FORMULA FOR SUCCESS

AN AGREED AGENDA ON MATHS & SCIENCE
FORMULA FOR SUCCESS

AN AGREED AGENDA ON MATHS AND SCIENCE

FINE GAEL AND THE LABOUR PARTY

NOVEMBER 2006
INTRODUCTION

Maths and science are the strongest currencies in our knowledge economy. In recent years our young, bright workforce has attracted a wealth of pharmaceutical and IT companies to invest in Ireland.

However, we cannot take the flow of well-paid, rewarding jobs for granted. The world’s largest economies are devoting ever more importance and funding to the development of science, technology, Information and Communications Technology (ICT) and engineering. Any country which believes that China and India will be content to focus on manufacturing, leaving scientific development to America or Europe, will be quickly left behind.

Ireland has committed to the Lisbon Strategy, which aims to make the European Union the most dynamic knowledge economy in the world by 2010. As that deadline fast approaches, we need to ensure that our young people can compete for a place at the top of the class. However, without a radical overhaul of maths and science at second level, Ireland will continue to lag behind its peers and its competitors.

The low number of students opting for higher level physics, chemistry and maths is a major weakness in our second level education system. We must challenge the perception amongst students that maths and science subjects are difficult and poorly rewarded. Our proposals for significant curriculum reform, innovation in teaching practice, the use of the internet in self-directed learning, investment in science resources for schools and the creation of ICT as a new subject will challenge this perception, benefiting all students.

This root-and-branch reform is long overdue. Numeracy is as important a life skill as literacy, and should be an educational priority. Scientific developments are radically changing the way in which our globe develops. Our young people deserve to be encouraged to enjoy these fascinating subjects through a change in the way maths and science are taught and learned.

The existing approach to maths and science is failing our young people, our education system and our economy. We can’t just tell students why they should study maths and science-related subjects at second and third level; we have to show them.

When it comes to mathematics, science, technology and ICT the international competition is sharper than ever. *Formula for Success* sets out our agenda for the reform and revitalisation of maths, science and ICT in our education system, and is a crucial step towards the creation of a modern, scientifically literate society and a world class knowledge economy.

Olwyn Enright, TD
Spokesperson on Education and Science
Fine Gael

Jan O’Sullivan, TD
Spokesperson on Education and Science
The Labour Party
EXECUTIVE SUMMARY

Our agenda for reform and investment in second level science and maths education includes the following policy proposals:

CURRICULUM AND ASSESSMENT

1. Science to Junior Certificate level should be a core requirement for all students, and participation rates of 100% should be achieved within three years.
2. A timetable for the roll-out of all science subjects at second level will be put in place with the endpoint being that all schools offer their students a full choice of science subjects for the Leaving Certificate.
3. We will build on the National Council for Curriculum and Assessment's (NCCA) revision of the secondary school maths syllabus to implement curriculum change within two years. The focus of mathematics teaching, learning and assessment will shift from rote-learning and procedural understanding to problem-solving and ‘real world’ applications.
4. We support the NCCA’s proposal for a reformed senior cycle curriculum, which includes the option of taking short courses for Leaving Certificate. When this new curriculum is fully implemented we will explore the possibility of allowing students to undertake an extra short course in maths, physics or chemistry, the points from which could be counted in addition to their six key Leaving Certificate subjects. We would cap the possible bonus points awarded, and they would only apply to third level courses with a maths or science component.

INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

1. We will oversee the introduction of a new subject, Information and Communications Technology (ICT), for the Junior Certificate.
2. Enhanced ICT training for teachers, provided through the National Council for Technology in Education (NCTE), will be put in place.
3. A new programme for upgrading computer hardware in schools will be initiated.
4. An expert panel will be convened, and asked to report within six months on the potential for using the internet for the widespread dissemination of high-quality lectures on Junior and Leaving Certificate maths and science courses.
5. We will develop the ICT element of maths on an incremental basis in line with curricular and assessment reform, moving towards computer-based segments of the maths curriculum.

TEACHING

1. We will conduct an audit of teacher training levels in maths and the sciences.
2. We will expand the scope and frequency of teacher in-service through existing systems such as the Second Level Support Service (SLSS).
3. We will introduce a new method of entry to teaching, designed to attract those who have worked in mathematics and science related industry or research.
4. We will institute flexible research fellowships for teachers of maths and science at second-level.
5. Structures for community-based teaching development will be established so that teachers from primary, secondary and third level can discuss teaching methodologies and curricular content, with a view to reducing perceived curricular gaps between levels and easing student transition from level to level.
RESOURCES

1. Schools will be encouraged to form clusters within which the Department of Education and Science should make additional commitments to develop science. Laboratory Technician hours will be allocated to schools on this clustering basis.
2. We will develop and publicise online maths tutorials along a self-assessment model for students who feel they need extra practice at procedural or problem-solving maths skills.
3. Every Leaving Certificate practical experiment on the curriculum will be filmed and made available freely on the internet.
4. The science equipment and facilities in our schools will be significantly enhanced.

RECOMMENDATIONS BEYOND SECOND LEVEL

1. We will encourage third level institutions to award points for completion of Foundation Level maths, and to accept grades A and B in Foundation Level maths for courses without a significant maths or science component.
2. Whilst constantly striving to improve maths at second level, we will also encourage third level institutions to make available pre-registration elective courses prior to students’ entry into college, with a view to both reviewing and developing students’ maths knowledge, as well as easing the transition from a secondary school to an independent learning environment.
3. The establishment of a National Science Centre, as recommended by the Task Force on the Physical Sciences and Forfás, should be progressed.
PART ONE – MATHS

INTRODUCTION

Our need for maths never stopped at the school gates, so why is it taught as if it did? Teaching abstract maths is like teaching children how to write sentences, but never how to have a conversation. Yet this is how Irish secondary school pupils have been taught since the 1960s. Problem solving and real-world scenarios have been neglected in favour of procedural understanding and rote learning.

The rationale behind the style of maths taught in Ireland is that if pupils learn maths in a purely abstract way, it can be better applied to a wide range of different areas. However, this is belied by our relatively poor showing in international surveys of mathematical ability. A recent US-sponsored survey, Trends in Mathematics and Science, placed Irish pupils 17th out of 29 countries. While our numeracy was above average, we were below average on ‘space and shape’ aspects of maths, like geometry and measurement.

Furthermore, third level maths lecturers and others have consistently raised concerns about the quality of first year students’ maths knowledge, skills and ability to make connections between different branches of the subject. This problem has manifested itself most worryingly in the high drop out rates in some Institutes of Technology, where difficulties with maths were singled out as a significant contributory factor.

Our proposal to radically overhaul the way maths is taught is not simply about targeting students who want to study maths or science-based courses at third level, though fostering world-class engineers, scientists and physicists is important. Like literacy, numeracy is a basic skill that allows us to function independently in society, and that alone should make it an educational priority. We need people who can build bridges and invent new drugs, but we also need people who can calculate mortgage repayments, balance a household budget and help their own children with their homework. Investing in maths is investing in informed, numerate, independent citizens.

CURRICULUM

We propose a radical overhaul of the maths curriculum to make it more reflective of the real-life experiences of students and the demands of modern education, industry and technology.

Our students need to transcend procedural understanding and rote-learning and move toward an awareness of contexts, theory and application. In the medium term, we believe that we should incorporate ‘problem-solving’ aspects into the curriculum so that students are required to apply their maths skills to specific real-world problems as part of their education.

For example, students at Ordinary Level could become familiar with applying their mathematical knowledge more frequently to everyday scenarios like statistical analysis, interest rates, mortgages, tax, currency conversion, weight, volume and area. The Higher Level course could include the applications of mathematical procedures to areas such as engineering, economics, industry and the sciences.

In the future, we propose to move mathematics education towards a Realistic Mathematics Education philosophy, a system of ideas which has paid huge dividends in the Netherlands and the US. This system sees students’ personal realities as both the source and the subject of their
maths understanding. For example, teachers teach maths procedure by starting with a real world situation, allowing students to see how a particular mathematical procedure might apply, and then developing their ability to apply this procedure back to a variety of situations as their skills grow.

Our objective in changing maths education in our country is to instil a new sense of confidence and capability in our students. Our students’ abilities must be enhanced and their experiences of maths in the classroom must provide them with a positive attitude to maths use in later life.

RECOMMENDATIONS

1. We will build on the NCCA’s revision of the secondary school maths syllabus to implement curriculum change within two years. The focus of mathematics teaching, learning and assessment will shift from rote-learning and procedural understanding to problem-solving and ‘real world’ applications.

2. Revise the Foundation, Ordinary and Higher Level syllabi so that students choose the level they study at for the Leaving Certificate based on their ability, not aspirations for points. Currently there is an artificial bottleneck at Ordinary Level caused by students too weak for the course but who need to matriculate for third level, and students too advanced for the course but who are afraid of failing Higher Level maths. This poses difficulties for teachers and contributes to the high failure rate at Ordinary Level (12 per cent in 2006) and to students’ difficulties in making the transition to third level maths.

3. Establish an NCCA committee to ensure that a cross-curricular approach is taken to future reviews. Maths teaching should be consistent and coherent across all subjects with mathematical content.

4. Revise the Applied Mathematics Syllabus in consultation with, among others, third level institutions, industry and the commercial sector, with a view to substantially increasing take-up and expanding course content to reflect the broader modern applications of mathematics.

5. Develop the ICT element of maths on an incremental basis in line with curricular and assessment reform, moving towards computer-based segments of the maths curriculum.

TEACHING

The kinds of changes that we want to bring about in maths education will not happen by changing the syllabus or the exam paper alone. We want to change the way students learn as well as what they learn. This will only come about through a change in teaching practice. Our aim is to shift the focus away from the perceived difficulty of ‘problem subjects’ and towards student capacity.

More specifically, we want students to:

- be able to relate maths to their own lives
- regulate their own learning
- solve problems collaboratively and creatively
- develop a plurality of approaches to maths

Studies show that teachers in higher-performing classrooms tend to spend less time talking, and more time allowing students to talk, that they encourage students to use multiple strategies to solve problems, and that they listen to students’ own ideas more. While many of these techniques are already in operation in Irish classrooms, they need to be expanded, developed and consolidated.
We already have some of the tools we need to help students learn better: quality training at Higher Diploma level and the Second Level Support Service (SLSS). However, we propose that teachers should engage in training which includes new teaching methods for the duration of their careers, rather than just the beginning. We would also propose that the SLSS, which has an excellent trans-curricular, student-focused and whole-school ethos, extend its remit to mathematics education.

However, we do not believe in simply more in-service. We want to foster a culture of collegiality and co-operation in schools, and we feel that high-quality professional development for teachers is a necessary step towards this goal. Up to now, in-service has been fragmented, spaced out over a period of months or years, with little or no follow-up or continuity. It has tended to be content-based, not skill based. It has been outside of school, not situated within the school community. Worst of all, it has been curriculum focused, not child focused. Research indicates that once-off in-service rarely results in real changes in teaching practice.

Maths teachers in a school should work together to develop individual lessons and teaching strategies, not just broad curricular schemes. Team building, not stand-alone teaching, should be our model for the future.

In co-operation with the Second Level Support Service, we will provide for hours for maths teachers within the school week to collectively develop lesson strategies. For example, teachers will develop a lesson plan, teach it, and then review it together. Teachers should work together to share what works best and to solve one another’s difficulties. This process will be the responsibility of the subject head in each school and regular in-service development from outside will be situated in the context of these collegiate groupings.

We will also ensure that collective professional development and support does not stop at the school gate. We will resource school clusters and local teaching forums for teachers from primary and second level so that schools can share ideas about teaching practices and curricula in co-operation with regional educational development officers.

To further expand the links between second and third levels, and allow teachers greater opportunities for professional development we will institute flexible research fellowships for teachers of maths at second-level.

**RECOMMENDATIONS**

1. We will conduct an audit of teacher training levels in maths.
2. Expand the scope and frequency of teacher in-service through existing systems such as the Second Level Support Service (SLSS). We will place particular emphasis on:
   a. Methodology as distinct from mere curricular content
   b. Cognitive processes and student learning
   c. Whole school development and collegiate mutual support
3. Establish in-school collegiate skills development programmes for teachers to enhance in-service.
4. Institute flexible research fellowships for teachers of maths.
5. Establish structures for community-based teaching development so that teachers from primary, secondary and third level can discuss teaching methodologies and curricular content, with a view to reducing perceived curricular gaps between levels and easing student transition from level to level.
RESOURCES

Just as Information Technology should be a component of maths education, it should also be a means. The internet can be used to extend learning opportunities into libraries and students’ homes, while computer programmes can enhance students’ ability to visualise problems, increase opportunities for conceptual understanding and can provide new avenues for individualised learning. We will resource schools so that all students can have timetabled hours-per-week for ICT-based mathematics tutorials.

We will also develop the internet to resource students’ maths learning, as well as teachers’ professional development. For example, we will make all past state exam papers available online. We will also develop extensive interactive on-line tutorials on websites such as scoilnet.ie for students who feel they need extra practice to develop their procedural skills. Students should be able to log-on to these websites and monitor their progress, and thus practice self-assessment and self-regulated learning.

We will also develop the web-based resources available to teachers, such as improving the availability on-line of lesson plans, sample schemes, and teaching strategies, as well as articles on cognitive development and international developments in maths education. Where video ‘model lessons’ have been developed successfully by staff, we will put them online. We believe that the internet contains huge potential to develop the professions’ sense of collective endeavour.

RECOMMENDATIONS

1. We will develop and publicise online maths tutorials along a self-assessment model for students who feel they need extra practice at procedural or problem-solving skills.
2. Make past papers available on the internet free of charge.
3. Further develop teachnet.ie for teachers’ professional development, and extend the site so that it contains comprehensive instructions on all aspects of the courses, as well as downloadable ‘lesson studies’ and videos of model lessons.

MATHS BEYOND SECOND LEVEL

Education is a continuum, not a series of discrete boxes. The maths curriculum at second level should look outside the school walls to third level, to industry and to the wider community.

Maths education at second level must correspond to what is required at third level so as to maximise students’ opportunities in their chosen field. This is particularly true in the Institutes of Technology where students are often overwhelmed by the chasm between Ordinary Level maths and the demands of third level. We believe that this should primarily be done through curriculum reform and new pedagogy at second level, but we would also support the development of pre-registration courses for students taking third level courses with a maths-based element to facilitate the transition to third level and reduce drop out rates.

RECOMMENDATIONS

1. We will address the negative effects of the points system on take-up at Foundation Level by encouraging third level institutions to award points for completion of Foundation Level maths, and to accept grades A and B in Foundation Level maths for courses without a significant maths or science component.
2. Encourage third level institutions to make available pre-registration elective courses prior
to students’ entry into college, with a view to both reviewing and developing students’ maths knowledge, as well as easing the transition from a secondary school to an independent learning environment.

3. Initiate and fund a programme of support for third level, industrial and other relevant science and technology organisations to engage with schools in developing students’ science and technology skills and awareness.
PART TWO – SCIENCE

INTRODUCTION

In the Ireland of 2006, there is universal agreement that our brightest future is irrevocably linked to the development of a ‘knowledge economy’. The need to use knowledge as a tool to sustain and build economic development, and the centrality of science, technology, information and communications (ICT) and engineering to the expansion and creation of this knowledge, is accepted.

However, whilst recent provision for enhanced scientific and technological research at third and fourth levels is welcome, this Government has consistently undervalued the role of post-primary education in the scientific sphere. The seeds of scientific development are sown at an early age, and we cannot expect to succeed at third level where we have failed at second.

Scientific development, by definition, continually presses forward. Today there is a huge amount of competition on the international scientific stage. In second level scientific education Ireland is lagging behind.

We cannot expect that other countries will stand still whilst we play scientific catch-up. Our challenge is to make Ireland a world leader in the provision of scientific and technological education, and to enhance our position on the international stage for developments in this area.

To meet this challenge, Ireland must now take dramatic steps to reform our education systems as they impact on science, so that we can build a new approach to science and technology from the ground up.

CURRICULUM AND RESOURCES

In Ireland, there is no requirement for second level students to study science, which contrasts sharply with the position in other European Union countries. In the United Kingdom, for example, students are required to take science and ICT to GCSE level.

Whilst the majority of students do take science to Junior Certificate level, more than one in ten do not, according to figures released by the Department of Education and Science earlier this year. Increasing Junior Certificate involvement in science to 100% was recommended by the Task Force on the Physical Sciences.

Junior Certificate science is the foundation on which achievement in the Leaving Certificate sciences is built. By allowing such a large number of young people to opt out of science at such a young age, we are severely limiting the scope of their later studies, not only at Leaving Certificate but also at third and fourth level. In addition, many young people with a talent and aptitude for science are not being given the opportunity to reach their potential in the discipline.

In addition, some schools have experienced difficulties in implementing the Junior Certificate science course. 35% of marks for Junior Certificate science are awarded for practical and project work, and the curriculum includes thirty experiments. Large classes, inadequate laboratory facilities, and the lack of laboratory assistants all add to the difficulties experienced by many schools in dealing with the highly important practical elements of the course.

At Leaving Certificate level, the key science subjects are biology, chemistry, physics, with the
combined physics and chemistry syllabus currently under review. A considerable gap has
developed between the uptake of biology on the one hand, and chemistry and physics on the
other. The graph below shows the 2004 figures in each subject itemised by gender and by level,
Higher (H) and Ordinary (O).

As is evident from this graph, biology is strongly favoured by Leaving Certificate candidates,
particularly by female students, and it is hard not to conclude that this preference is occurring at
the expense of both chemistry and physics. With regard to physics, 4,166 males attempted the
higher-level paper in 2004, compared with 1,670 females attempting the same paper. The
perception that some science subjects are more suited to either male or female candidates is
anachronistic and must be challenged.

As a proportion of the total number of Leaving Certificate candidates, the numbers leaving
second level education having studied the higher level Leaving Certificate papers in either
chemistry or physics is worryingly low. The graph below shows the total candidates taking
higher level papers in physics, chemistry and biology.

In terms of access to the full complement of science subjects, in the 2004/2005 school year
there were only 497 post-primary schools offering physics, chemistry and biology to Leaving
Certificate level. This is far short of the total number of post-primary schools in the State, which
now stands at 742.

Clearly, this situation is disadvantaging students with an aptitude for the sciences who may
unwittingly find themselves without the option to study a particular science subject to Leaving
Certificate level.
RECOMMENDATIONS

1. Science to Junior Certificate level should be a core requirement for all students, and participation rates of 100% should be achieved within three years.
2. A timetable for the roll-out of all science subjects at post-primary level should be put in place with the endpoint being that all schools offer their students a full choice of science subjects at Leaving Certificate level.
3. The curriculum for each of the science subjects should be reformed to focus on the practical, ‘hands on’, applications of science. In addition, each curriculum should be updated on a rolling basis, with amendments that take account of the latest developments in the scientific sphere. Frequent review and updating should be commonplace with regard to the science curricula. The concept of ‘less is more’ should also inform curriculum development in the sciences, in order to ensure that the teaching and understanding of key scientific concepts is a large part of the focus of science in schools.
4. The full list of equipment needed to teach science to Junior Certificate level, and for each of the sciences at Leaving Certificate level, should be readily available. A full audit of all school science facilities should be undertaken, and cross-referenced against the equipment list, to identify the gaps in scientific equipment in every school. Investment to bring all schools up to standard in terms of equipment and facilities should then be undertaken.
5. Schools should be encouraged to form clusters within which the Department of Education and Science could make additional commitments to develop science. Laboratory Technician hours should be allocated to schools on this clustering basis.
6. A special School Science Fund should be established for specific science-based initiatives that schools themselves put in place. This would allow schools which may have a specific interest in science or commitment to the subject to enhance resources available to them.
7. A panel of science teachers should be engaged to film every Leaving Certificate practical experiment, which should then be made available freely on the internet.

ASSESSMENT

The Leaving Certificate examination places considerable pressure on students to gain as many points as possible for entry to third-level courses. In this context, subjects viewed as being difficult in which to secure a higher grade, such as maths and the sciences, are at a disadvantage.

In addition, whilst science subjects show a clear potential for the incorporation of continuous assessment and project work, this potential has not been tapped and poor facilities and equipment hamper developments in this area.

The learning of the science subjects at Leaving Certificate level would benefit from a new flexibility of approach. By allowing students to present assessment and project work at points throughout the Leaving Certificate cycle, the practical, and enjoyable, applications of science could be heightened.

With regard to college entry, each student calculates the points that they have earned from the Leaving Certificate by adding points from no more than six subjects. The NCCA has proposed a reformed senior cycle curriculum, which would include the option of taking short courses for Leaving Certificate.

When this new curriculum is fully implemented, the option of allowing students to undertake an extra short course in maths, physics or chemistry, the points from which could be counted in addition to their six key Leaving Certificate subjects, should be explored. Under such a scheme,
the possible bonus points awarded would be capped, and only apply to third level courses with a maths or science component.

Such a scheme could introduce a new element of flexibility in assessment, be educationally valuable for Leaving Certificate students, and incentivise a higher up-take of science subjects.

**RECOMMENDATIONS**

1. The State Examinations Commission should urgently examine the perception amongst students, particularly those at Leaving Certificate level, that mathematics and science subjects are more difficult to achieve higher grades in than other subjects on the curriculum, and propose recommendations on how this perception can be addressed.

2. A practical element as part of the examination for each Leaving Certificate science subject should be introduced as a matter of priority. The success of the introduction of practical assessment is clearly linked to equipment, facilities and additional supports in the form of laboratory technicians.

3. We support the National Council for Curriculum and Assessment's proposal for a reformed senior cycle curriculum, which includes the option of taking short courses for Leaving Certificate. When this new curriculum is fully implemented, we will explore the possibility of allowing students to undertake an extra short course in maths, physics or chemistry, the points from which could be counted in addition to their six key Leaving Certificate subjects. We would cap the possible bonus points awarded, and they would only apply to third level courses with a maths or science component.

**OTHER RECOMMENDATIONS**

1. All second-level schools should be strongly encouraged to have a ‘scientific’ member on their Board of Management. This person could be drawn from local science-based industry, or be an individual involved in high-level scientific research. Partnerships between schools and local science-based industry should be promoted.

**TEACHING**

The success of any science strategy is inextricably linked to the manner in which science is taught in our schools. For this reason, the professional development of science teachers must be considered alongside curriculum and examination reform.

Science Foundation Ireland (SFI) runs the STARs (Secondary Teacher Assistant Researcher) programme, designed to enable teachers to engage in scientific research during the summer months. The primary aim of this programme is to disseminate new skills and knowledge to teachers which can be passed on to their students, and 44 secondary school teachers took part this summer. This is a welcome initiative, as scientific development continually presses forward and the circulation of new knowledge will be critical to ensuring that second-level education is as up-to-date and interesting as possible.

However, in addition to initiatives of this type, a concerted effort must be made to encourage those who may be working in scientific or mathematic fields to consider entering teaching. A more dynamic and flexible approach to teacher recruitment is needed, so that those who may have worked in science for a period of time, but who now wish to bring their particular skills to the classroom, can be attracted into the profession.
The development of our teachers is critically important. We need to encourage good entrants to the profession, and reward teachers with regular training, the potential for career advancement and the opportunity to combine teaching with research work where possible.

RECOMMENDATIONS

1. The level of professional development for science teachers, provided by the Second Level Support Service (SLSS), should be substantially enhanced.
2. We will conduct an audit of teacher training levels in the sciences.
3. A number of flexible research fellowships will be available each year to teachers of science at second-level.
4. New methods of entry to the teaching of science, designed to attract those who have worked in mathematics and science related industry or research but who have a particular interest in changing careers and entering the classroom, will be introduced.

INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

Information and Communications Technology (ICT) has assumed a central role in our modern society, affecting both the way we live and the way we develop economically. In the education sphere, access to ICT is not only necessary to equip young people with skills that they will need as adults, but should also be prioritised for use as an educational tool in our schools. In the recently published OECD document Are Students Ready for a Technology-Rich World? it is noted that:

"an effective use of ICT in schools can have an immediate positive impact on the schools’ learning environments, for example by: creating more dynamic interaction between students and teachers, increasing collaboration and teamwork in problem-solving activities, stimulating creativity in both students and teachers, and helping students to control and monitor their own learning”.

OECD research has shown that school students with an established habit of computer usage tend to perform better in key school subjects. In particular, the relationship between computer usage and performance in mathematics is noteworthy. Students who have used computers for a number of years mostly perform above average when compared with those who do not have access to computers or have only been using them for a short time.

In Ireland, the percentage of 15 year-olds using computers frequently, both at home and at school, is below the OECD average. About one quarter of Irish 15 year-olds use computers frequently whilst at school, compared with an OECD average of more than 40%, and frequent usage rates of more than 50% in Austria, Australia, Denmark, Hungary, Italy, and Mexico.

However, a recent audit of computers in second level education found that almost one in five computers in our schools is over six years old, with more than 5,500 computers being beyond repair or use.
1. The introduction of a new subject, Information and Communications Technology (ICT), for the Junior Certificate programme should be progressed.

2. Enhanced ICT training for teachers, provided through the National Council for Technology in Education (NCTE), should be put in place.

3. There has been no direct investment in software and hardware in schools since 2002. A new programme for upgrading computer hardware in schools will be initiated.

4. Particular focus needs to be directed towards the development and evaluation of interactive computer software, to be utilised especially in mathematics and science classes. An expert panel will be quickly convened, and expected to report within 6 months, as to the potential for using the internet as a mechanism for the widespread dissemination of high-quality content lectures focussed on the Junior and Leaving Certificate maths and science courses.

5. Schools should have access to technical support to fix problems with equipment which inevitably arise.

**SCIENCE BEYOND SECOND LEVEL**

In addition to the undoubted importance of science in our education system, science is also central to our everyday lives. Scientific developments shape our world, and relentlessly change the way we do things.

We need to ensure that all people, both children and adults, can access scientific knowledge, in a way which is engaging, interactive and enjoyable. In the 19th century, foresighted provision was made for institutions such as the National Museum, National Gallery, National Library and Natural History Museum – institutions of national importance which continue to enlighten us to this day.

Both the Task Force on the Physical Sciences and Forfás have recommended the development of a National Science Centre. Such a centre should be a national resource for the promotion of science, on a par with similar institutions which have been developed abroad.

**RECOMMENDATIONS**

1. The establishment of a National Science Centre, as recommended by the Task Force on the Physical Sciences and Forfás, should be progressed. This National Science Centre, which would encourage visits from as broad a representation of society as possible including schools, children and students, would be a vital resource for the dissemination of scientific information and have up-to-date exhibitions and interactive models in place to stimulate interest in science.