Australian Government
Chief Scientist

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I would like to acknowledge the Gadigal People of the Eora nation as the Traditional Owners of this land. In my recent work leading the national conversation around Australia's Science and Research Priorities, it's been really gratifying to see broad acknowledgement of the importance of paying attention to First Nations knowledge systems, and the incredible insights that the First Peoples have about this land we live and work on.

I was given broad slather for the topic about which I will talk to you tonight. I understand this made it rather difficult for your organising team to advertise what this event would be about. I was surprised and flattered when my team showed me that the booking page online simply said, "Want to hang with one of the coolest people on the planet?" I had to show this to my kids! But that means you all turned up out of purest curiosity, and I think that right there is the best possible trait for a university to encourage. So that's what I'd like to talk about: curiosity, looking for answers, and how that journey of discovery is really the point of higher education.

I'm a huge supporter of universities and university extracurriculars. In fact, I wouldn't be here without the University of Sydney – my parents met here at the then-Newman society, resulting in baby Cathy and my siblings many years later. Universities have a critical role in shaping the individual, so they can contribute to making our communities and broader society better. It's a kind of superpower. When else do we give people this time and space to grow and think deeply? We need people to have time to be a bit radical, to challenge and consider whether the rules and assumptions of yesterday hold up in the world of today or tomorrow. To me, that challenge to explore – and the drive to find the answers – is the defining feature of a good university experience, not just the piece of paper at the end of a degree.

I suspect the founder of the first institution of higher learning, Plato, would agree. His school wasn't a university by modern standards, of course. His Academy was founded just outside Athens in 387 BC, amongst the olive trees. It didn't award any degrees, nor would the word 'university' even be coined for another millennium, but it was a public school for higher learning, which used lectures and seminars to educate its members on topics from physics to politics, mathematics to philosophy. In Plato's view, education was a life-long process that should be focussed on the growth of the individual, developing their abilities to the limits of their talents. After all, they were to be the future guardians of society. I don't champion all of Plato's ideas, of course – he also proposed removing children from their families at the age of seven, mandatory military service, and an exam-based system of government. But I absolutely agree that to build a society of the future, we need to ensure that our education systems develop people in every facet, not just a single discipline.

I particularly worry that the massive digital revolution we've seen in response to the COVID pandemic doesn't equally enable all kinds of curiosity and exploration, even as I celebrate the increased accessibility it provides. What are the incidental opportunities you're missing or gaining through your mode of attendance? Higher education is a huge part of our society; we must make sure that it continues to provide the full gamut of opportunities for people to grow and develop, even as the world changes around us.

Fortunately, I'm not the only one thinking about this. In order to fulfil their duty to their

students, universities always need to keep one eye to the future. If we want to teach students to question everything, we need to keep up with what 'everything' includes. Australian universities are very good at this, by the way. By most counts, there are just over 20,000 universities worldwide. That may sound like a lot, but it's not really – spread over the global population. That leaves roughly one university for every 400,000 people, and not all universities are the same. The Times Higher Education ranking, for instance, tracks less than 10 percent of these.

In Australia, we have 43 universities. The Times Higher Education ranking lists seven of them in its global top 100. Rankings like this don't tell the full story, of course, but they do show that Australians should be very proud of our university sector. However, we all know life isn't static. We can't rest on our laurels. The University of Sydney is Australia's oldest university, founded back in 1850 as a public institution of higher education. It was one of the first universities in the world to admit female students on an equal basis with male students. The University of Sydney Union is, likewise, the oldest student organisation in Australia, enabling a huge amount of extracurricular development for its students.

The changes that Australia and the university have seen during that period are immense. Convict transportation to Australia only ended in 1868 – 18 years after the university opened. We've seen world wars and Australian federation. Canberra was founded, as was CSIRO. The Sydney Harbour Bridge was built, cane toads introduced, a bad thing that I won't attribute to scientists; and antibiotics invented, clearly a very good thing done by scientists. We've endured droughts, fires, and most recently, the COVID pandemic, and I haven't even touched on the massive technological and communications changes that have revolutionised our society. We'd never expect that the University of Sydney's training curriculum from 1850 would stand up against today's expectations. So how do we balance the interests of students and the needs of our society? How do we make sure students are still gaining the social experience of university, while benefitting from the increased accessibility that remote learning has enabled? How do we help universities support their students?

Over recent years we've seen a real focus on universities improving their pastoral care and safety on campus responsibilities, but are we embracing the full human potential and encouraging diversity and inclusion in all aspects of campus life? Right now, the federal government is in consultations to develop an Australian Universities Accord. Announced in November last year, the Accord will review the higher education system and produce a long-term plan to make sure providers have a pathway to meet Australia's current and future needs. This is critical. As the discussion paper notes, more than nine in 10 jobs of the future will require post-school qualifications, with 50 per cent of new jobs expected to require a bachelor's degree or higher. The panel chair, Professor Mary O'Kane, has called for people to be bold and to think big in their feedback to the Accord consultations. It's good advice, here and elsewhere in life.

The most important challenge is to envisage what kind of a higher education system Australia will need in 2030, 2040 and 2050, and what we can do to get there. In my view, higher education has a significant role as an equaliser and in giving our next generations a step upwards. My own mother was the first in her family to attend

university, which in turn gave me a platform to follow in her footsteps and build my career.

You might wonder why Australia's Chief Scientist is so keen on talking about university, rather than – well – science, but as you've heard already, I'm keen on our history too. Once upon a time, science had a different meaning. In middle English, it was simply knowledge; stemming from the Latin *scientia* – it was, especially, knowledge based on demonstrable and reproducible data. So a scientist was anyone who developed deep knowledge of something that wasn't widely known. But being a scientist is also about questioning that knowledge; about re-examining assumptions, testing hypotheses, and building something new. When we pair knowledge with action, investigation and foresight, we get outcomes.

But how do we make this happen? How do we decide which areas of science to investigate? After all, science and learning are infinite; there must be a way to focus our efforts. Let's consider the global climate challenge. Fundamental research – the knowing part of science – has told us that we have a problem, and has outlined its magnitude. Applied sciences are helping us find ways to address and adapt to the problem and protect our world. Alone, these skills aren't going to solve the problem with sufficient scale, in the timeframes we need. If we've got to get to a 43% reduction in emissions by 2030, that's six-and-a-half years away. That's less time than countries get to plan the Olympics. We need teamwork, a shared goal, and something to help keep our efforts in step. We need focus, and that applies across all the science disciplines, not just to emissions reduction and transitioning our energy grid to renewables.

That overarching science vision is what I've been invested in lately, with the Australian Government asking me to lead a national conversation on its behalf as part of a refresh of Australia's science and research priorities. These priorities will provide direction for our science system. They're not intended to be a complete list of what research Australia does, but what they will do is focus our attention on major challenges and opportunities we need to address. Just as universities must keep one eye on the constantly expanding frontiers of knowledge, so too should our priorities.

The most recent version of the science and research priorities was written in 2015. This was in a time when gravitational waves had not yet been discovered. That's before COVID, before the massive rise in remote working; before the global race to create a COVID vaccine, and the attendant breakthroughs in mRNA technologies; and before generative AI and machine learning. We didn't have acknowledgements to Country, nor much consideration of Indigenous knowledge. The 2015 priorities did not realise we were on the cusp of major advances in quantum science that will bring another step change in medicine, communications, banking and many other sectors of our economy. They certainly don't account for the task of a lifetime ahead of us, as we tackle climate change on a deadline through finding new forms of energy for homes, industry and transport.

I've spent the past two months running consultations for this process across the whole of Australia, and I'm really impressed by the out-of-the-box thinking people have been bringing to the table. While there's still a lot to do before the draft priorities are ready for feedback, I think there will be some standout themes that we can all

learn from. For all of us – universities, scientists, communities and individuals – answers are rarely found on the beaten path. I've talked extensively about the positive role of curiosity and discovery in developing us as people, institutions and societies.

The less popular side of this is that we need to remember to embrace risk and uncertainty. This is a very tricky tension to maintain and be comfortable with, but if we are certain of everything, we stop learning. Science is about discovering the things we don't know. As such, truly ground-breaking science inevitably results in some failures or mistakes. When those failures aren't rewarded, research proposals become conservative – we stop asking the genuinely unknown questions. We need to embrace the experiments that end in 'failure' as well as those that end in success. An outcome, either way, still extends our understanding.

For you as individuals, this holds true as well. Only trying those things you know you will enjoy or be good at will rob you of opportunities to grow. We also need to embrace cross-discipline mobility and learning – coming at the same questions from very different angles. I mean this broadly, not just in the sense of doing a major and co-major. Think of each discipline like the earth's tectonic plates – in the middle of your discipline alone, it's calm. The big disruptions come at the fault lines where you're butting up against other disciplines.

The cochlear implant is a particularly famous example. Pioneered by Professor Graeme Clark at the University of Melbourne, this work brought together disciplines that had rarely been married before. The idea of curing deafness was generally thought to be impossible from a surgical perspective at that time. But Clark's ambition went beyond surgery. After completing his training as a general surgeon and ear, nose and throat specialist, he left a thriving practice to do a PhD in neurophysiology – the field that investigates the nervous system. The story that followed is fascinating, and worth a read if you're ever curious about how the development of the cochlear implant once depended on a senior surgeon jangling a donation can on the footpath to fund his research. Ultimately, without his unique skillset, the device wouldn't have come to fruition. In his words, "It was a team effort, varying from physiology to anatomy, pathology to surgery and then, later, to audiology and speech science." Electronics and engineering were essential, too, with the whole fate of the cochlear implant once hanging on a single loose wire in the transmitting equipment. Today, more than 700,000 people across the world can hear as a direct result of this invention.

Of course, cross-discipline learning doesn't have to be nearly as grand as this. It's also about developing other parts of yourself and connecting with people who hold those differing skillsets. I'd say that on-campus life teaches a lot of people almost as much as the set curriculum does. I can talk on this one from personal experience. When I was doing my PhD, I was involved in university politics; I became the National Secretary of the Council of Australian Postgraduate Associations, CAPA. At that time, funding for universities was being squeezed, and laboratory demonstrators had their salaries reduced. I was making more money behind the counter in a toy shop and tutoring high school students than I was making in laboratory demonstrating. It was frustrating and a lot of us quit working in the teaching laboratories. Driven by that frustration and the meagre ($3400) postgraduate

scholarships, which were taxed, I focussed a lot of my efforts with CAPA into increasing postgraduate student stipends. I was really gratified to get a big win – an increase to $7800 and tax free! Of course, it came in just as I finished my PhD.

The whole process taught me an enormous amount about things my degree had never touched on – things like advocacy, politics, and how to wield influence even though I didn't have a massive budget behind me. You could argue that this extracurricular activity was one of the most formative experiences for my role today as Australia's Chief Scientist. Another example is when I played university netball as an undergraduate – the people I met there and the connections I made ultimately led to my first published paper. I should note that we were a terrible netball team, but there is so much value in trying new things, meeting new people, and opening new doors.

I've touched on a lot of things tonight. Fortunately for you, this lecture won't be in any exam. But the biggest test of all – life – is ongoing. My career began in the 1980s. Things have changed enormously in those past 40 years, and the pace of change is only increasing. For many of you here tonight, your careers are beginning now in the 2020s, and will play out over the 40 years to come. Your working lives will be times of incredible change. When you are my age, it will be after 2060.

Your working lives will be in an era of quantum technologies. These will fundamentally change the way we think about everything from personalised medicine to the development of new molecules and new materials. Quantum computers will allow us to think about problems we want to solve in an entirely different way. They will make possible what was once considered impossible. As I've said before, I think we will have a fully error-corrected quantum computer developed during your careers.

Your working lives will encompass the transition to electric vehicles. The European Union has committed to cutting 100 per cent of car emissions by 2035; President Biden is aiming to have two in three new cars sold be electric vehicles by 2032. Australia faces the same imperatives. This represents a fundamental shift across the transport system, and along with self-driving cars, will require new technologies and new infrastructure that will transform our road network. During your working lives, NASA's Artemis program will build a permanent base on the moon and prepare for human missions to explore Mars. An Australian woman will go into space under our own flag – in fact, she's being trained already. Personalised medicine will become widespread, while personalised health monitors will transform diagnosis. We will work out how to fully incorporate reuse and recycling across the economy and start to draw a curtain on the era of disposable, non-degradable waste.

Your task – and the task of all of us who have a choice and some influence – is to shape those transformational changes for good. Your other task is to let loose on new ideas. If you have an idea that seems bonkers, don't dismiss it – test it out. Safely! If you have a solution that seems impossible, don't set it aside. Ask, "What technologies would shift this task from the box marked 'impossible' to the box marked 'possible'?"

So here’s my message for you – my advice, with no homework or grading attached. As students and educators, I want you to realise that knowledge comes from many sources. We don’t want to restrict ourselves to the confines of a lecture theatre or laboratory and miss valuable insights from other systems of understanding or life experiences. As you graduate from the lecture halls and into the broader world, I want you to realise this axiom holds true everywhere. Explore other disciplines of learning. Embrace uncertainty. Get into your extracurricular activities. And stay curious. We need your fresh thinking to lead us into the future we all want to see.