

## Acceptance speech

16 June of 2022

### Robert S. Langer, awardee in the Biology and Biomedicine category (14th Edition)

I feel so humbled to receive this award, particularly because of the tremendous accomplishments of the previous and current recipients, Drs. Katalin Karikó and Drew Weissman.

I want to explain why I'm here. When I finished my chemical engineering degree in 1974, I received many job offers to join oil companies – which is what most chemical engineers did then. But I had a dream of using my background to improve people's health. So, I applied to many hospitals and medical schools, but none wrote back. Then one day, someone suggested writing to Dr. Judah Folkman at Harvard. He said "sometimes he hires unusual people," and he offered me a job. So, I took what seemed to everyone like a huge risk and began doing research in a hospital. I was the only engineer there. The projects that I began working on were: (1) trying to discover the first substances that could stop cancer blood vessels from growing (and thus stop tumor growth) and (2) developing tiny particles – called microparticles or nanoparticles – that could deliver these and other large molecular weight substances such as nucleic acids to the body. Many scientists told us this was **impossible**. So, I spent two years working on this project and I found over 200 different ways to get this to not work. But finally, I discovered I could modify certain materials, form them into tiny particles, and use them to deliver macromolecules. I then used these particles to create bioassays that enabled us to discover the first substances that stopped cancer blood vessels and help stop cancer. As an aside, it took 28 years from our earliest publication until the FDA approved the first blood vessel inhibitor. Today, such inhibitors, like Avastin, Lucentis, and Eylea have been used to treat millions of patients with cancer or vascular eye diseases like macular degeneration and diabetic retinopathy.

About two years after I started working on these projects, I was asked to give a talk to a very distinguished scientific audience. I had never given a big talk before. I was actually pleased by the end of the talk because I hadn't forgotten too much of what I intended to say. So, I thought that when I was done with that talk, all these distinguished scientists, being nice people, would encourage me, this young guy. But when I was done speaking, a number of people stated, "We

don't believe anything you've just said. You can't get these molecules to be delivered from these particles. It's not possible." Also, shortly after that talk, I tried to receive funding to support my research and wrote a number of grants. My first nine were rejected. When I was done with my postdoctoral work, I applied for faculty positions to many chemical engineering departments – but no one would hire me. So, I ended up in a nutrition department. But in that department, the year after I got the position, the department chairman who hired me left, and a number of the faculty decided to give me advice. Their advice was that I should leave too. Another challenge I had was getting a patent. We filed a patent and the Patent Office turned it down five straight times. Almost everyone told me I should give up, but I don't like to give up, and I started thinking about new ways to get this patent allowed, legally, of course. I scoured the literature and discovered there had been a paper published by five famous scientists that said, "Folkman and Langer have reported some SURPRISING RESULTS that clearly demonstrate the opposite of what scientists had said before." We showed this to the patent examiner, who said, "I will allow this patent if Dr. Langer can get affidavits from the five people saying they really wrote it." So, I wrote to all five, and they were kind enough to say they really wrote it, and we got this broad patent. This would lead to new ways of treating schizophrenia, alcoholism, opioid addiction, diabetes, cancer, and other diseases. Over the years, I, and my colleagues and students, have started some 40 companies to get our discoveries to patients. One of those companies was Moderna. I and three others started Moderna to develop messenger RNA therapeutics and vaccines. The molecules had to be delivered in nanoparticles – made using many of the principles ours and other labs had developed – otherwise the RNA would be destroyed. However, many people in the scientific community and the press criticized both me and the company, and said this would never work. For example, when we started developing vaccines to treat Covid-19, *The Boston Globe* ran a front-page article entitled, "This is not how you do science," with my picture underneath it. But Moderna and its terrific employees, some of whom are my former students, never gave up. Today the Moderna vaccine and one made by Pfizer and BioNTech – also using nanoparticles and mRNA – are used all over the world. I want to add that my journey here, to a large extent, mirrors that of Drs. Karikó and Weissman. They made seminal discoveries involving making mRNA noninflammatory, which is crucial for all medical therapies. However, their early work was very underappreciated for a long time, and Dr. Karikó had to leave her job at Penn. Both Drs. Karikó and Weissman deserve tremendous credit, not only for the vaccines, but also for being role models for the world and never giving up regardless of what others said.

Once again, it's an incredible honor to be here. Thank you, very, very much.