pathways involving microRNAs and small interfering RNAs.

I believe that the success of these projects emerged in part from a unique research culture and infrastructure. Now I want to help put in place similar opportunities on a larger scale, as president of the Chan Zuckerberg Science Initiative, a philanthropic effort launched in late 2016 to support biomedical research.

THE THREE INGREDIENTS

What made the *C. elegans* field successful?

A common reference. By the mid-1960s, fruit flies and yeast had already been studied for decades. But biologist Sydney Brenner, then at the LMB, wanted to develop a new model organism for studying the big questions in development and neuroscience. He picked *C. elegans*.

The LMB group began realizing Brenner's goal by developing a shared infrastructure. Brenner and his PhD student Jonathan Hodgkin created genetic tools, such as strains of worms with well-characterized mutations, and mapped the functions of hundreds of genes. Biologist John Sulston led a team that described the complete lineage of all cells, documenting every step in the transformation of a single-cell embryo to the adult worm (J. E. Sulston *et al. Dev. Biol.* **100,** 64–119; 1983). White, Brenner and their team mapped the connections of all of the worm's neurons, naming every neuronal cell and mapping its lineage and place in the circuit.

Descriptive science — observing, recording, describing and classifying phenomena — is often valued less than hypothesis testing. But the common resources that result help everyone. Every experiment I have done has been grounded in White and colleagues' wiring paper, affectionately known as *The Mind of a Worm* (J. G. White *et al. Phil. Trans. R. Soc. Lond. B* **314,** 1–340; 1986).

The success of these projects, and the recognition of their value by the community, meant that it was easy to convince *C. elegans* researchers of the worth of the first genome projects discussed in the 1990s. They were similarly game for making and sharing the first RNAi libraries (collections of small interfering RNAs for disrupting gene function, matched to every gene in the worm's genome), the Wormbase organismal database (a repository of everything that's known about *C. elegans* biology) and, more recently, the global genetic-diversity resource CeNDR (www.elegansvariation.org).

Creative exploration. Today, people are often encouraged to stay in a research niche for long stretches of their careers — to learn 'more and more about less and less'. One effect of this is that students stay in the same fields as their advisers, and both learn less than they might have done had they diversified.

By contrast, the MRC mavens took a gamble that there were many interesting questions left in biology, and that buying lots of lottery tickets — in the form of different research areas — would pay off for the success and prestige of the field. Thus, there was a conscious decision among those involved in the foundational work on *C. elegans* to maximize discovery by encouraging people to explore the worm's biology widely. When I joined his lab, Horvitz told me I could study any problem that could be addressed in a worm.

Openness. Today, two concerns tend to come up in discussions about releasing findings before their formal publication: is the work accurate, and will people steal the results?

When I started working on *C. elegans*, people published in a semiregular newsletter called the *Worm Breeder's Gazette* (*WBG*). Most of the groups that were using the worm as a model organism published in every issue; the one-page abstracts typically described a single result. The *WBG* was fast. A few weeks or months after you had a result, it would be out there for everyone to see. In fact, some *WBG* abstracts preceded papers by five years or more.

"We want all of biomedical science to be faster, more robust, sharable and scalable."

Some of the findings reported in the *WBG* didn't hold up long-term. And that was okay; results that can't be replicated soon get ignored. As for stealing others' work, I think that the very openness of the *C. elegans* field acted as a deterrent. Everyone knew what was in the *WBG*, and there was a clear expectation that if you used someone else's result, you included that person in your study or cited them. The scientists who read the *WBG* were the same ones who were going to review your grants, papers and case for promotion, so the implicit requirement to respect that culture had teeth. In many cases, the openness seemed to relieve tensions; people could find out in advance whether similar work was in progress in another lab, and coordinate publications.

The roundworm *Caenorhabditis elegans*.

SINCLAIR STAMMERS/SPL

SHAPING SCIENCE TODAY

The mission of the Chan Zuckerberg Science Initiative, founded in 2016 by Mark Zuckerberg and Priscilla Chan, is to support science and technology that will make it possible to cure, prevent or manage all diseases by the end of the century. It's a bold goal. But the end of the century is still 82 years away. Going back in time a similar distance, much of modern medicine would have been unthinkable — from organ transplants and deep brain stimulation to treating cancer by manipulating the immune system.

All of these advances were built on a foundation of basic biomedical science. To enable the next generation of discoveries, we at the Chan Zuckerberg Initiative want all of biomedical science to be faster, more robust, sharable and scalable. We're starting a number of different programmes — both locally and globally — to try out ideas for accelerating science and driving collaboration.

First, we want to support scientific infrastructure projects that change the landscape for research fields. In collaboration with other groups and funders, we are supporting the Human Cell Atlas (HCA), an endeavour to map all the cells in the human body. For the trillions of cells that make up the human body, we don't know how many cell types there are, nor their exact numbers, locations, molecular compositions and spatial relationships in tissues and organs. Such knowledge could benefit all biologists who study humans.

In addition to funding experimental scientists working on the HCA, the Chan Zuckerberg Initiative is funding external collaborators and an in-house group of software engineers and computational biologists focused on developing new data platforms and tools for biomedical science. This is an opportunity, because many of the advances in technology that have happened in the commercial sector have not been available to academic science. As a neuroscientist, I take this personally: numerous recent innovations in machine learning and neural networks originated in neuroscience, so biologists should be able to share the benefits.