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The big picture in science

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Basic science and methods development is essential to ensure that lifesaving advances and improvements to the human condition continue moving forward. Such research needs strong and sustained funding support from governments.

It is a very worrying moment for the future of scientific research, in the United States, but also globally. But let's just take a minute to appreciate what an amazing time it is to be alive. We now have the technology to cure several cancers, treat obesity and metabolic disorders, manage HIV, and rapidly develop and deploy vaccines to mitigate global pandemics — things that were unthinkable even a few short decades ago. We must not forget that basic scientific research and methods development is the engine that powers the advances that have real-world impact.

Much of basic research is about exploring uncharted territory in the natural world. This is not at all easy; it requires intense curiosity, creativity, grit and a willingness to take risks. Sometimes the methods and tools needed to explore something new just don't exist and need to be developed. Methods development research can have the potential for transformative impact, but can be particularly slow and expensive. For example, a crowning achievement like AlphaFold was possible only because of the 50-plus-year history of basic methods development and the large compendium of solved protein structures generated by the structural biology field. Basic research is not typically a major pursuit of the private sector, as the likelihood of developing a sellable product is just too low for the up-front investment required. Private funding is sometimes available, but may come with stipulations or be limited. Basic research really needs large and sustained financial investments by governments.

Good science can be done by well-trained, ethical, conscientious scientists anywhere in the world, but countries that prioritize investing in science tend to generate the most impactful research results. A clear trend can be seen, for example, by looking at data from China: in 2023, seven of the top ten institutions worldwide, ranked according to their contributions to natural and health science journals as tracked by Nature Index, were based in China, which aligns with the Chinese government's increased research spending from year to year. Countries with immigration policies that welcome foreign students and postdocs, many of whom decide to stay put for the durations of their careers, also benefit in more ways than one from the influx of talent.

Perhaps more than any other human activity, scientific research also relies on international collaboration and global sharing of information. 'Big science' done by international consortiums, such as HuBMAP (represented in this issue by the Resource by Börner et al.), can be particularly impactful in tackling large-scale problems. Some issues relevant to improving the human condition, exemplified by the United Nations' Sustainable Development Goals, are so immense that global cooperation is essential.

Scientific research is bolstered by discussion, critique and competition, but also by sharing of methodologies and research outputs. Countless researchers from all over the world come together at conferences and workshops to present their novel findings and establish collaborations. It is now commonplace for academic researchers (and also many researchers based at for-profit companies) to share their raw data and software code with the community. Preprint servers are being increasingly embraced, and the rise of various mechanisms for open access publication ensures that scientific output is available to others to build upon. If funding is cut, for example, to databases that support entire research fields, the results could be catastrophic. That is not say to that there isn't waste in scientific research. But, in our view, the solution to mitigating waste is to examine inefficiencies in a measured way.

Research doesn't always yield the results that were anticipated, and sometimes projects fail outright. Even when a research team publishes a fantastic, well-validated result, that doesn't mean that it can be taken as dogma. Alternative interpretations are often possible. Research results need to be independently reproduced and studied from multiple angles before they become textbook knowledge. And even then, new technology or method developments might allow a well-established result to be tackled in a different way, turning knowledge that was previously understood on its head. None of this means that science isn't reproducible or isn't a worthwhile endeavor. It's just reality.

This messiness, however, can be difficult to communicate to people without a scientific background. As outlined in a recent *Nature* Editorial, we need more people who are trained as scientific communicators and 'knowledge brokers'. There are ongoing efforts worldwide for formal training of such individuals who understand both the science and how government functions, but more work is still needed.

Scientific findings enrich our lives and challenge our world views. Just as a painting or a piece of music can move us, an astounding image of a distant galaxy or the perfect radial symmetry of a diatom can remind us how beautiful the natural world is. Basic research funding is also downright essential to ensure that we will see continued advances in lifesaving treatments and in mitigating global problems such as the impacts of climate change. Let's not lose sight of this.

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