As this document shows, we live in a world shaped by science and new technologies. Our living standards are among the highest in the world because science enables us to have clean drinking water, nutritious food, abundant energy and other resources, good health and a relatively clean environment. Science and technical innovation are also increasingly important to economic competitiveness and social harmony. Science has brought new developments and new industries, from the laser to ultrasound scanning. It has been equally important in lifting the competitiveness of traditional industries, so that our agriculture and mining increasingly rely on science and innovation to offer products to the world. Science underpins our health by providing a clean environment as well as advanced medical care. It enables us to protect our natural resources, including outstanding natural assets like the Great Barrier Reef and tropical rainforests.

However, while scientific excellence requires physical infrastructure such as laboratories and equipment (Chapter 2), it also requires people with the right skills (the human capital) to undertake the research, develop ideas, apply new technology and operate in the knowledge economy.

Constitutionally, the State Government has a major responsibility for school-based education and vocational education and training. A principal objective of the Government has been to increase the levels of education achieved by Queenslanders in recognition that the higher the education levels, the more likely the State will achieve and sustain its Smart State ambitions which are predicated on leading-edge skills, knowledge and creativity.

Statistics show that people with higher levels of education tend to achieve better labour force outcomes (see Figure 3).
Primary and secondary education

Queensland has a high-quality, internationally-competitive education and training system that aims to develop the literacy skills, technical skills and motivation for learning needed for life in the information society.

In 2002 the Queensland Government introduced its Education and Training Reforms for the Future (ETRF) strategy. Key elements of the ETRF package are –

→ a long-term investment in information and communication technology and teacher training in schools

→ trialling a full-time preparatory year

→ investigating a new approach to the middle years of school

→ flexible opportunities for 15, 16 and 17 year olds to achieve a senior certificate or vocational education qualifications

The fundamental objective of these reforms is to increase the number of students completing Year 12 from 68 per cent to 88 per cent by 2010. This will match the figure projected for leading OECD countries. The reforms seek to engage young people in the concept of ‘learning or earning’ and provide them with the skills and confidence to take their place in and contribute to the Smart State.

ICT skills in schools

The Government has made a major commitment to funding ICT in schools. $121.7 million over four years has been allocated to the ICTs for Learning Strategy. This strategy is providing opportunities for teachers to integrate ICT into their teaching practice, assisting Queensland state schools to replace outdated computers and providing increased access to computer networks and the internet.

By 2005 the aim is to have one computer for every five students in State schools across years 3-12. 60 per cent of computers linked to the internet and 40 per cent of subject areas delivered through ICT.

Queensland schools now have cutting edge online learning services such as –

→ the Virtual Schooling Service which delivers secondary subjects to over 400 students in 63 schools

→ the Learning Place which provides teachers with online professional learning experiences and has supported the development of 350 online professional learning communities

→ the Eco-Online website, a collaborative arrangement between the Queensland Government and the Smithsonian Institution (USA), which provides a unique online education resource for schools in the field of environmental education

Excellence in ICT is being rewarded via the annual ICTs for Learning Teachers’ Awards which recognise teachers who transform teaching and learning in their classrooms using ICT. There is also the ICT Innovators Grants scheme that provides up to $50,000 for innovative projects in schools in association with industry partners – $830,000 is being distributed across 39 winning Queensland schools under this scheme.
Science education

In 2002, Education Queensland established eight Technology, Maths and Science Centres of Excellence in Queensland schools comprising three in and around Brisbane and five in rural and regional locations. The centres provide specially designed maths, science and technology programs and put students in contact with industry mentors who help them with career choices and development (see case study on page 80).

Other initiatives have included –

→ the Girls in Science, Maths and Technology Summer Schools which have been running at the University of Southern Queensland at a cost of $60,000 annually

→ support for out-of-school and holiday science education programs which have generated significant interest and enthusiasm among school-aged students

Career choices

The Government has placed emphasis on helping students and other young people choose careers in science and technology. Measures include –

→ the Information and Communication Technology, Skills, Training and Role Models (i-STAR) program which promotes pathways for Queenslanders seeking jobs in the ICT industry including traineeships, apprenticeships, TAFE courses, university degrees and private training. Previous projects have included girls’ computer clubs, ICT focused camps and mentoring programs, ICT careers breakfasts and expos

→ the ICT Careers Awareness Kit that promotes ICT careers to youth, with a focus on young women. The kits have been distributed to all secondary schools and TAFE institutes in Queensland with a CD-ROM version of the kit being distributed to public libraries – www.iib.qld.gov.au

→ the Ausbiotech careers evening where members of the biotechnology industry provided 150 tertiary students with information about career opportunities available in the biotechnology industry

→ the Smart Future website which promotes and profiles a range of science and technology careers and training needs for students aged 14 to 18 years – www.smartfuture.qld.gov.au
Vocational education and training

Vocational education and training (VET) is providing opportunities for Queenslanders to develop the skills they need to participate in new and emerging industries. TAFE Institutes and other training providers are ensuring that people are trained in science-based industries such as biotechnology, ICT, eCommerce, aquaculture, and other areas of innovation including aviation, winemaking, pharmaceuticals and creative industries.

VET graduates are able to benefit from the academic and practical experience of teachers and tutors and can immediately apply their newfound knowledge when they move into the workplace. For example, three recent graduates of a TAFE Queensland biotechnology course were able to put their award winning ideas for extending the shelf life of fresh herbs without preservatives straight to the market, immediately earning from their learning.

Queenslanders are also taking advantage of opportunities to articulate from higher VET qualifications into university courses, or topping up their practical skills at TAFE after finishing their higher education degree. More and more pathways between VET and Queensland universities are becoming available to graduates.

There is a range of other pathways for studying VET in the sciences and knowledge industries, including school-based and traditional apprenticeships and traineeships, skilling of work entrants, re-skilling for existing workers, and attaining qualifications from entry level to diploma and advanced diploma courses.

Young people today are able to start gaining the skills they will need for the future during their years at school, and later by participating in VET and higher education options. However, keeping ahead in the Smart State economy means that knowledge workers need to constantly update their skills through adulthood – reliance on qualifications and skills gained in youth will not be sufficient to guarantee a place in industries and services that rely increasingly on knowledge acquisition and dissemination. VET is a major key to re-skilling and up-skilling, particularly for adult learners as they progress within and between new and emerging industries.

Aviation is one major industry that is creating demand for new skills and Queensland has responded by investing $15 million to date in the development of a centre of excellence in aviation training. Aviation Australia, which opened in December 2001, offers leading-edge training in innovative industry-supported aviation skills and has helped attract aerospace industries to Queensland. Qantas and Virgin Blue plan to open major maintenance facilities in Queensland in 2004, which will add to the State’s reputation as the aviation hub of the Asia-Pacific region.
Higher education – research and training

Traditionally the Commonwealth Government has been responsible for university funding for undergraduate and postgraduate training, and academic salaries. But the pressures on university budgets, coupled with the important investments being made in Queensland science and technology, have required the State Government to enter this area in specific circumstances.

For example, the State is providing $77.5 million in operational funding for the Institute for Molecular Bioscience (IMB) at the University of Queensland, part of which goes to support academic and staff salaries. The $2 million (over four years) Smart State Fellowships scheme has also been established to support skills acquisition, as well as help attract Australian Research Council (ARC) funding for Queensland centres of excellence.

Other tertiary initiatives have included –

- the Queensland-Smithsonian Fellowship Program, a joint program of the Queensland Government and the world famous Smithsonian Institute, to foster scientific exchanges between Queensland and the Institute
- funding for 160 scholarships in visualisation and games development via the Queensland and Northern Territory Multimedia Centre (QANTM)
- funding for the Australian Microelectronics Centre, which operates a postgraduate microchip system design program to grow a pool of qualified and talented chip designers for the ICT industry
- funding for the Bachelor of Biotechnology Innovation Degree at the Queensland University of Technology (see case study on page 81)
- Growing the Smart State research program which provides PhD students with funding of up to $4,000 per year (increasing to a maximum of $5,000 per year in 2003/04) for up to three years to support research that is relevant to policy development and decision making in State Government agencies

Community awareness

More widely, the Queensland Government has undertaken programs to raise awareness about science and innovation in the general community, the importance of science and innovation for Queensland’s future, and opportunities to participate in the knowledge economy.

These programs have included traveling events such as the Queensland Museum’s Science Roadshow (now in its sixth year) and the Queensland University of Technology’s Innovation Train, which ran in 2002. Other events have included –

- careers evenings for students
- the Brainwaves Festival and the Bio Event Tent held during National Science Week
- the annual Science in Parliament forum which brings together Queensland parliamentarians and scientists to share developments in science internationally and within Queensland

The Government has also allocated funding to establish a Queensland BioBus that will tour the State promoting biotechnology and career opportunities.

Public Smart State forums have encouraged community discussion and debate about the ethical issues of science as well as the benefits. For example, forums have been held in Brisbane, Townsville and Emerald on the ethics associated with biotechnology (such as genetically modified foods and cloning) where speakers on both sides of the debate contributed to the discussion.
Science on Saturday

The Government proposes to build on and complement its out-of-school science programs through a more comprehensive statewide Science on Saturday program. The new program will be an out-of-hours program aimed at students aged 7 to 10 years and a portion of students aged 10 to 14 years.

International Biology Olympiad

The Government will contribute $75,000 towards the International Biology Olympiad, which will be held in Queensland in 2004. This is the world’s biggest science Olympics for students. The event lasts for seven days and involves 200 of the top science students from 50 countries, competing in a series of laboratory experiments and exams.

This will be the first time that the event is held in the southern hemisphere and will provide Queensland students with a great opportunity to mix and interact with the world’s best biology students.

International Young Physicists’ Tournament

Education Queensland will contribute $15,000 towards the International Young Physicists’ Tournament (IYPT) to be held in Brisbane in 2004. This will be the first time that the event has been held outside Europe and will involve over 20 countries. It will encourage gifted young scientists to become actively involved in scientific research, and the event will provide a springboard for organising a national qualifying tournament that will be open to all physics students in Australia by 2005.

Vocational education and training

By investing in VET, the Government is ensuring Queenslanders are able to move into smart jobs, and industry is able to access the right people with the right skills at the right time. Each year, businesses, industries, community organisations and individuals based in metropolitan, regional and remote Queensland are able to influence the way in which Government funds are invested in VET for traditional, emerging and new economic areas.
In 2003-04, the Queensland Government will continue to invest in training for smart jobs in science and innovation. For example, approximately $3 million will be invested in around 400 full-time equivalent student places in biotechnology related courses. In addition, approximately 6000 full time equivalent student places will be created in specialist information technology and telecommunications training programs through an investment of more than $44 million and approximately $5 million for apprentices and trainees.

One of Queensland’s fastest growing areas of employment is in the arts, cultural and creative industries. By investing $30 million for almost 4000 full-time equivalent student places in these areas of creativity and innovation, the Government is ensuring a vibrant, inclusive and diverse society.

A further $25.5 million will be used to deliver training priorities for up-skilling and re-skilling existing workers in new and emerging industries including the creative arts and industries experiencing change.

Innovation is occurring not only in new and emerging industries but also in traditional areas such as manufacturing and related industries. Investment in training means that graduates will bring to the workplace new ways of looking at old issues, thereby reinvigorating existing industries. In 2003-04, $33 million will be invested in training, in manufacturing and related skills for around 4400 full-time equivalent student places and approximately $30 million for apprentices and trainees.

Building on significant funding to date, the Government will invest a further $3.6 million in aeroskills training to ensure a skilled labour market is able to meet anticipated future demand.

Awards and prizes

Awards and prizes are another way of promoting innovation and at the same time recognising the achievements of Queensland innovators. The Government has established two innovation awards –

→ the Premier of Queensland’s SMART Awards which honour innovative and entrepreneurial businesses in the categories of Services, Mining or Minerals Processing, Manufacturing, Agribusiness, and Science or Technology and showcase the winning companies as role models – [www.sd.qld.gov.au](http://www.sd.qld.gov.au)

→ the Smart Women – Smart State awards which recognise achievements by women in the fields of science, engineering and technology – [www.qldwoman.qld.gov.au/events/smartaward](http://www.qldwoman.qld.gov.au/events/smartaward)

An important goal of the Government has been to ensure that Queenslanders have access to high-quality science education that is relevant to the needs of the Smart State. The Government will allocate $14 million over three years to build on its current initiatives with a comprehensive vision for science education that will integrate existing initiatives and develop new directions.

The 2002 Queensland Science Summit

The roles of science and science education were discussed around the State in 2002, leading to the Science Summit which was held in Brisbane and chaired by the Chief Scientist of the Department of Primary Industries, Dr Joe Baker AO. Following that meeting a Steering Committee comprising experts in science, industry, education and government prepared a report which sets out key principles for a new approach to science education in Queensland. That report was used as the basis for our renewed vision for science education.

All Queenslanders must have access to the opportunities provided by science and technology in the modern world and the knowledge economy.

New technology is being developed at an ever-increasing rate. We will need to be skilful and prepared if we are to take advantage of the opportunities offered by science and this new technology.

The Queensland Government is committed to the best possible standard of science education at all levels from pre-school to post-graduate study.

This is essential for producing the next generation of scientists who will only be attracted to science careers if there is increasing awareness of the wider opportunities for scientists in the modern world.

The Queensland Government recognises the importance of improving science education to ensure the whole community has a basic understanding of science and can use that understanding to help shape decisions that will affect their future. The Government is committed to making available new educational opportunities at all levels.

All school students should study science at least until the end of Year 10 and preferably beyond. For a sustainable future, the community must be aware of the impacts of their decisions and actions on the environment.

To encourage all students to study science, science learning must excite and fascinate students. Science learning should be based on inquiry into real-world problems. The goal is for teaching at all levels to demonstrate science as a continuing process of inquiry that draws on and extends the body of knowledge we know as science.

We will build on the excellent work that has been done to encourage capable young women to study information and communication technology. We cannot afford to neglect half of the talented young people who will be the next generation of scientists.
To make our students aware of the importance of modern science to their future world, we are determined to attract and retain outstanding science educators at all levels. As such, the Government will establish networks of educators to promote best practice in teaching with prestigious awards to recognise leaders in the field.

Primary schools need special attention and extra support to meet the demands of teaching science because many primary teachers were not formally trained in science. We now recognise the importance of developing at an early age an understanding of the process of scientific inquiry. The Government will set up mentoring programs across all levels of schooling that guide the development of teachers and excite the next generation of students.

As many of today’s adults finished their schooling without the basic understanding of science needed to function effectively in the twenty-first century, the Queensland Government will also extend informal education opportunities for adults at the community level.

Queensland’s commitment to professional development will include measures to ensure that science teachers are up to date with the latest developments in science and science teaching, giving their teaching the immediacy and excitement it requires.

The State’s research facilities and science-based industries are important resources and we will work creatively to use them in new partnerships with the education sector for mutual benefit. Information and communication technology now makes it possible for students to have a wide range of new learning experiences, from having access to on-line resources to conducting experiments or observing natural systems in real time.
Future directions

From the Science State – Smart State initiative, the Queensland Government has developed a six-step action plan for improving science education in Queensland and enhancing community understanding of the role science plays in everyday life.

This plan will improve the scientific literacy of Queenslanders, encourage more young people to aspire to careers in science, and improve the overall quality of science education in the Smart State.

A high-level task force will be set up to implement this action plan, chaired by a prominent science educator to be known as the Queensland Science Education Ambassador. This broad-based task force will include members from government, industry, education providers, research organisations and teacher associations.

The action plan targets students, teachers and the learning environment, and seeks to strengthen partnerships. The task force will oversee an ambitious program of professional development for all science teachers, including Science Links programs, District Forums and an Awards program. Through the task force, the Government will also establish new approaches for bringing together educators and other important community, industry and Government sectors.
Action 1. Science for Life

More than $1.5 million will be used to support the Queensland Government’s vision to engage young people in science. This will result in:

- all young people in State schools studying science to the end of Year 10
- more young people studying a science subject to the end of Year 12
- increased opportunities for all young people to engage with science
- increased numbers of school leavers continuing with tertiary studies in science
- increased understanding of the natural world, so young people can make responsible decisions concerning their own and the community’s future well-being

From 2005, the study of science to the end of Year 10 will be compulsory for all students in State schools. Currently some students in Year 10 miss out on science learning experiences as a result of school organisational issues or because they have already completed the Year 1-10 science syllabus.

This move will raise the minimum level of science education for all students. We are setting the foundation for life-long learning in science to ensure that the whole community has a basic understanding of scientific principles. Extension science activities will be provided for those in Year 10 who have already completed the core syllabus.

Measures are being developed to encourage more students to pursue the study of science beyond Year 10. By 2005, we will introduce a “Science in Society” elective subject for senior school students. This subject will provide learning experiences about science and its real world application for senior students who do not study a specific science subject.

The raising of the base level of science education will be supplemented by a strong commitment to enhancing the education of our best and brightest; those who will become the next generation of scientists.

The Queensland Government will support a range of out-of-class activities that provide rich experiences in science, including:

- Girls in Science Summer Schools
- Siemens Summer School (see case study on page 81)
- Engineering Link Project
- International Young Physicists’ Tournament
- Biology Olympiad
- National Science Week including Bush to Beach website and quiz night
- CSIRO Student Research Scheme
- National Youth Science Forum

The Queensland Government is determined to ensure that science opportunities are equally available to all young people including students from non-English speaking backgrounds, students in special schools, Indigenous students and rural and remote students.

Interactive science activities such as BioBus, CSIRO Science Education Centres, the ScienCentre, Science on Saturday and school-based science clubs will continue on an ongoing basis, allowing a broad range of young people to engage with modern science.

A key step to encouraging students to consider careers in science will be increasing access to scientists and real-life science experiences in industry and research institutions. There is clear evidence that these experiences are successful in stimulating students to aspire to science and technical careers.

To facilitate the transition of advanced science students from school to tertiary science courses, the Government will liaise with universities to establish formal agreements that allow senior students studying science at an advanced level to gain credit toward tertiary-level science studies.

We will develop a sustainable model of science and technology magnet schools. These schools will build on existing facilities and involve partnerships with universities, industry and business to cater for students who are committed to achieving excellence in science and technology.
Better information about science and science teaching career opportunities will be made available through the development of static displays and the websites "myfuture" http://www.myfuture.edu.au and "SmartFuture" http://www.smartfuture.qld.gov.au.

Action research projects give Queensland students an insight into both the process of scientific inquiry and the practical application of scientific knowledge. For example, Palm Beach – Currumbin State High School students, working in collaboration with the Palm Beach Surf Club and the Gold Coast and Hinterland Environment Council, developed a project to monitor and care for the Currumbin Creek estuary. They canvassed community concerns, assessed the scientific parameters for monitoring the health of the waterway, undertook a “clean up the beach” program and propagated native grasses to help restore the natural ecosystem.

Schools such as Emerald and Rockhampton State High Schools have made practical, innovative, low-cost changes to their science programs to ensure their students have the best possible education despite not living in a major centre. Project-based extension subjects such as ‘Ingenious Inventions’, ‘Robotics’, and ‘Project Science’ have been developed, using an inquiry-based approach to learning which links science education with industry, technology and the workforce. Geographic isolation has been addressed through innovative use of technology, trips to larger centres and involvement in external programs.

Hands-on science activities such as the CSIRO Student Research Scheme provide Queensland students with much more than a work experience. Each student undertakes a 20-hour research project under the supervision of a professional scientist. They then prepare scientific reports giving the results of their research and present their findings to their fellow students, as well as to the other students and scientists involved in the scheme, at a presentation evening. More than 75 per cent of the students who have participated in this scheme have gone on to study science or engineering at university.

Indigenous students were invited to participate in an experiment to send ochre samples into space on a NASA Space Shuttle mission. After testing for compounds and crystallinity of the samples, students packaged the crushed ochre into special vials sent from NASA. The samples made the trip into space aboard the Space Shuttle after which they were returned and retested. Students discovered that the moisture content of the samples had reduced significantly. Students were involved in all phases of testing and packaging of samples. Via information sessions conducted during the project, students also learned more about space exploration: www.schools.ash.org.au/murrumba/inspace/stjosephs/index.htm

Having special learning needs is no barrier to participation in science education. In the International Year of Freshwater, Aspley Special School has been participating in a project that involves returning a local creek to its natural state and assisting in maintaining it for future generations. Partners in this project include primary, secondary and non-government schools, a tertiary facility, Environmental Education Centres, community groups, local businesses and the Brisbane City Council. Each school is participating within their own capacity. The students at Aspley Special School are involved through their bush-house program in potting up and propagation of native plants. The students also participate in tree planting activities, environmental restoration, and water quality monitoring and testing.
Action 2. Inspiring Science

The Government’s $10.2 million commitment to best practice in science teaching will result in:

→ a workforce of enthusiastic and competent teachers who provide exciting and relevant science experiences for students

→ improved recruitment of high-quality teachers across all levels of science education

→ all science teachers engaging in continuous professional development and updating their knowledge and skills in science education

To achieve the primary goal of a workforce of enthusiastic and competent teachers who provide exciting and relevant science experiences for their students, Queensland needs to recruit high-quality teachers and invest in their professional development. As part of this process Destination Statements will be developed for science teachers, setting out the range of understandings and skills that characterise teachers who are implementing best practice in science education.

The Queensland Government will establish alternative entry pathways for scientists and other experts to become teachers. Scholarships will be offered to encourage outstanding secondary students to enrol in double degrees involving science education. This is a creative way of expanding the talent pool from which we draw science teachers.

With scientific knowledge expanding faster than at any previous time in human history, the Queensland Government will designate science education as a priority area for professional development. Science teachers in primary schools will be able to access funds from the Commonwealth Quality Teacher Program (CQTP).

The Queensland Government will also support professional development for secondary teachers based on initiatives at the district level. Initiatives include cluster projects that respond to identified local teacher needs. In addition, scholarships will be available to release teachers from classroom duties to undertake placements of two to four weeks in industry or research institutions.

Professional development is part of the teaching load. It is not an additional obligation. Schools must allocate appropriate funds to professional development and be accountable for its use. By the end of 2005, at least 70 per cent of teachers of science, across primary, special and secondary State schools, will have undertaken professional development in science education.

Science will also be deemed a priority area for the Information and Communication Technologies (ICTs) for Learning Innovation Grants in 2004/2005.

The Government is committed to strengthening the connection between science teaching practice and education research by such methods as attachments of science teachers to research groups and the inclusion of teachers in the dissemination of research results through conferences and journal articles.

The Queensland Government will establish a new program of Science Links to support science teachers. Networks of teachers will be established to promote mentoring and best practice in science teaching in all schools, augmented by web-based support systems that will be especially useful to teachers in rural and remote areas. We will implement a comprehensive science induction program for recent graduates and teachers transferring to new schools.

Leaders in science in primary schools will be identified and supported, helping them to build on the impressive work being done in some of those schools and encourage the development of a broader range of highly engaging science activities for use in teaching.

Annual District Science Forums will be held to bring primary and secondary science teachers together with science experts and other qualified community members. These Forums allow participants to share learning experiences and scientific understanding, helping teachers to develop learning activities which take students to the forefront of modern science.

The eight existing Technology, Mathematics and Science Centres of Excellence will continue to provide experiential professional learning and sharing of best practice programs for teachers and students.
For example, 11 teachers from Biloela’s primary and secondary schools have entered a two-year partnership with science educators at Central Queensland University. Each teacher defined a study program in consultation with a university adviser. The process allowed the teachers to overcome the barriers of isolation and change their teaching practices in line with modern educational research.

The Queensland Institute of Medical Research (QIMR) aims to champion medical research as a career, provide work experience at several critical stages of this pathway and educate and mentor bright students and teachers from Queensland, interstate and overseas.

QIMR is currently developing a significant Indigenous Health Research Program. This program aims to improve health outcomes for Indigenous people and to have Indigenous scholars and researchers carrying out research projects. QIMR seeks to encourage Indigenous students from across the state to come to the institute for work experience with a view to taking up a career in the science, health, research area.

QIMR provided workplace experiences for science educators in 2002 through the “Cross-Cultural Health and Science Student and Teacher Exchange” program. Teachers from Darwin and Brisbane gained valuable insights into both medical research practice and cross-cultural issues.

Partnerships between science educators, universities and research institutions around Queensland are helping to ensure sharing of ideas and promotion of leading edge teaching practices.
The Queensland Government is committed to ensuring that State schools are able to make extensive use of the internet for science education, and students are working on innovative new technology-based projects.

For example, students at Smithfield State High School are presented with real-life problems that require electronic monitoring and switching. They design systems and use programmable logic controlled switches to maintain desired conditions. At the request of a junior science class, they designed and implemented a system to maintain desired temperatures in fish tanks. The school has joined with Tully State High School to form the Far North Technology, Maths and Science Centre of Excellence.

Action 3. Connecting Science

It is vital that science education also reflects the provisional nature of science knowledge, the way technology changes and the importance of open-ended scientific inquiry.

The Queensland Government has allocated $0.5 million to support its vision for innovation in science education. This will result in:

- science being taught as a continuing process of practical inquiry into real-world issues and problems
- more opportunities for teachers and students to engage in experiences beyond the classroom

In a technologically sophisticated world, it is essential to increase the use of interactive, open-ended science activities that focus students on real-world issues and problems. It is now possible for students and teachers to use the internet to collect data, interrogate experts, obtain a wider range of opinions, or develop innovative ways of approaching complex topics. To ensure these opportunities are available to all State schools, the Queensland Government will continue to invest in computers and broadband access to the internet through its ICTs for Learning strategy (see also Chapter 3).

The on-line Science Education Gateway on Curriculum Exchange will be expanded. It will have engaging, interactive science activities for students across all year levels as well as examples of learning activities which integrate ICTs into science across all phases of schooling. The Learning Federation will provide additional on-line learning experiences.

We will implement a Scientists in Schools program to bring science experts into classrooms. This program will assist teachers to stay abreast of the latest developments in their fields of science and help students to appreciate the provisional nature of science knowledge.

A project will also be undertaken in two existing primary schools to determine the feasibility of upgrading science facilities. These results will be used to inform the capital works program.

Productive partnerships will be established between primary and secondary schools to promote mutually beneficial interactions. For example, giving primary schools access to laboratory facilities in neighbouring secondary schools, giving secondary classes access to field sites being used by neighbouring primary schools, sharing resources and above all else, sharing expertise.

The Queensland Government is committed to ensuring that State schools are able to make extensive use of the internet for science education, and students are working on innovative new technology-based projects.

Project Atmosphere Australia Online is an innovative website which allows students to engage in a variety of weather-based activities including data collection and reporting, as well as questioning experts on-line and joining student activity lists. This teacher-developed online project for school communities was a finalist in the International Stockholm Challenge Awards.

http://www.schools.ash.org.au/paa1
Action 4. Science All-Stars

To create a culture of excellence in science teaching, $0.4 million has been committed to recognise, acknowledge and celebrate best practice in science teaching. The Queensland Government plan for recognition of excellence in science education will result in:

→ increased acknowledgement of outstanding students and best-practice in science teaching

→ improved retention of high-quality science teachers

→ greater engagement of schools and industry in promoting science education

The Queensland Government will provide an awards program that recognises outstanding achievements by students, teachers and industry partners. Staff, students and industry will be eligible for these awards. Annual awards will be presented for excellence in the design and/or delivery of education programs that illustrate the principles of scientific inquiry and context-based learning.

We will fund a new program of scholarships so science teachers can undertake post-graduate studies in science or science education, thus improving the expertise of the teaching community. These awards will be presented each year as part of National Science Week.

At St Augustine’s, Currumbin Waters, the science co-ordinator’s passion for outcomes-based education has influenced the whole school. By example and by mentoring colleagues, she has enthused other teachers and transformed the school perspective on science education, giving students more control over their own learning.

‘Rather than telling children the answer or instructing them how to do something we allow them to first determine what they are thinking, and then to challenge their ideas and modify their thinking about why something may be happening. It empowers the student and gives them some responsibility’.

The staff have used a number of inventive ways to apply outcome theories to topics of investigation such as growing vegetables, designing and building moving toys, food testing, rearing chickens, and building solar cookers.

Rebecca Hack, the Science Subject Master at Rockhampton State High School, was one of the winners of the Westfield Premier’s Educational Scholarships in 2002. With a focus on experiential learning, Rebecca used some of her scholarship to visit many educational institutions in the United States of America, such as the Scripps Oceanographic Institute in San Diego and the Buck Learning Institute in San Francisco. She worked with Meredith Porstmore in Boston on robotics and attended the National Science Teachers Association conference, along with 20,000 other teachers. She also visited classrooms in Detroit and Chicago that focused on hands-on investigative science lessons. Rebecca says the visits expanded her experience of science, and at the same time reinforced many of her own ideas about good science teaching. She recommends the scholarships to all science teachers.

We will publicly recognise and celebrate the achievements of Science Success Schools that reach high levels of student participation in science education. These schools will also use web sites and on-line technology to share their success strategies.

Outstanding Year 12 science students will be eligible for awards to assist their progression to tertiary science studies.

Other annual awards will be available for:

→ primary school teachers

→ educational institutions

→ industry
Action 5. Partners in Science

A central element of the Queensland Government’s vision for science education is the establishment of new approaches for bringing together educators and other important community, industry and Government sectors.

Our $0.4 million commitment to developing and supporting strong science education partnerships will result in:

- more productive science partnerships between industry, business, government, research and educational institutions
- improved learning experiences for students and teachers across all phases of schooling
- increased investment in Queensland science education
- increased public awareness and community engagement in science education

The Queensland Government will encourage science educators to form professional partnerships at the individual level with appropriate personnel in research institutions, government agencies and business. We will develop mechanisms that allow interested stakeholders to be involved in the revision of science education. In particular, we will encourage schools to engage industry partners in the development of learning experiences which combine practical relevance with scientific integrity.

We will also encourage ongoing investment in Queensland science education through corporate, public, private and community driven ventures. For example, primary and secondary schools will be supported to establish professional partnerships with local industry, universities and research institutions. These partnerships will benefit schools by providing financial support and expertise, professional experiences outside the classroom for teachers and students, and the matching of teachers and students with qualified mentors.

The Queensland Government will promote industry connections that allow young people to take on vocational education and training experiences together with their science studies. Industrial partners will be encouraged to participate in establishing Industry Science Scholarships intended to support a student to undertake tertiary-level studies in science that is applicable to the industry concerned. The existing Technology, Maths and Science Centres of Excellence are obvious focal points for new partnerships with relevant organisations.

We will continue to support teacher professional associations. For example, funding was provided to the Australian Science Teachers Association to support their national conference in 2003.

Recognising that many adults completed their formal education without achieving the scientific literacy they need for the twenty-first century, the Queensland Government will support projects that increase public awareness of science and engagement in science education. For example, we will continue to link with university programs that provide in-depth learning opportunities for students and adults such as Bright Minds™ at the University of Queensland, and the Innovation Train and the Extreme Science Van at the Queensland University of Technology.
The Outback Learning Festival began as a small series of events happening at different schools in Mt Isa. It has grown into a major community learning experience involving local industries such as MIM and WMC, Queensland Rail, Department of Natural Resources and Mines, Indigenous groups, local libraries and various schools. Using the Queensland University of Technology Innovation Train as a focus, the community participates in a variety of special activities that are intended to foster awareness of the need for life-long learning.

National Science Week involved nearly 100,000 adults and children in 330 events around Queensland in 2002. Events included school-based science shows, talks by scientists, competitions, projects and statewide community events such as the Brainwaves Science Festivals and the Bush to Beach Community Science Quiz Night. The Queensland Innovation Science and Technology (QIST) network has been set up to publicise science awareness activities. All government agencies, universities, research institutions, schools and community groups can join the network.

www.qist.net.au

Queensland students and science educators are involved in a range of interactive science events and workshops that are the result of partnerships formed between industry, business, government research and educational institutions.
Action 6. Making It Happen

This is an ambitious plan to equip students, teachers and the community with confidence when facing the challenge of shaping their future. It will take considerable commitment and concerted effort to realise its objectives.

For that reason, the Government will take proactive steps to ensure the success of this action plan, designed to result in:

- increased scientific literacy of Queenslanders
- more young people aspiring to careers in science
- improved quality of science education in Queensland

The Minister for Education will appoint a special task force to implement the action plan to advance science education. A prominent science educator will be appointed to the new position of Queensland Science Education Ambassador and will chair the task force. Members of the task force will be drawn from universities, vocational education and training institutes, TAFE, schools and industry. The task force will be appointed for three years and a project team will be established to support the task force in implementing the action plan.

As it is recognised that skilled teachers are the agents who will ultimately bring about the changes in science education, a priority action for the task force will be establishment of a set of Destination Statements for teaching science.

These Destination Statements, to be developed within six months, will clearly describe the range of understandings and skills that typically characterise those teachers who are implementing best practice in science education. The statements will assist teachers in all phases of science education to determine the most appropriate professional development to move toward the agreed standards.

Following the announcement of the Destination Statements, the task force will monitor and evaluate the changes in science education in Queensland. By the end of 2005, at least 70 per cent of teachers of science, across primary, special and secondary State schools, will have undertaken professional development in science education.

The results from two large-scale national studies will be used to establish baselines from which to measure the change in students’ levels of scientific literacy over the next three years following implementation of this action plan:

- The Program for International Student Assessment (PISA) – an OECD project involving an international sample of 15-year-olds conducted every three years
- The Primary Science Assessment Project (PSAP) – a national sample of Grade Six students to be conducted in October 2003 and repeated every three years

On an annual basis, the Queensland Studies Authority will report the percentage of students successfully undertaking science subjects in the senior years. Tertiary admissions data will identify the percentage of students enrolling in education and other science-related courses. Particular attention will be given to monitoring the number of students commencing courses leading to a career in science or science education. In addition, data on the percentage of students enrolling in Vocational Education and Training courses within the science sector will be monitored. The task force will submit an annual report to the Minister for Education detailing progress on this action plan.
The Way Ahead

The Queensland Government recognises the importance of science education for the future prosperity and growth of the Smart State.

The actions presented here outline how we intend to implement the reforms derived from the extensive Science State – Smart State consultation process. We look forward to working with teachers, students, parents, industry, researchers and the community to maximise the benefits of these reforms for Queensland.
Spotlight on Science 2003–2006

Intent:
The intent is to improve the scientific literacy of Queenslanders, encourage more young people to aspire to careers in science, and to improve the quality of science education in Queensland.

Desired outcomes:

**Science for Life**
- All young people in State schools will study science to the end of Year 10
- More young people will study a science subject to the end of Year 12
- Increased opportunities for all young people to engage with science
- Increasing numbers of school leavers continuing with tertiary studies in science
- Increased understanding of the natural world, so young people can make responsible decisions concerning their own and the community’s future well-being

**Inspiring Science**
- A workforce of enthusiastic and competent teachers who provide exciting and relevant science experiences for students
- Improved recruitment of high-quality teachers across all levels of science education
- All science teachers engaging in continuous professional development and updating their knowledge and skills in science education

**Connecting Science**
- Science will be taught as a continuing process of practical inquiry into real-world issues and problems
- More opportunities for teachers and students to engage in experiences beyond the classroom

Supporting actions:

**Action 1: Strategies**
- Require study of science to the end of year 10 for students in State schools from 2005
- Develop a “Science in Society” elective subject for senior school students
- Increase support for out-of-class and interactive science activities
- Provide access to real-life science experiences in industry and research institutions
- Extend formal agreements between the school system and higher education institutions that allow senior students studying science to gain credit toward tertiary-level science studies
- Develop a sustainable model of science and technology magnet schools for students who excel in science
- Increase access to information and advice about science careers

**Action 2: Strategies**
- Professional Development
  - Develop Destination Statements that describe the range of understandings and skills that characterise teachers who are implementing best practice science teaching
  - Establish alternative entry pathways for scientists and other experts to become teachers
  - Provide scholarships for outstanding school students to undertake university double degrees involving science education
  - Establish science education as a priority area for professional development with at least 70 per cent of teachers of science in State schools undertaking professional development in science education by 2005
  - Establish science as a priority area for the ICTs for Learning Innovation Grants in 2004/2005
  - Strengthen the connection between science teaching practice and education research
- Science Links
  - Establish physical and electronic networks to promote mentoring and best practice in State schools
  - Implement science induction programs for teachers new to a school
  - Identify and support leaders in science in primary schools
  - Mandate annual District Science Forums for primary and secondary teachers to share expertise with tertiary personnel, science and community experts
  - Expand the experiential professional learning and sharing of best practice programs provided by the Technology, Mathematics and Science Centres of Excellence

**Action 3: Strategies**
- Increase use of interactive science activities that are relevant in a technologically sophisticated world
- Expand the online Science Education Gateway on Curriculum Exchange with engaging, interactive science activities for students across all year levels
- Provide examples of learning activities which integrate ICTs into science across all phases of schooling
- Implement a Scientists in Schools program
- Determine the feasibility of upgrading science facilities in established primary schools
- Establish productive partnerships between primary and secondary schools to broaden students’ experiences
Science All-Stars

- Increased acknowledgement of outstanding students and best-practice in science teaching
- Improved retention of high-quality science teachers
- Greater engagement of schools and industry in promoting science education

Partners in Science

- More productive science partnerships between industry, business, government, research and educational institutions
- Improved learning experiences for students and teachers across all phases of schooling
- Increased investment in Queensland science education
- Increased public awareness and community engagement in science education

Making it Happen

- Increased scientific literacy of Queenslanders
- More young people aspiring to careers in science
- Improved quality of science education in Queensland

Action 4 Strategies

- Instigate a comprehensive awards program for outstanding science teachers, students, educational institutions and industry supporting the science education initiative
- Provide scholarships for teachers to undertake post-graduate studies in science or science education
- Acknowledge and reward Science Success Schools that achieve high levels of student participation in science education
- Share the strategies of Science Success Schools

Action 5 Strategies

- Assist educators to form partnerships with industry and research institutions to promote mentoring relationships and help develop science courses that have maximum benefits for participants, industry and the community
- Encourage ongoing investment in Queensland science education through corporate, public, private and community driven ventures
- Promote industry connections that allow young people to take on vocational education and training experiences together with their science studies
- Encourage partners to develop Industry Science Scholarships to support young people undertaking tertiary-level studies in science
- Promote partnerships between Centres of Excellence and local organisations
- Support teacher professional associations
- Increase public awareness of science and engagement in science education

Action 6 Strategies

- Establish a task force to implement the action plan and advance science education in Queensland
- Appoint a Queensland Science Education Ambassador to chair the task force
- Develop Destination Statements for science teachers
- Monitor and evaluate changes in science education
Case study:

Skilling students for jobs of the future

Science plays a part in every aspect of life and holds the key to ensuring Queensland remains at the forefront of emerging technologies such as information technology, communications and biosciences. Developing a ‘science smart’ population is vital to the further introduction and success of new technology industries in Queensland.
The State Government has established eight Centres of Excellence in Technology, Maths and Science to improve science teaching in primary and secondary schools and to develop partnerships with industry and tertiary institutions.

Queensland also boasts Australia’s first school-based bioscience complex, established at Cavendish Road State High School in Brisbane.

The multi-million dollar high-tech facility, which houses biotechnology and kinesiology laboratories, enables students to undertake specialised studies in biotechnology and biomechanics.

Cavendish Road State High School has developed a unique partnership with Griffith University which allows years 11 and 12 students studying biology, chemistry and biotechnology, to receive credit towards their future science degrees.

This kind of partnership is igniting and maintaining student interest in science.

Supporting innovative degree programs

To enhance the capacity of Queensland’s internationally competitive biotechnology industry, the Queensland Government has helped to establish a Bachelor of Biotechnology Innovation degree at the Queensland University of Technology in Brisbane.

This innovative degree will produce capable and enthusiastic graduates, skilled in the business of biotechnology research and commercialisation.

As Queensland is Australia’s most biodiverse State, students of the Bachelor of Biotechnology Innovation degree are able to participate in key biodiscovery research projects, and take their research through the development and commercialisation processes.

The degree will develop scientists with the entrepreneurial skills that are essential to attracting venture capital and bringing advanced technology products to global markets.

Promoting science and technology careers to young Queenslanders

The Department of Innovation and Information Economy sponsors a range of programs designed to ensure young Queenslanders are aware of the exciting and diverse range of science and technology careers available.

For example, the Siemens Science Experience gives students entering Year 10, a three-day, hands-on science experience at a university in Brisbane or in a major regional centre.

The program enables students to gather on a tertiary campus where they meet scientists, hear about their research topics and do hands-on laboratory work designed to encourage them to pursue further science studies.

Arranged in association with participating universities and Rotary clubs, the Siemens Science Experience represents a very tangible way in which the Queensland community can help foster the scientists of tomorrow.

The Queensland Government also supports the annual Biofutures forum, an awareness program that demonstrates to students the importance of innovation in today’s society. Over six days, students gather extensive information through a range of forums, hands-on workshops, hypotheticals and careers seminars.

These Queensland Government supported activities help to promote innovation, entrepreneurship and careers in biotechnology to school students, and contribute to the long-term prosperity of Queensland’s knowledge industries.