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Talented Student Program

Faculty of Science
sydney.edu.au/science/tsp
Introduction
Welcome

By nurturing the intellectual curiosity of our students through initiatives such as the Talented Student Program, our Faculty of Science is ensuring that tomorrow’s leaders, decision makers and innovators are well trained, critical and creative thinkers who can apply their knowledge to improve our world.
This is a particularly fascinating time to study science, as major technological advances are opening up new areas, from molecular biology to nanotechnology.

The boundaries between traditional areas are blurring as interdisciplinary research allows us to make important contributions to a wide range of issues in environmental, health and technology related industries that underpin our future prosperity and the quality of life in Australia and the world.

The coming century will see us confront challenges such as climate change, an increasingly populated world with decreasing resources and epidemics of obesity and diabetes.

Our ability to face these issues and develop truly effective, sustainable and innovative solutions relies not only on our research but also on the success of the students we are preparing to address these extraordinary global challenges.

The Faculty of Science is committed to fostering the next generation of science talent, and the University of Sydney is the ideal environment in which to do this because of the unique way it embeds undergraduates in the research enterprise from the beginning of their degree.

I invite you to take your first step towards a lifelong path of active and engaged enquiry by learning more about where the Talented Student Program can take you.

Professor Trevor Hambley
Dean, Faculty of Science
The Talented Student Program (TSP) is a unique offering for students who are seeking to expand their intellectual horizons and indulge their academic curiosity.
As a TSP student, you will have greater course flexibility, undergraduate research opportunities, networking and access to academic advice in your interest area to provide you with individual direction. These are just some of the personalised factors that have assisted more than 2000 graduates over the past 23 years to succeed not only at university, but also on their chosen career path.

The TSP is not exclusive to those who want a career in science or research. In fact many of our graduates pursue careers and professions outside of these areas including law, medicine, business, information technologies and government, just to name a few.

What sets our TSP graduates apart is their experience in creative, critical thinking and problem solving. This makes them highly sought after employees who, as future leaders, will positively contribute to improving our world.

Follow your curiosity and find out what the TSP has to offer.

Associate Professor Dale Dominey-Howes
Associate Dean (Talented Student Program)
Discover
What sets our program apart?

Flexibility
As a TSP student you will have greater flexibility in your choice of study and can individually tailor your degree to align with your interests, needs and talents. You will be able to enrol in units, or combinations of units, that may not otherwise be available within your degree.

Academic mentor
You will be matched with an academic mentor based on your shared scientific interests. This will ensure that you receive individual supervision and guidance at each stage of your degree.

Exposure to research
You will be introduced to genuine research from your first semester, when you will have the opportunity to engage in research projects with small numbers of fellow students, a senior student mentor and an academic mentor.

Acceleration
It is possible for some students (such as International Olympiad participants) to accelerate their studies by simultaneously undertaking a TSP activity and entering second-year study in that particular field. TSP students may also accelerate their degree by studying more than the usual workload each semester (subject to academic approval).

Recognition
Projects undertaken through the TSP are included separately on your University of Sydney transcript. This allows potential employers to see that you have completed challenging units of study.

Networking opportunities
Each year the Faculty of Science holds a variety of activities and events exclusively for TSP students, giving you networking opportunities with other TSP students, TSP alumni, academic and research staff, and community and industry leaders.
How to get involved

Entry to the TSP is by invitation only, from the Dean of Science, Professor Trevor Hambley.

To be considered for the program in your first year, you normally need an ATAR (or equivalent) of 99.00 or higher.

The Dean may consider slight variations to these requirements if you have demonstrated exceptional performance in scientific study, such as by being awarded a medal in an International Science or Mathematics Olympiad.

It is also possible to gain entry to the TSP in the second or third year of your degree if you meet the academic average mark (AAM) requirements. TSP students often join other high-achieving students in particular disciplines by enrolling in the Special Studies Program available in that discipline.
Our people
Enjoy diverse opportunities

Enjoy the many benefits of the program from first year through to your senior years, with the opportunity to become a project mentor in third year.

“The best part about the TSP is getting to experience real research life and doing exciting experiments at such an early academic stage. It is also a great opportunity to get to know professors and researchers in your field of interest and make friends with so many other smart and interesting students. The TSP provides a precious ‘trial and error’ opportunity for us to find out what we are truly passionate about. Plus you get to master extra knowledge and skills not included in the regular curriculum.”

Kehuan Shi
Third-year international TSP participant
“The thing I enjoy most about the TSP is its flexibility, which allows me to mould my degree around my interests and enrol in more challenging subjects. In first year, my TSP showcase project was in psychology, which I enjoyed so much that in my third year I mentored a TSP showcase project of first-year students in mathematics. I definitely recommend the TSP, because it allows you to challenge yourself and to get into areas you might not have thought about otherwise, and teaches you skills you wouldn’t normally learn through coursework.”

Victor Khou
TSP participant and mentor

“In my role as a TSP coordinator and mentor in mathematics and statistics, I advise students and find projects to cater for their interests. The TSP gives them a lot of flexibility to design their degree by doing projects or units of study ahead of time. They also work and socialise with like-minded students, building an environment that fosters creativity.”

Associate Professor Daniel Daners
TSP Coordinator and Academic Supervisor
School of Mathematics and Statistics
Our people
Inspiring mentors

Professor Bryan Gaensler, international leader in astronomy and former TSP student himself, inspired TSP students such as Alison Hammond to major in physics after her TSP experiences.

Professor Bryan Gaensler

Former TSP student; former director, ARC Centre of Excellence for All-sky Astrophysics, School of Physics; current Director, Dunlap Institute for Astronomy and Astrophysics, University of Toronto

Having been fascinated by science since he was a small child, Professor Bryan Gaensler has come full circle – from inspired TSP student to inspirer of the next generation of TSP students.

“It’s been fantastic to be able to help TSP students in their research journey,” he says. “As a supervisor, the TSP lets me be part of a student’s very first exposure to research, and it’s a great way to inspire them to complete honours research and PhD studies as they reach those stages.”

Professor Gaensler’s own scientific journey began with the science books his parents bought him, sparking his interest in the subject from the age of three. His decision to study at university was inspired by a science excursion to the University of Sydney in his senior years of high school.

“In Year 11, my science teacher took us on an excursion to the School of Chemistry, where we did some X-ray crystallography and determined the crystal structure of some solids.

“That confirmed that I wanted to study science at university, and that I wanted to do this at the University of Sydney,” he explains.

During his Bachelor of Science degree, Professor Gaensler was a TSP student.
“I always planned to major in and do my honours research in physics, so I did all my TSP research in physics.

“The best part of the TSP for me as a student was participating in the writing of a scientific journal paper – my very first paper! The TSP is unique in that it lets you do real research from day one – not just reproducing existing experiments where there’s an expected result, but doing something genuinely new.

“There’s obviously a generational gap between me and the TSP students of today, but one thing we have in common is that terrifying but addictive feeling of doing research – of stepping off into the unknown for the very first time.”

Professor Gaensler’s students regularly cite him as an inspiring supervisor, lecturer and mentor.

“I’d like to think it’s because I’m enthusiastic, and because I show them how to take the equations and theories they’ve learned in class and apply them to interesting and novel situations,” he says.

“It’s thrilling to see students like Alison Hammond [see page 12] being inspired through the TSP to conduct research they might not have known they’d be interested in.

“As Alison says, she hadn’t intended to major in or do her honours research in physics, but TSP projects early in her degree opened up the world of astronomy for her.”
Our people
Inspired students

Alison Hammond

TSP student

Her first-year TSP project in physics inspired Alison Hammond to change the course of her studies in the double degree of Bachelor of Arts/Bachelor of Laws, to end up majoring in and doing her honours year in physics.

“I had originally planned to major in history and maths within my Bachelor of Arts degree, and I thought I would probably do honours in history,” she says. “By midway through second year, though, I was enjoying physics more, largely due to my first-year TSP project, so I decided to pursue a major in physics.”

“By the end of second year I’d pretty much decided to do honours in physics, having had another good TSP project experience.”

Alison became interested in astronomy in Year 12 as she completed the HSC Cosmology distinction course. Finding that astronomy was a particular research strength of the School of Physics at the University of Sydney, her passion for the subject was fuelled by the TSP projects she carried out with astronomers Professor Peter Tuthill, Professor Geraint Lewis and Dr Julia Bryant. Alison especially enjoyed her second-semester TSP projects, in which she was able to work on real problems and questions under an academic supervisor.

“The process of working under a supervisor and to a timetable mirrors the reality of many jobs, and was relatively new to me,” she says. “This type of experience that I gained from my TSP projects will be valuable for whatever job I am in later on.”

Alison chose Professor Bryan Gaensler (see page 10), then Director of the ARC Centre of Excellence for All-sky Astrophysics, as her honours supervisor for her research in astronomy.

“I was inspired by Bryan’s vision for the honours project I undertook with him - the idea of investigating anything over the lifetime of the entire universe was exciting! He emphasised how the work was new, why it was important, and how helpful it could be to the astrophysical community,” she says.
“During honours Bryan asked excellent questions, which would spur me on to investigate further, look at the data differently or try something new. I was inspired by the way he led his research group, which met weekly, encouraging people to collaborate and share what they were working on.”

Alison’s successful honours research with Professor Gaensler won her the University Medal for her honours work in physics and the 2012 Bok Prize from the Astronomical Society of Australia for the most outstanding honours research in astronomy in Australia.

“The TSP really developed my ability to work individually or in a pair, without constant supervision and instruction. There was both a need and a freedom to be self directed, self motivated, organised and able to clearly articulate what I was doing. All of these skills are important ones that I now use every day.”

Alison Hammond
TSP student

“I made wonderful friends through the TSP. In first and second year I did my physics projects in pairs with other students, and both my project partners remain close friends. The entire TSP physics and maths cohorts were also small enough to be real communities, which extended into honours. Spending time with so many like-minded people was amazing!”
Peter Miller is an inspirational high school science teacher and University of Sydney graduate, who encouraged TSP student Mahiar Mahjoub to follow his passion for science.

**Peter Miller**

**Science teacher, Alexandria Park Community School**

Peter Miller opens up the world of science for his high school students as he works to create articulate, confident and open-minded citizens of the future. He was enthusiastic about science, and had a positive attitude and pleasant demeanour – a great all-rounder.”

“Mahiar was my first student to attend the one-week biology and chemistry vacation schools at the University of Sydney. When he returned to school, he kindly shared all his resources – and they are still doing the rounds three years later!”

Peter hoped that Mahiar would go on to study science at university, and encouraged him to study six units of science in Year 11: physics, chemistry and biology. Mahiar completed these units and continued on with HSC chemistry and biology. “I was thrilled that he kept biology, because so often your most promising candidates drop biology and continue with physics and chemistry.
Instead of feeling forced to choose these subjects, as sometimes happens, I would rather students study whatever they love and enjoy best.”

An alumnus of the University of Sydney himself, Peter had followed his own interest in biology, completing the first year of a Bachelor of Science and then transferring to a Bachelor of Science in Agriculture, from which he graduated in 1973.

He has retained his connection to the University, having recently brought his students to HSC science lecture days and attended teacher in-service days.

“I dedicate myself to opening the possibility of science as an inspiration for every student,” he says. “In my classes, I try to reawaken students’ fascination with the science world and their passion to know how we find out stuff.

“I acknowledge the role of Mahiar’s principal, Bob Bruce, himself a science teacher, in fostering a culture of challenging the science status quo, matched with the responsibility to be part of creating solutions.

“We need inspirational science teachers and leaders to be working with students, especially in Years 9 and 10, as they are deciding on options for their future.

“We need to ensure that the world of investigating facts, and the rich cultures of science across the world today and in the past, are shared with students so they are encouraged to be part of the future of science.”
Mahiar Mahjoub
Third-year TSP student

Having been fascinated by science in high school, Mahiar Mahjoub decided to pursue his love for scientific investigation at university. He chose the University of Sydney because of the TSP, which allows him to explore different areas of scientific research.

“The TSP has given me access to world-class research at the University of Sydney, which has an excellent reputation internationally,” he says.

“I never envisioned majoring in biochemistry and mathematics. Coming from high school, I was unsure about what I would major in, which is how lots of other students feel too. Studying in the Bachelor of Science and taking part in the TSP gave me the flexibility I wanted to ‘window shop’ and test different areas of science first hand to gain an idea of what they are all about.”

Mahiar has completed TSP projects in each of his three years of study, including a first-year biochemistry project that inspired him to continue studying biochemistry.
“My TSP projects have let me delve into different areas of biochemistry, such as bioinformatics and structural biology,” Mahiar says. “The best thing about the TSP is the opportunity to choose a project that you are very interested in, enabling you to channel all your motivation and energy into it.

“By taking part in that process you become familiar with the experimental as well as the theoretical side of science. You become familiar with the academic practice and culture, from communication to lab skills to critical thinking and training yourself to read academic literature, which greatly enhances your knowledge and understanding of the current state of research in your specific area.”

Mahiar was particularly inspired by his high school biology teacher, Peter Miller (see page 14), at Alexandria Park Community School, who himself studied science at the University of Sydney.

“Mr Miller nurtured a sense of curiosity in us to understand and answer the biggest questions in nature,” says Mahiar. “He treated his classroom as a forum for discussion and debate, rather than taking a standard old-school approach.

“After providing us with textbooks to read in our own time, he spent our class time showing us documentaries on the concepts being taught, and sought to engage us fully in the content by encouraging us to ask questions and propose answers to some of the most tricky questions.”

With his experiences in the TSP having opened up the world of biochemistry for Mahiar, he is planning to do honours research in this field, focusing on either protein engineering or cancer epigenetic dynamics. With his major in mathematics he is planning to use mathematical modelling in his honours research to predict protein function or to map the dynamics of cancer.

“By participating in the TSP, you are making a real start in your research career,” he says. “The program allows you to explore the horizons of science beyond the lecture halls, and experience real science.”
Our history
Reputation for excellence

With more than two decades of success, the TSP has given high-achieving science students the opportunity to ignite their curiosity. Now is your chance to join this impressive group of leaders.

The Talented Student Program formally began in 1993 to offer high-achieving science students the opportunity to study additional challenging material that would count as credit towards their science degree.

The first intake consisted of 18 commencing students. Today, after 24 years of steady growth, the program comprises a total of 280 students across all undergraduate science degree stages. More than half are commencing first-year students.

Initially offering only a handful of subjects in select disciplines, the TSP now offers students a selection of more than 300 unique units of study across all science disciplines.
The TSP was examined externally in 2005 as part of the Australian Universities Quality Agency (AUQA) review of the University, and as a result was added to AUQA’s National Good Practice website, reinforcing the TSP’s reputation for excellence.

Since its inception, more than 2000 students have participated in the TSP and many are now leaders in a variety of fields and industries, proving that nurturing curiosity through investigative, research-led education makes an enormous contribution to the ways in which these graduates approach the roles they take up in society.

In 2013, to mark the 20-year anniversary of the TSP, the Faculty of Science held a special event for current and past TSP students, as well as those who inspired their interest in science.

This event, hosted by Adam Spencer, was an opportunity to recognise not only our TSP students but also those who helped to ignite their curiosity.
Career opportunities
Where will the program take you?

The Talented Student Program has seen many great minds pass through its ranks. Here are some inspiring graduates who share how the program helped them in their diverse careers.

“I write about a broad range of scientific topics for children, in CSIRO’s educational publications. This involves a lot of research, such as reading papers across the full range of scientific fields – one week I might be talking about genetics, the next week it’s astrophysics.

“My science degree taught me how to process and interpret information in a scientific context. The TSP project I did drove home the importance of making science relevant to a wide range of audiences, and thinking about the social implications of scientific research.”

Patrick Mahony
Science Writer, CSIRO Publishing
“Scientific research allows you to make real contributions — whether they are physical technologies or advances in knowledge. A career in science gives you a unique opportunity to be curious (and ask questions) and then use lots of different methods to answer those questions. The TSP allowed me to conduct real scientific research for the first time, and realise that chemistry has the potential to contribute to all areas of scientific research.”

**Dr Liz New**  
Research Scientist, School of Chemistry

“My science degree and the TSP taught me to continually question why things are the way they are, rather than just accepting them at face value. Consequently I feel that my science and TSP experience has enriched my medical studies. I gained a deeper understanding of scientific concepts and the ability to critically appraise scientific research papers, which has improved how I practise in my day-to-day life as a doctor.”

**Monique Atkinson**  
Resident Medical Officer, Westmead Hospital
“Operations research is concerned with the application of scientific methods to decision making, so my science background is directly relevant to my career. At DSTO we add scientific rigour to the defence decision-making process.

“One of the things I like about this job is that the topics we look at are many and varied, and require a whole range of skills – it’s not purely concerned with any area of science or mathematics. I have a broad science background, which introduced me to a whole range of scientific topics and problem-solving techniques, and the ability to think widely has helped in my DSTO career.”

Marc West
Operations Analyst, Defence Science and Technology Organisation (DSTO)

“The skills I learned through the TSP projects and broadly through my science degree have been extremely useful in my practising as a lawyer. I work on a variety of commercial litigation matters, with a particular focus on the area of pharmaceutical and life sciences law. My science background is definitely an advantage in this niche area of law, as it means I can focus my attention on the legal issues without being bogged down by difficulties understanding the science. Having that general understanding in science – and particularly in the discipline that I majored in, pharmacology – definitely enables me to gain a good grasp of the scientific issues speedily.”

Jin Ooi
Lawyer, Corrs Chambers Westgarth
“As a clinical research associate I am the main point of contact between the sponsor, such as a pharmaceutical company, and the site, such as a hospital, at which a clinical trial is being run. I provide the site with support to ensure the clinical trial is well run, patients’ safety and rights are protected, the data collected is accurate and site staff adhere to protocol.

“The TSP allowed me to develop crucial skills that I use in my job, such as critical thinking, lateral thinking, organisation, presentation skills, the ability to communicate scientific concepts to a variety of audiences, and reading and understanding scientific protocols and concepts.”

Dr Eleanor Roach
Senior Clinical Research Associate, Roche
Harrison Steel

Fifth-year TSP student in Bachelor of Engineering (Mechanical (Space)) and Bachelor of Science (Advanced)

Harrison Steel has worked at the forefront of scientific understanding in a number of fields through his three TSP projects, with his second-year projects resulting in two peer-reviewed scientific publications.

Working with Dr Pulin Gong in the School of Physics for one of his second-year projects, Harrison investigated neurodynamics by simulating neural networks in the brain.

“Our neuron models were designed to fire and interact with one another in similar ways to those in the brain. By tuning the neuronal models, we are able to generate networks that show a range of emergent behaviour, such as large-scale interacting patterns propagating through the network, much like what is observed in the brain,” Harrison says.

“I then utilised this network for actual computation, tackling the computationally challenging ‘travelling salesman problem’, which seeks to find the shortest possible route for a travelling salesman between a list of cities, where each city is visited once and the route ends at the origin city.”

The process of finding an optimised route to solve the travelling salesman problem has applications for many areas of research and industries, including logistics, manufacturing, optimisation of processes, DNA sequencing, and astronomy.

“I was able to find solutions to the problem by using interacting patterns propagating through the network to find optimal paths,” Harrison says.

Using a combination of literature-based research and theoretical research, Harrison demonstrated and quantified a range of interacting behaviour in the neural network model, which could be used for computation. He then used the neural network to produce accurate and efficient solutions to the problem.
“The work I did on quantifying the possible interactions between patterns became part of a peer-reviewed publication, where I am one of the authors,” Harrison says.

“I chose this TSP project as it allowed me to develop a theoretical understanding of a broad range of topics – like neurons and their networks, assessing computational capabilities, the travelling salesman problem and techniques for solving it – as well as actually implementing this understanding in modelling and solving problems.

“This TSP project was a fantastic opportunity to develop my skills, as well as to experience what being a real scientist is like. From this research, I was awarded a summer research scholarship which allowed me to stay working on my project over the holidays, alongside PhD students and field-leading researchers. It provided invaluable insight into the daily lives of scientists.”

Based on his strong track record of research experience gained through the TSP, Harrison has been offered and completed internships at NASA’s Ames Research Centre in California, USA, and Deutsches Elektronen-Synchrotron in Hamburg, Germany.

“I would strongly recommend participating in the TSP. Having the opportunity to participate in active fields of research is invaluable, and it can open many doors to future projects, internships and jobs, as well as giving you an idea about what a career as a scientist may actually be like.”
Inverse optics problems in visual perception

First-year TSP Showcase project
Celia Killen, Qi Xuan Lim, Jeong In Park, April Saleeba, Karina Grunewald Zola
(pictured right)

You might remember the internet sensation ‘The Dress’ – a photograph of a striped dress and bolero jacket, which some people saw as black-and-blue striped and some saw as gold-and-white striped.

A group of first-year TSP students investigated how these differences in visual perception arise when a group of people are looking at the same stimulus – in this case, a photograph of a dress. “The image of ‘The Dress’ captured global attention because of its colour ambiguity,” explains project participant Qi Xuan Lim. “As science students we are not comfortable with ambiguities! So we began our research into the effects of illumination on changing colour perceptions, looking specifically at ‘The Dress’ illusion.”

Supervised by Dr Phillip Marlow from the School of Psychology, and with third-year TSP mentor Dylan Sherman, the group took an experimental approach to their investigation by conducting an online survey.

Fellow participant April Saleeba explains: “We investigated the role of interpretation of illumination in visual perception through our survey, looking specifically at the viral phenomenon of ‘The Dress’. Our research was experimental, but we also used literature in the area of illumination perception to guide our research.”

The team hypothesised that there is a relationship between how a person perceives the illumination of an object and the colour they identify that object as being. To test this, they used the original image of the dress, as well as an image of the dress with the background cropped out, to develop four online surveys.
“We found a significant relationship between perception of illumination hue as tinged either blue or yellow, and identification of the colours blue-and-black or white-and-gold,” says April.

“We also found a significant relationship between perception of direct illumination or shadow, and what colour they saw the dress as.”

Qi Xuan adds: “The majority of participants who perceived the dress as being in direct illumination saw the dress as blue and black, while most participants who reported seeing the dress in shadow perceived it as white and gold. Similarly, there was a greater tendency for participants who saw the dress as blue and black to perceive a yellow-tinged illumination, and for those who saw the dress as white and gold to perceive a blue-tinged illumination.”

April explains: “When we perceive an object to be in shadow, we discount the bluish hues and thus perceive white and gold. However, when we see an object as being in direct illumination, we attribute the yellowish hue to natural lighting, and this results in us seeing blue and black. Put simply, perception of illumination has a relationship with interpretation of colour.”
With all five members enrolled in the Bachelor of Psychology, the team enjoyed unravelling the workings of visual perception and the mechanisms behind this particular phenomenon.

“The best part of this TSP project was the opportunity to challenge myself to conduct actual scientific research, despite only being in first year,” says April. “I felt I could make a real contribution and learn skills that will be advantageous throughout university and beyond. Overall, it was an amazing experience.”

Qi Xuan says: “I would definitely recommend the TSP to other students. The benefits of participating are immense. Doing a TSP project is like doing a mini honours project: it gives you your first taste of the challenging and exciting world of research, along with access to resources that are second to none.”

Image credit: smh.com.au
By nurturing your intellectual curiosity through the Talented Student Program (TSP) in the Faculty of Science, you will become a well-trained, critical and creative thinker who can apply your knowledge to improve our world, and become one of tomorrow’s leaders, decision makers and innovators.

As a TSP student, you will have access to additional challenging material – including exposure to cutting-edge research within the faculty – to enable you to maximise your intellectual growth and potential.

Through the TSP, you will have greater course flexibility, undergraduate research opportunities, networking opportunities and an academic mentor from your nominated interest area to provide you with individual advice and direction.

Follow your curiosity and find out what the TSP has to offer.

sydney.edu.au/science/tsp