me. It has become our language of intimacy, a different sort of English that relates to family talk, the language I grew up with.

4. You should know that my mother’s expressive command of English belies how much she



actually understands. She reads the *Forbes* report, listens to *Wall Street Week*, converses daily with her stockbroker, reads all of Shirley MacLaine's books with ease—all kinds of things I can't begin to understand. Yet some of my friends tell me they understand 50 percent of what my mother says. Some say they understand 80 to 90 percent. Some say they understand none of it, as if she were speaking pure Chinese. But to me, my mother's English is perfectly clear, perfectly natural. It's my mother tongue. Her language, as I hear it, is vivid, direct, full of observation and imagery. That was the language that helped shape the way I saw things, expressed things, made sense of the world.

5. Lately, I've been giving more thought to the kind of English my mother speaks. Like others, I have described it to people as "broken" or "fractured" English. But I wince when I say that. It has always bothered me that I can think of no way to describe it other than "broken," as if it were damaged and needed to be fixed, as if it lacked a certain wholeness and soundness. I've heard other terms used, "limited English," for example. But they seem just as bad, as if everything is limited, including people's perceptions of the limited English speaker.

6. I know this for a fact, because when I was growing up, my mother's "limited" English limited *my* perception of her. I was ashamed of her English. I believed that her English reflected the quality of what she had to say. That is, because she expressed them imperfectly her thoughts were imperfect. And I had plenty of empirical evidence to support me: the fact that people in department stores, at banks, and at restaurants did not take her seriously, did not give her good service, pretended not to understand her, or even acted as if they did not hear her. My mother has long realized the limitations of her English as well. When I was fifteen, she used to have me call people on the phone to pretend I was she. In this guise, I was forced to ask for information or even to complain and yell at people who had been rude to her.

7. I think my mother's English almost had an effect on limiting my possibilities in life as well. Sociologists and linguists probably will tell you that a person's developing language skills are more influenced by peers. But I do think that the language spoken in the family, especially in immigrant families which are more insular, plays a large role in shaping the language of the child. And I believe that it affected my results on achievement tests, I.Q. tests, and the SAT. While my English skills were never judged as poor, compared to math, English could not be considered my strong suit. In grade school I did moderately well, getting perhaps B's, sometimes B-pluses, in English and scoring perhaps in the sixtieth or seventieth percentile on achievement tests. But those scores were not good enough to override the opinion that my true abilities lay in math and science, because in those areas I achieved A's and scored in the ninetieth percentile or higher.

8. This was understandable. Math is precise; there is only one correct answer. Whereas, for me at least, the answers on English tests were always a judgment call, a matter of opinion and personal experience. Those tests were constructed around items like fill-in-the-blank sentence completion, such as, "Even though Tom was \_\_\_\_\_, Mary thought he was \_\_\_\_\_." And the correct answer always seemed to be the most bland combinations of thoughts, for example, "Even though Tom was shy, Mary thought he was charming," with the grammatical structure "even though" limiting the correct answer to some sort of semantic opposites, so you wouldn't get answers like, "Even though Tom was foolish, Mary thought he was ridiculous." Well, according to my mother, there were very few limitations as to what Tom could have been and what Mary might have thought of him. So I never did well on tests like that.

9. The same was true with word analogies, pairs of words in which you were supposed to find

some sort of logical, semantic relationship—for example, “*Sunset* is to *nightfall* as \_\_\_\_\_ is to \_\_\_\_\_.” And here you would be presented with a list of four possible pairs, one of which showed the same kind of relationship: *red* is to *stoplight*, *bus* is to *arrival*, *chills* is to *fever*, *yawn* is to *boring*. Well, I could never think that way. I knew what the tests were asking, but I could not block out of my mind the images already created by the first pair, “*sunset* is to *nightfall*”—and I would see a burst of colors against a darkening sky, the moon rising, the lowering of a curtain of stars. And all the other pairs of words—*red*, *bus*, *stoplight*, *boring*—just threw up a mass of confusing images, making it impossible for me to sort out something as logical as saying: “A sunset precedes nightfall” is the same as “a chill precedes a fever.” The only way I would have gotten that answer right would have been to imagine an associative situation, for example, my being disobedient and staying out past sunset, catching a chill at night, which turns into feverish pneumonia as punishment, which indeed did happen to me.

10. I have been thinking about all this lately, about my mother’s English, about achievement tests. Because lately I’ve been asked, as a writer, why there are not more Asian Americans represented in American literature. Why are there few Asian Americans enrolled in creative writing programs? Why do so many Chinese students go into engineering! Well, these are broad sociological questions I can’t begin to answer. But I have noticed in surveys—in fact, just last week—that Asian students, as a whole, always do significantly better on math achievement tests than in English. And this makes me think that there are other Asian-American students whose English spoken in the home might also be described as “broken” or “limited.” And perhaps they also have teachers who are steering them away from writing and into math and science, which is what happened to me.

11. Fortunately, I happen to be rebellious in nature and enjoy the challenge of disproving assumptions made about me. I became an English major my first year in college, after being enrolled as pre-med. I started writing nonfiction as a freelancer the week after I was told by my former boss that writing was my worst skill and I should hone my talents toward account management. But it wasn’t until 1985 that I finally began to write fiction. And at first I wrote using what I thought to be wittily crafted sentences, sentences that would finally prove I had mastery over the English language. Here’s an example from the first draft of a story that later made its way into *The Joy Luck Club*, but without this line: “That was my mental quandary in its nascent state.” A terrible line, which I can barely pronounce.

12. Fortunately, for reasons I won’t get into today, I later decided I should envision a reader for the stories I would write. And the reader I decided upon was my mother, because these were stories about mothers. So with this reader in mind—and in fact she did read my early drafts—I began to write stories using all the Englishes I grew up with: the English I spoke to my mother, which for lack of a better term might be described as “simple”; the English she used with me, which for lack of a better term might be described as “broken”; my translation of her Chinese, which could certainly be described as “watered down”; and what I imagined to be her translation of her Chinese if she could speak in perfect English, her internal language, and for that I sought to preserve the essence, but neither an English nor a Chinese structure. I wanted to capture what language ability tests can never reveal: her intent, her passion, her imagery, the rhythms of her speech and the nature of her thoughts.

13. Apart from what any critic had to say about my writing, I knew I had succeeded where it counted when my mother finished reading my book and gave me her verdict: “So easy to read.”

## TEXT B

### On Familiar Style (abridged)

William Hazlitt

1. The proper force of words lies not in the words themselves, but in their application. A word may be a find-sounding word, of an unusual length, and a very imposing from its learning and novelty, and yet in the connection in which it is introduced may be quite pointless and irrelevant. It is not pomp or pretension, but the adaptation of the expression to the idea, that clinches a writer's meaning: as it is not the size of glossiness of the materials, but their being fitted each to its place, that gives strength to the arch; or as the pegs and nails are as necessary to the support of the building as the larger timber, and more so than the mere showy, unsubstantial ornaments.
2. I hate anything that occupies more space than it is worth. I hate to see a load of band-boxes go along the street, and I hate to see a parcel of big words without anything in them. A person who does not deliberately dispose of all his thoughts alike in cumbrous draperies and flimsy disguises, may strike out twenty varieties of familiar every-day language, each coming somewhat nearer to the feeling he wants to convey, and at last not hit upon that particular and only one which may be said to be identical with the exact impression in his mind.
3. This would seem to show that Mr. Cobbet is hardly right in saying that the first word that occurs is always the best. It may be a very good one; and yet a better may present itself on reflection or from time to time. It should be suggested naturally, however, and spontaneously, from a fresh and lively conception of the subject. We seldom succeed by trying at improvement, or by merely substituting one word for another that we are not satisfied with, as we cannot recollect the name of a place or person by merely plaguing ourselves about it. We wander farther from the point by persisting in a wrong scent; but it start up accidentally in the memory when we least expect it, by touching some link in the chain of previous association.
4. There are those who hoard up and make a cautious display of nothing but rich and rare phraseology—ancient medals, obscure coins, and Spanish pieces of eight. They are very curious to inspect, but I myself would neither offer nor take them in the course of exchange. A sprinkling of archaisms is not amiss, but a tissue of obsolete expressions is more fit *for keep than wear*. I do not say I would not use any phrase that had been brought into fashion before the middle or the end of the last century, but I should be shy of using any that had not been employed by any approved author during the whole of that time.
5. Words, like clothes, get old-fashioned, or mean and ridiculous, when they have been for some time laid aside. Mr. Lamb is the only imitator of old English style I can read with pleasure; and he is so thoroughly imbued with the spirit of his authors that the idea of imitation is almost done away. There is an inward unction, a marrowy vein, both in the thought and feeling, an intuition, deep and lively, of his subject, that carries off any quaintness or awkwardness arising from an antiquated style and dress. The matter is completely his own, though the manner is assumed. Perhaps his ideas are altogether so marked and individual as to require their point and pungency to be neutralized by the affectation of a singular but traditional form of conveyance. [...]

6. It is as easy to write a gaudy style without ideas as it is to spread a pallet of showy colors or to smear in a flaunting transparency. “What do you read?” “Words, words, words.”—“What is the matter?” “*Nothing*,” it might be answered. The florid style is the reverse of the familiar. The last is employed as an unvarnished medium to convey ideas; the first is resorted to as a spangled veil to conceal the want of them. When there is nothing to be set down but words, it costs little to have them fine. [...]

7. If some of us, whose “ambition is more lowly”, pry a little too narrowly into nooks and corners to pick up a number of “unconsidered trifles,” they never once direct their eyes or lift their hands to seize on any but the most gorgeous, tarnished, thread-bare, patchwork set of phrases, the left-off finery of poetic extravagance, transmitted down through successive generations of barren pretenders. If they criticize actors and actresses, a huddled phantasmagoria of feathers, spangles, floods of light, and oceans of sounds float before their morbid sense, which they paint in the style of Ancient Pistol. Not a glimpse can you get of the merits or defects of the performers: they are hidden in a profusion of barbarous epithets and willful rhodomontade. Our hypercritics are not thinking of these little *fantoccini* beings—

*That strut and fret their hour upon the stage—*

but of tall phantoms of words, abstractions, *genera* and species, sweeping clauses, periods that unite the Poles, forced alliterations, astounding antitheses—

*And on their pens Fustian sits plumed.*

8. [...] Such persons are in fact besotted with words, and their brains are turned with the glittering but empty and sterile phantoms of things. Personifications, capital letters, seas of sunbeams, visions of glory, shining inscriptions the figures of a transparency, Britannia with her shield, or Hope leaning on an anchor, make up their stock-in-trade. They may be considered hieroglyphical writers. Images stand out in their minds isolated and important merely in themselves, without any ground-work of feeling—there is no context in their imaginations. Words affect them in the same way, by the mere sound, that is, by their possible not by their actual application to the subject in hand. They are fascinated by first appearances, and have no sense of consequences. Nothing more is meant by them than meets the ear: they understand or feel nothing more than meet their eye. The web and texture of the universe, and of the heart of man, is a mystery to them: they have no faculty that strikes a chord in unison with it. They cannot get beyond the daubings of fancy, the varnish of sentiment. Objects are not linked to feelings, words to things, but images revolve in splendid mockery, words represent themselves in their strange rhapsodies.

9. The categories of such a mind are pride and ignorance—pride in outside show, to which they sacrifice everything, and ignorance of the true worth and hidden structure both of words and things. With a sovereign contempt for what is familiar and natural, they are the slaves of vulgar affectation—of a routine of high-flown phrases. Scorning to imitate realities, they are unable to invent anything, to strike out one original idea. They are not copyists of nature, it is true; but they are the poorest of all plagiarists, the plagiarists of words. All is far-fetched, dear bought, artificial, oriental in subject and allusion; all is mechanical, conventional, vapid, formal, pedantic in style and execution.

10. They startle and confound the understanding of the reader by the remoteness and obscurity to their illustrations; they soothe the ear by the monotony of the same everlasting round of circuitous metaphors. They are the mock-school in poetry and prose. They flounder about between fustian in

expression and bathos in sentiment. They tantalize the fancy, but never reach the head nor touch the heart. Their Temple of Fame is like a shadow structure raised by Dulness to Vanity, or like Cowper's description of the Empress of Russia's palace of ice, "as worthless as in show 'twas glittering"—

*It smiled, and it was cold!*

## Unit 7

### TEXT A

#### We Must Tear Down the Barriers That Impede Scientific Progress

Open science would eliminate article paywalls, data hoarding and siloed lab work

Michael M. Crow & Greg Tananbaum

1. We are in the midst of a once-in-a-generation opportunity to remake our approach to science. This moment, in all its difficult uncertainty—COVID-19, economic turmoil and the crescendo of a long overdue national discussion about racial justice—demonstrates why universities, funders and other research stakeholders should move decisively to embrace open science. By adopting what are called “open science” practices, we can align the incentive structures of research production and consumption with our values, and catalyze the scientific progress our society so desperately needs.
2. Open science, to quote Michael Nielson's *Reinventing Discovery*, is “the idea that scientific knowledge of all kinds should be openly shared as early as is practical in the discovery process.” That open science is an integral tool in the fight against COVID-19 is indisputable: the importance of access to scientific articles and data to help identify promising vaccines and therapeutics was recognized by publishers and researchers alike early in the pandemic. As a consequence, the research community has worked rapidly to take down the barriers—including article paywalls, data hoarding and siloed lab work—that chronically impede scientific progress.
3. The open dissemination, discussion and testing of COVID-19-related science has quickly taken the place of these outdated norms. Within one month of the first reported case, the virus was rapidly sequenced and openly posted to GenBank, the NIH genetic sequence database. Scores of researchers racing to learn more about COVID-19 shared their early findings as openly accessible preprints. These findings were tested and refined in real-time discussions that were tracked publicly and transparently. Papers that could not withstand replication and reproducibility efforts were quickly and publicly debunked, allowing the scientific community to pursue more promising research avenues. Society and commercial publishers made subscription-controlled coronavirus articles available to all. The protocols and technology behind the Yale School of Public Health's COVID-19 saliva test have been made available as open source.
4. Two clear conclusions can be drawn from this rapid alignment. First, the daily workings of science have practical ramifications in all our lives. Scientific norms affect not just researchers

working in labs, but also policy makers, doctors, patients, families, and the general public. Second, open science is the form of research dissemination and global collaboration that best reduces vexing limits to knowledge that are exacerbated by COVID-19. If rapidly and openly sharing research data and papers is critical to understanding and combating coronavirus, doesn't the same hold true for cancer? Heart disease? Climate change? The scientific community—moving with great speed and clarity of purpose—has clearly signaled that open science is the most efficient way to tackle issues that have a significant and direct effect on the lives of the general public. The unambiguous conclusion is that open is better for science.

5. Importantly, open is also better for the economy. For example, around the turn of the century, the massive and massively successful Human Genome Project placed research results in the public domain. This commitment to open science generated nearly \$800 billion dollars in economic benefits between 1988 and 2010, a return on investment of \$141 for each dollar of the federal government's investment in the project. More than 310,000 jobs in the U.S. economy were created, directly and indirectly, totaling almost four million job-years of employment as a result of this scientific undertaking. Similarly, we also owe the development of global positioning systems to the real-world implementation of open science principles, a development that produced more than \$50 billion in economic benefits.

6. Indeed, across a range of sectors from health care to energy, a McKinsey estimate from 2013 put the potential economic value of open data alone in the trillions of dollars annually, equivalent to more than three times the global economic impact of the automotive industry. By leaning into open science practices, we can fuel innovation, job creation and economic growth. As Franklin Roosevelt opined in 1941, at a similar moment of upheaval and uncertainty, “the enjoyment of the fruits of scientific progress in a wider and constantly rising standard of living” is one of America's basic expectations.

7. In addition to being better for science and better for the economy, open is better for society. ASU has found strength in defining success not in whom it excludes, but whom it includes. When knowledge and innovation rest in the hands of the few, we struggle to reach our collective potential. Access to data and published research democratizes information and allows more voices to join the scientific conversation. It removes a layer of insularity in ways both big and small. To take one example at the systemic level, the average library expenditures at Historically Black Colleges and Universities (HBCUs) are significantly less than those of non-HBCU counterparts. This translates in real terms to a racialized inequality of access to the journal articles, books, and other materials upon which future research can be formulated.

8. At the individual level, the exchange of scientific information often occurs in direct personal interactions. Data that are otherwise proprietary may be shared among close peers and colleagues. Scholars without access to paywalled articles can request copies from the authors, but may be hesitant to do so if they are not part of the same informal networks. By making these materials open for all—to access, replicate, question and build upon—we can contribute to both levelling the playing field and widening the circle of science.

9. Universities, philanthropies, government agencies and other stakeholders can accelerate the positive effects of open science—in the fight against COVID-19, in our efforts to strengthen the economy, and in our quest for a more just society—by aligning our incentive structures with our values. Practically, this means exercising specific points of leverage—including hiring, funding, tenure and promotion—to ensure that research practices become more open. Many

examples are flowering today. Dozens of university departments include language in their job postings along the lines of “This department values transparent, replicable research and open science principles.” This sets the expectation that open practices will be a component of not only the job interview but, for the successful candidate, of the job itself. A wide range of philanthropies are now asking grant applicants to explain how they have historically made their work open, and how, if funded, they will make their outputs open going forward. This provides a powerful incentive (the promise of financial support) for researchers to adhere to open practices.

10. Aligning research incentives to reward open science practices may seem daunting, but university and philanthropic leadership can start the process by taking specific, concrete actions that have already been proven effective in practice. While a number of organizations have launched fully actualized open science programs, notably McGill’s Montreal Neurological Institute-Hospital (The Neuro) and the Rochester Institute of Technology’s Open@RIT, university presidents and provosts can move their institutions systematically toward open simply by engaging in a structured dialog with their researchers. In this spirit, we call on universities to emulate MIT and launch an open science task force. MIT’s work began with a concise charge from its provost, to “coordinate a renewed Institute-wide discussion of ways in which current policies and practices might be updated or revised to further the Institute’s mission of disseminating the fruits of its research and scholarship as widely as possible.”

11. The MIT model is a true collaboration among the administration, chairs and faculty that includes the development and deployment of open science plans tailored to the disciplinary considerations of each department. It is predicated on the acknowledgement that what constitutes open science best practices in, say, anthropology, will differ from what works for zoology.

12. Facilitating this bespoke departmental approach are the many emerging norms and policies articulated by professional societies such as the Linguistics Society of America, the Society for the Improvement of Psychological Science and the American Geophysical Union. Ideally, the recommended policies that arise from these task forces will resonate with faculty from both an institutional and a disciplinary perspective. The ultimate goal is to develop “mutually reinforcing vectors,” an environment in which researchers hear consistently from a range of influencers at their university, within their discipline, and across potential funding sources that open practices are both warmly encouraged and properly rewarded.

13. In support of this “mutually reinforcing vectors” approach, we also call on philanthropies to adopt grant-making policies that encourage researchers to share their outputs (articles, data, code, materials, etc.) openly and rapidly. In this effort, they can lean on the work of funders ranging from the American Heart Association to the Gates Foundation to the Michael J. Fox Foundation to craft language and workflows that have been field-tested over thousands of grant conferrals. Philanthropies can also draw from policy language templates (developed by the Open Research Funders Group and endorsed by funders including the Sloan Foundation and the Wellcome Trust) to implement a stepwise approach to more closely aligning their incentivization schemes with open science principles.

14. While open is better for science, the economy, society, it is not magic. It takes concerted, direct effort by key stakeholders to effect change. It also takes a community of practice—sharing successes, roadblocks, and solutions; developing and testing resources that

explain the whats, whys and hows of open; and identifying key opportunities to expand the “coalition of the willing.” One such effort is the National Academy of Science, Engineering, and Medicine’s Roundtable on Aligning Incentives for Open Science (in which we both participate). The Roundtable includes direct representation from colleges and universities, philanthropies and government agencies.

15. Crucially, the broader network of stakeholders engaging with the Roundtable also includes more than 500 professors, postdocs, librarians, professional society representatives, publishers, funders and other stakeholders. For any university or philanthropy finding itself not yet prepared to take the plunge in the manner we have outlined above, we warmly encourage you to engage with the roundtable to get a better sense of the tangible steps your peers are taking to stimulate open science within their institutions.

16. There are hurdles to widespread adoption of open science practices, to be sure. Researchers need proper training on data management plans, reuse licensing and other good open science hygiene. Infrastructure must be developed and nurtured to preserve scientific data, curate it and render it actionable. And organizations must overcome their natural entropy, which makes tackling big, cross-cutting initiatives like open science challenging. While these obstacles are nontrivial, they are small in comparison to the scientific, economic, and societal benefits of open. In a moment of great peril, maintaining the status quo will ultimately prove more costly.

## TEXT B

### How Astronomers Revolutionized Our View of the Cosmos

*The universe turns out to be much bigger and weirder than anyone thought*

Martin Rees

1. In 1835 French philosopher Auguste Comte asserted that nobody would ever know what the stars were made of. “We understand the possibility of determining their shapes, their distances, their sizes and their movements,” he wrote, “whereas we would never know how to study by any means their chemical composition, or their mineralogical structure, and, even more so, the nature of any organized beings that might live on their surface.”

2. Comte would be stunned by the discoveries made since then. Today we know that the universe is far bigger and stranger than anyone suspected. Not only does it extend beyond the Milky Way to untold numbers of other galaxies—this would come as a surprise to astronomers of the 19th and early 20th century to whom our galaxy was “the universe”—but it is expanding faster every day. Now we can confidently trace cosmic history back 13.8 billion years to a moment only a billionth of a second after the big bang. Astronomers have pinned down our universe's expansion rate, the mean density of its main constituents, and other key numbers to a precision of 1 or 2 percent. They have also worked out new laws of physics governing space—general relativity and quantum mechanics—that turn out to be much more outlandish than the classical laws people understood before. These laws in turn predicted cosmic oddities such as black holes, neutron stars and gravitational waves. The story of how we gained this knowledge is full of accidental discoveries, stunning surprises and dogged scientists pursuing goals others thought unreachable.



3. Our first hint of the true nature of stars came in 1860, when Gustav Kirchhoff recognized that the dark lines in the spectrum of light coming from the sun were caused by different elements absorbing specific wavelengths. Astronomers analyzed similar features in the light of other bright stars and discovered that they were made of the same materials found on Earth—not of some mysterious “fifth essence” as the ancients had believed.
4. But it took longer to understand what fuel made the stars shine. Lord Kelvin (William Thomson) calculated that if stars derived their power just from gravity, slowly deflating as their radiation leaked out, then the sun’s age was 20 million to 40 million years—far less time than Charles Darwin or the geologists of the time inferred had elapsed on Earth. In his last paper on the subject, in 1908, Kelvin inserted an escape clause stating that he would stick by his estimate “unless there were some other energy sources laid up in the storehouse of creation.”
5. That source, it turned out, is nuclear fusion—the process by which atomic nuclei join to create a larger nucleus and release energy. In 1925 astrophysicist Cecilia Payne-Gaposchkin used the light spectra of stars to calculate their chemical abundances and found that, unlike Earth, they were made mainly of hydrogen and helium. She revealed her conclusions in what astronomer Otto Struve described as “the most brilliant Ph.D. thesis ever written in astronomy.” A decade later physicist Hans Bethe showed that the fusion of hydrogen nuclei into helium was the main power source in ordinary stars.
6. At the same time stars were becoming less mysterious, so, too, was the nature of fuzzy “nebulae” becoming clearer. In a “great debate” held before the National Academy of Sciences in Washington, D.C., on April 26, 1920, Harlow Shapley maintained that our Milky Way was preeminent and that all the nebulae were part of it. In contrast, Heber Curtis argued that some of the fuzzy objects in the sky were separate galaxies—“island universes”—fully the equal of our Milky Way. The conflict was settled not that night but just a few years later, in 1924, when Edwin Hubble measured the distances to many nebulae and proved they were beyond the reaches of the Milky Way. His evidence came from Cepheids, variable stars in the nebulae that reveal their true brightness, and thus their distance, by their pulsation period—a relation discovered by Henrietta Swan Leavitt.
7. Soon after Hubble realized that the universe was bigger than many had thought, he found that it was still growing. In 1929 he discovered that spectral features in the starlight from distant galaxies appeared redder—that is, they had longer wavelengths—than the same features in nearby stars. If this effect was interpreted as a Doppler shift—the natural spreading of waves as they recede—it would imply that other galaxies were moving away from one another and from us. Indeed, the farther away they were, the faster their recession seemed to be. This was the first clue that our cosmos was not static but was expanding all the time.
8. The universe also appeared to contain much that we could not see. In 1933 Fritz Zwicky estimated the mass of all the stars in the Coma cluster of galaxies and found that they make up only about 1 percent of the mass necessary to keep the cluster from flying apart. The discrepancy was dubbed “the missing mass problem,” but many scientists at the time doubted Zwicky’s suggestion that hidden matter might be to blame. The question remained divisive until the 1970s, when work by Vera Rubin and W. Kent Ford (observing stars) and by Morton Roberts and Robert Whitehurst (making radio observations) showed that the outer parts of galactic disks would also fly apart unless they were subject to a stronger gravitational pull than stars and gas alone could provide. Finally, most astronomers were compelled to accept that some kind of “dark matter” must

be present. “We have peered into a new world,” Rubin wrote, “and have seen that it is more mysterious and more complex than we had imagined.” Scientists now believe that dark matter outnumbers visible matter by about a factor of five, yet we are hardly closer than we were in the 1930s to figuring out what it is.

9. Gravity, the force that revealed all that dark matter, has proved to be nearly as baffling. A pivotal moment came in 1915 when Albert Einstein published his general theory of relativity, which transcended Isaac Newton’s mechanics and revealed that gravity is actually the deformation of the fabric of space and time. This new theory was slow to take hold. Even after it was shown to be correct by observations of a 1919 solar eclipse, many dismissed the theory as an interesting quirk—after all, Newton’s laws were still good enough for calculating most things. “The discoveries, while very important, did not, however, affect anything on this earth,” astronomer W.J.S. Lockyer told the *New York Times* after the eclipse. For almost half a century after it was proposed, general relativity was sidelined from the mainstream of physics. Then, beginning in the 1960s, astronomers started discovering new and extreme phenomena that only Einstein’s ideas could explain.

10. One example lurks in the Crab Nebula, one of the best-known objects in the sky, which is composed of the expanding debris from a supernova witnessed by Chinese astronomers in 1054 A.D. Since it appeared, the nebula has kept on shining blue and bright—but how? Its light source was a longtime puzzle, but the answer came in 1968, when the dim star at its center was revealed to be anything but normal. It was actually an ultracompact neutron star, heavier than the sun but only a few miles in radius and spinning at 30 revolutions per second. “This was a totally unexpected, totally new kind of object behaving in a way that astronomers had never expected, never dreamt of,” said Jocelyn Bell Burnell, one of the discoverers of the phenomenon. The star’s excessive spin sends out a wind of fast electrons that generate the blue light. The gravitational force at the surface of such an incredibly dense object falls way outside of Newton’s purview—a rocket would need to be fired at half the speed of light to escape its pull. Here the relativistic effects predicted by Einstein must be taken into account. Thousands of such spinning neutron stars—called pulsars—have been discovered. All are believed to be remnants of the cores of stars that exploded as supernovae, offering an ideal laboratory for studying the laws of nature under extreme conditions.

11. The most exotic result of Einstein’s theory was the concept of black holes—objects that have collapsed so far that not even light can escape their gravitational pull. For decades these were only conjecture, and Einstein wrote in 1939 that they “do not exist in physical reality.” But in 1963 astronomers discovered quasars: mysterious, hyperluminous beacons in the centers of some galaxies. More than a decade passed before a consensus emerged that this intense brightness was generated by gas swirling into huge black holes lurking in the galaxies’ cores. It was the strongest evidence yet that these bizarre predictions of general relativity actually exist.

12. When did the universe begin? Did it even have a beginning? Astronomers had long debated these questions when, in the middle of the 20th century, two competing theories proposed very different answers. The “hot big bang” model said the cosmos began extremely small, hot and dense and then cooled and spread out over time. The “steady state” hypothesis held that the universe had essentially existed in the same form forever.

13. The contest was settled by a serendipitous discovery. In 1965 radio astronomers Arno Penzias and Robert Wilson were trying to calibrate a new antenna at Bell Labs in New Jersey.

They had a problem: no matter what they did to reduce background interference, they measured a consistent level of noise in every direction. They even evicted a family of pigeons that had been nesting in the antenna in the hope that they were the source of the problem. But the signal persisted. They had discovered that intergalactic space is not completely cold. Instead it is warmed to nearly three kelvins (just above absolute zero) by weak microwaves. Penzias and Wilson had accidentally uncovered the “afterglow of creation”—the cooled and diluted relic of an era when everything in the universe was squeezed until it was hot and dense.

14. The finding tipped the balance firmly in favor of the big bang picture of cosmology. According to the model, during the earliest, hottest epochs of time, the universe was opaque, rather like the inside of a star, and light was repeatedly scattered by electrons. When the temperature fell to 3,000 kelvins, however, the electrons slowed down enough to be captured by protons and created neutral atoms. Thereafter light could travel freely. The Bell Labs signal was this ancient light, first released about 300,000 years after the birth of the universe and still pervading the cosmos—what we call the cosmic microwave background. It took a while for the magnitude of the discovery to sink in for the scientists who made it. “We were very pleased to have a possible explanation [for the antenna noise], but I don't think either of us really took the cosmology very seriously at first,” Wilson says. “Walter Sullivan wrote a first-page article in the *New York Times* about it, and I began to think at that point that, you know, maybe I better start taking this cosmology seriously.”

15. Measurements of this radiation have since enabled scientists to understand how galaxies emerged. Precise observations of the microwaves reveal that they are not completely uniform over the sky. Some patches are slightly hotter, others slightly cooler. The amplitude of these fluctuations is only one part in 100,000, but they are the seeds of today's cosmic structure. Any region of the expanding universe that started off slightly denser than average expanded less because it was subjected to extra gravity; its growth lagged further and further, the contrast between its density and that of its surroundings becoming greater and greater. Eventually these clumps were dense enough that gas was pulled in and compressed into stars, forming galaxies. The crucial point is this: Computer models that simulate this process are fed the initial fluctuations measured in the cosmic microwave background, which represent the universe when it was 300,000 years old. The output after 13.8 billion years of virtual time have elapsed is a cosmos where galaxies resemble those we see, clustered as they are in the actual universe. This is a real triumph: we understand, at least in outline, 99.998 percent of cosmic history.

16. It is not only the big cosmic picture that we have come to understand. A series of discoveries has also revealed the history of the elemental building blocks that make up stars, planets and even our own bodies.

17. Starting in the 1950s, progress in atomic physics led to accurate modeling of stars' surface layers. Simultaneously, detailed knowledge of the nuclei not just of hydrogen and helium atoms but also of the rest of the elements allowed scientists to calculate which nuclear reactions dominate at different stages in a star's life. Astronomers came to understand how nuclear fusion creates an onion-skin structure in massive stars as atoms successively fuse to build heavier and heavier elements, ending with iron in the innermost, hottest layer.

18. Astronomers also learned how stars die when they exhaust their hydrogen fuel and blow off their outer gaseous layers. Lighter stars then settle down to a quiet demise as dense, dim objects called white dwarfs, but heavier stars shed more of their mass, either in winds during their lives or

in an explosive death via supernova. This expelled mass turns out to be crucial to our own existence: it mixes into the interstellar medium and recondenses into new stars orbited by planets such as Earth. The concept was conceived by Fred Hoyle, who developed it during the 1950s along with two other British astronomers, Margaret Burbidge and Geoffrey Burbidge, and American nuclear physicist William Fowler. In their classic 1957 paper in *Reviews of Modern Physics* (known by the initials of its authors as BBFH), they analyzed the networks of the nuclear reactions involved and discovered how most atoms in the periodic table came to exist. They calculated why oxygen and carbon, for instance, are common, whereas gold and uranium are rare. Our galaxy, it turns out, is a huge ecological system where gas is being recycled through successive generations of stars. Each of us contains atoms forged in dozens of different stars spread across the Milky Way that lived and died more than 4.5 billion years ago.