NATIONAL COUNCIL FOR CURRICULUM AND ASSESSMENT

BOARD OF STUDIES FOR THE REVIEW OF TECHNOLOGY EDUCATION IN THE JUNIOR CYCLE

NCCA

National Council for Curriculum and Assessment
An Chomhairle Náisiúnta Curaclaim agus Measúnachta

FINAL REPORT

Adopted by Council September 2004

Technology Subjects in the Junior Cycle

Materials Technology (Wood), Metalwork,

Technical Graphics, and Technology

National Council for Curriculum and Assessment
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Contents

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Board of Studies for the

Review of Technology Education in the Junior Cycle

Final Report

1 Introduction

In December 1998, the Department of Education and Science requested the NCCA to "…undertake a review of all technological subjects at Junior Certificate level. The proposals of the Council as outlined in the document Curriculum and Assessment Policy Towards the New Century (p.42, 43) provide a coherent framework for this review".

A Board of Studies was established under the chairmanship of Diarmuid Ó Murchú. Council provided a detailed brief for the review and outlined a number of contexts that underscored the need for review. These included:

- the growing perception in society in general, and in government and business circles particularly, of the pivotal role science and technology will play in sustaining Ireland's economic development and in developing an informed and active citizenry
- the increasing attention in education systems internationally to defining and describing what we mean by a technology subject at a time of rapid technological change and to modernising the curriculum in this area
- the ongoing NCCA reviews of junior and senior cycle provision and, in the process, consideration of the contribution and role of technology subjects to broad and balanced educational provision
- the concern at the low uptake of physical science/technology subjects at junior and senior cycle
- the need to ensure participation within the technology subjects by the full range of the student cohort with regard to ability, aptitude and gender
- the 1993 NCCA policy on the development of the technology subjects at junior cycle should be revisited, given the time, events and developments that have taken place during the intervening period.

The Board of Studies began its work in October 1999, and its main task was to review provision for technology education at junior cycle, currently comprising four subjects: Materials Technology (Wood), Metalwork, Technical Graphics and Technology.

The brief for the review was to

- specify the purposes and aims of technology education in the junior cycle
- specify the key components of technology education at this level
- propose how the purposes, aims and key components specified should be structured and provided for in the curriculum area of technology; in this context a range of options should be considered including full and short courses
- propose appropriate modes and techniques of assessment and assessment criteria
- take cognisance of the implications of proposals for other subjects within the curriculum
- prepare an implementation plan, with specific recommendations to address the in-career development needs of teachers and the improved presentation and promotion of the technology subjects
- have regard to the resource implications of proposals and indicate the level of resources needed by schools to implement the new curriculum arrangements effectively.

The work the Board of Studies involved engagement with a wide range of areas:

- uptake of provision and trends in participation over the last ten years
- international trends in technology education at this level
- identification of aims and key components
- possible configurations for the delivery of technology education in light of the aims and key components
- progression to, and developments in, the technology subjects at senior cycle
- development of an agreed framework for provision at junior cycle
- consultation on this framework
- preparation of a report on the outcomes of the consultation process.

In the course of its work, the Board of Studies presented an interim report to the Council of the NCCA in March 2000.

This final report to Council presents a summary of the relevant areas considered by the Board of Studies, including some that were set out in more detail in the interim report, and makes recommendations on the way forward for technology education in junior cycle.

2 International Developments in Technology Education

In the initial stage of its work, developments and curriculum arrangements for technology education in a range of countries were considered by the Board of Studies. These included New Zealand, The Netherlands, Scotland, Northern Ireland and Canada (British Columbia). In some countries, technology education is provided by means of a specific subject, sometimes part of the core curriculum, while in others it is addressed in a number of subject areas. In some countries provision is made for the study of *science and technology*.

This did not point towards a consensus emerging internationally on curriculum structures for technology education. In most countries a range of national factors are instrumental in arriving at appropriate structures. However, a more significant degree of consensus emerged in relation to the aims and key components of technology education (see table 1 below). The Board of Studies was in a position to draw on this consensus when developing its own thinking on the proposed key components of technology education in Ireland.

Canada (British Colombia)	**New Zealand**	**Netherlands**	**Northern Ireland**
Communications Production Control Energy Power Self and Society	Information and Communication Production/Processes Electronics and Control Structures Mechanisms Materials Biotechnology Food Technology	Product Design Construction Systems Technology Products Technology and Society	Communicating Manufacturing Control Energy Components Planning Materials Appraising

Table 1. Key components of technology education in selected countries

3 Student uptake of the technology subjects

The Board of Studies considered statistical data relating to technology education in Ireland, under various headings. These were drawn from the statistical reports of the Department of Education and Science, and illustrated the trends in uptake and provision over the decade following the introduction of the Junior Certificate.

The general headings included

- the number of schools providing each subject in the Junior Certificate programme
- the number of students taking the stated subject in the Junior Certificate programme

Number of schools providing each subject

Over the ten-year period from 1990/1991, the number of schools declined from 771 to 733 (Table 2). In parallel with this the table also shows an increase in the number of schools offering the individual technology subjects in the first five years of the decade, whilst there was a decline during the following five years up to 2000/01.

Number of second level schools providing each subject in the Junior Certificate Programme			
Subject	**1990/91**	**1995/96**	**2000/01**
Materials Technology (Wood)	468	477	470
Metalwork	304	311	309
Technical Graphics	517	532	508
Technology *	109	194	160
Total number of schools	771	748	733

Table 2. Number of schools providing each subject

* It should be noted that the subject Technology had been introduced to second level schools as a new subject in 1989/90, with restricted take-up, and had not reached its full three-year cohort by 1990/91. The uptake of this subject increased from 109 schools in 1990/91 to 194 schools in 1995/96. In the following five-year period, while more schools continued to introduce this subject, the overall number of schools offering the subject declined appreciably from 194 to 160.

Number of students taking the stated subject in the Junior Certificate Programme

There was a fall of 10% in the total student cohort, i.e. in the three years of the Junior Certificate programme, between 1990/91 and 2000/01 (Table 3). In light of this fall, the small increase in uptake indicated for Materials Technology (Wood) becomes more significant. Similarly, the relatively large decline indicated for Metalwork and Technical Graphics over this period is not as stark as the raw figures might suggest, although still giving cause for concern, particularly in the case of Technical Graphics.

Trends in the number of students taking technology subjects					
Subject	**1990/91**	**1995/96**	**2000/01**	**Change from 1990/91 – 2000/01**	**Change from 1995/96 – 2000/01**
Materials Technology (Wood)	52504	57405	52805	+ 0.6	-8.01
Metalwork	34264	33744	28721	- 16	-14.88
Technical Graphics	68631	65353	50455	- 26.5	-22.79
Technology	5710 (Restricted uptake)	14063	11351	**	-19.28
Total Students	201105	205417	180998	- 10	-11.88

Table 3. Uptake of technology subjects (figures for the three years of junior cycle)

** The subject Technology was not established across the three years of the junior cycle throughout this ten-year period. The five-year period between 1995/96 and 2000/01 is more representative of the trend in uptake for this subject and shows that there was a decline of 19.28%, whilst over the same period the total student cohort in the junior cycle declined by 11.88%.

The most recently available statistics (2001/2002) show very little change from those at the end of the ten-year period above. These do not compare favourably with international trends, where uptake in technology education is steadily increasing, especially in countries such as Scotland, New Zealand and Canada (British Colombia), where curricular provision for technology education has been reviewed and modernised (ICSTI 1999) and its study is part of the core curriculum at this level.

Furthermore, current statistics in relation to population trends predict a decline of 20% in the school-going population at post-primary level over the ten-year period up to 2006 (CSO 1999). This trend, allied to the trends in subject uptake within some of the technology subjects, gives rise to concerns surrounding the future of this area within the curriculum and underscores the need to establish future provision on a sound, well-developed footing.

The strategic importance of science and technology to the continued prosperity of our economy points to the necessity of having a modern and forward-looking curriculum in these areas for our young people.

During the course of the Board's deliberations, there was much discussion of the reasons for the trends evident from the statistics. The cost to schools of providing practical subjects relative to other subjects, the limited space available in what is perceived as an 'overcrowded' curriculum, the shortage of teachers of technology subjects, the status of the technology subjects compared with other subjects and areas (including ICT), and the fact that some subjects had been 'modernised' through curriculum review while others had not, were viewed as significant contributory factors, among many others.

4 Aims and key components of technology education

The Board of Studies focused on analysis of the strengths and weaknesses of current provision and on this basis proceeded to establish aims for technology education at junior cycle. The key components of technology education and a range of models/curriculum structures for the delivery of those aims and key components were also considered.

Technology education at junior cycle

Technology is a distinct form of creative activity where human beings interact with their environments **in** response to needs, wants and opportunities. At junior cycle, technology education contributes to a broad, balanced and general education of students, though which they grow in competence, increase in confidence and become more enterprising.

The value of technology education comes from the use of the wide variety of abilities required to produce a drawing or make an artefact, leading to a sense of competence and a feeling of personal empowerment. The acquisition of manipulative skills is an important component of this sense of competence and can help give students a feeling of control of their physical environment. In a rapidly changing global society, students need to appreciate that technological capability is necessary and relevant for all aspects of living and working. Many subjects can contribute to the development of a technological capability. However, the technology subjects, which incorporate the principles of design and realisation in a creative manner, are central to this development.

Technological capability includes

- knowledge and understanding of appropriate concepts and processes
- skills of communication, design and realisation, problem solving
- the ability to apply knowledge and skills by thinking and acting confidently, imaginatively, creatively and with sensitivity
- the ability to evaluate technological activities, artefacts and systems critically and constructively.

Aims of technology education

It follows that the aims of technology education are to

- contribute to a balanced education, giving students a broad and challenging experience that will enable them to acquire a body of knowledge, understanding, cognitive skills, and manipulative skills and competencies, thereby preparing them to be creative participants in a technological world
- enable students to integrate such knowledge and skills, together with qualities of co-operative enquiry and reflective thought, in developing solutions to technological problems, with due regard for issues of health and safety
- facilitate the development of a range of communication skills, which will encourage students to express their creativity in a practical and imaginative way and in a variety of forms, including verbal, graphic and model, and involving the use of appropriate media
- provide a context in which students can explore and appreciate the impact of past, present and future technologies on the economy, society, and the environment

Key components of technology education

The key components of technology education include

- **Design and Communication**
- **Materials and Processing**
- **Energy and Control**
- **Health and Safety**
- **Technology, Society and the Environment**

Design and Communication

Design is central to technology education in that it provides a mechanism through which problems can be solved in response to identified needs. It provokes the imagination and develops critical thinking in a structured way. Design processes, including the elements of investigation, analysis, generation and selection of ideas, drawing, making and evaluation are central to technology education. Communication skills of presentation, visualisation and spatial reasoning are enhanced and developed by transferring mental ideas and research into visual images such as drawings or reports. The component of communication incorporates sketching, drawing and use of information and communications technologies.

Materials and Processing

Materials provide the media through which expression is given to design. A wide variety of choice exists and knowledge of the properties of a material is essential before judgements can be made as to its appropriateness for a particular application. The range of materials involved includes wood, metal, plastics, fabrics, ceramics, and composites.

Processing is where materials are manipulated and design is given life and this gives rise to a sense of achievement in students. The skills of measuring, marking out, shaping, forming and finishing are central to materials and processing.

Energy and Control

Materials can only be manipulated and shaped into solutions to a design by the application of energy and control during manufacture. This component involves use of mechanical, chemical, electrical, pneumatic and hydraulic systems. The use of structures, mechanisms, energy and control can also add functionality to a designed product, where considered appropriate.

Health and Safety

The area of health and safety permeates all activities in any technological experience where correct procedures and safety precautions in relation to tools, machines, processes and materials are observed.

Technology, Society and the Environment

The implications of particular design and manufacture solutions and their impact on technology, society and the environment must be taken into account in order to enhance the quality of life. This component incorporates the environment, economics, aesthetics and the history of technological developments.

Provision of key components

Technology education is activity based and, although presented above as discrete sections, the key components should be taught in an integrated manner through the undertaking of specified tasks. Within any activity-based technology subject the key component of materials and processing will be a major element and should have significant weighting. The other key components will be integrated and given appropriate weightings relative to their emphasis depending on the activity and process at any given time.

In establishing provision for technology education through syllabus development, the balance between the various key components above will require careful consideration, so that the range of skills which technology education seeks to develop can be catered for.

5 Considering a range of configurations

The discussion and the establishment of aims and key components for technology education gave rise to some broad parameters or criteria that provided a basis for considering the range of options for possible curriculum frameworks that had emerged from discussions, and the relative merits of each. It was agreed by the Board of Studies that a proposed framework should

- be consistent with the aim of a broad and balanced education at junior cycle
- underpin the specific aims of technology education
- incorporate the key components of technology education
- provide a basis for the promotion of technology education
- provide a basis for access to technology education by all junior cycle students, irrespective of ability, aptitude and gender
- have the potential for students to take three subjects in the area of technology education in the Junior Certificate
- make realistic demands on students, teachers, schools and the system, in terms of implementation support for any revised provision.

While Technical Graphics contributes significantly to the aims of technology education, it places a greater focus on the key components of design and communication than do the other technology subjects and, consequently, it is less focused on components such as manufacture, materials, and energy and control. On this basis the Board of Studies has recommended that Technical Graphics should be considered as a stand-alone subject and that its syllabus should be revised in parallel with the syllabus development arising from any proposed common framework for the other three technology subjects.

Other considerations

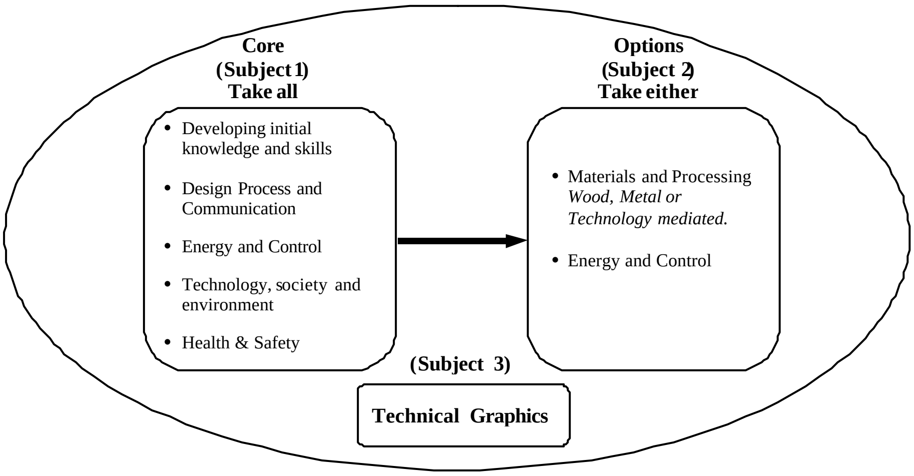
It was proposed that the adoption of any curriculum framework that provided options should be predicated upon agreement that technology education comprises a core area of experience at junior cycle and that all schools should have the facilities and resources to provide a technology education for their students. Any progressive curriculum framework should have built-in potential for the introduction of ‘new’ technologies to the framework, such as those of food technology and biotechnology.

The interim report of the Board of Studies was warmly received by Council and the Board was advised to continue its work Council advised that the Board of Studies should apply the proposed criteria to the models already identified (see Appendix 1), with particular emphasis on a core and extensions framework (Option 2). Council stressed the importance of agreement on an overall framework with a view to facilitating increased uptake of the technology subjects. The issues of resources and teacher availability should be considered in the context of supporting any new arrangements for provision.

6 Developing framework configurations

Following the presentation of its interim report, the Board of Studies continued the work of developing a number of configurations. A core and options configuration was drawn up that would allow students to select two from a possible three subjects in the materials area (figure 1). (Subject 1), and would be a pre-requisite for students wishing to take a second subject from the options (Subject 2). It would also be possible for a student to take a third subject (Technical Graphics). To enable the Board to form a clearer opinion on its merits, details of content within this framework were developed, including topic, content and learning outcomes.

Figure 1 **Technology Education at Junior Cycle**



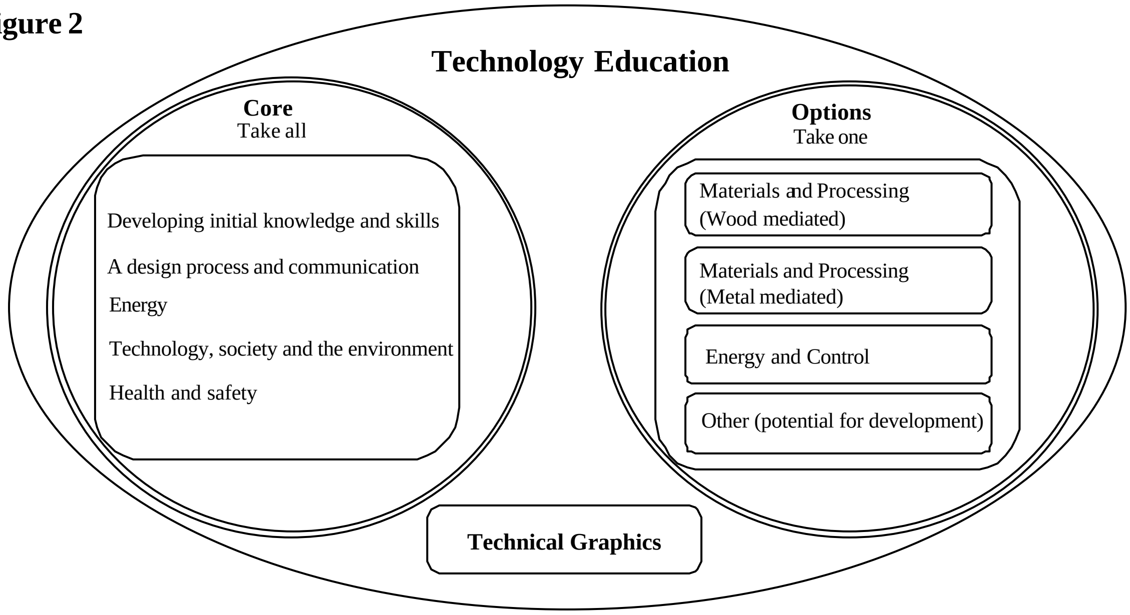
While the Board of Studies considered that this framework would provide for a range of options, there was concern that it might establish a hierarchy whereby Subject 1 would be considered more important than either of the options that formed Subject 2. The framework was presented at a technology education seminar for members of relevant NCCA committees. The following were some of the views expressed at this seminar in relation to the framework.

- It is unwieldy and would likely prove difficult to implement.
- Issues such as timetabling might become a problem where a student could not take Subject 2 without first having taken Subject 1.
- A student who might wish to take only metalwork, for example, would (under this framework) have to take a general subject first, in order to be able to specialise in metalwork (which would then be his/her second subject).

- Materials Technology (Wood) is flourishing while most other subjects are declining; the reasons for this should be examined and used to build up the other technology subjects.

Consideration of the feedback from this seminar provided the impetus for the Board of Studies to develop a further framework. The revised framework (figure 2) retained the concept of a core and options, but avoided many of the difficulties that had been identified with the first framework. Under this arrangement, the Core is combined with one of the Options to form a full subject, with each option mediating the Core topics differently. The configuration also makes provision for other options to be added in the future.

Figure 2



It was proposed that this configuration, including the expanded topics/content and learning outcomes that had been developed (see Appendix 2), should form the basis of a wider consultation.

7 Consultation on the framework

The consultation document *'A Framework for Provision'* and an accompanying questionnaire were sent to all second-level schools and the partners in education in March, 2003. Initially, the period of consultation extended to the end of June. In response to an appeal by the subject associations, this was later extended to the end of September.

Following this consultation process a report was prepared for the Board of Studies, based on the submissions received. These submissions took three forms:

- twenty completed individual questionnaires
- a discursive type of submission from three subject associations, the State Examinations Commission, and a report on the views of 3rd and 4th year Engineering student teachers at University of Limerick
- a common single-page letter from one hundred and eighteen individual teachers.

Numerical data from the questionnaires was collated and represented in graphic form. The questionnaires and other submissions included written and qualifying commentary that presented the views and opinions of the respondents on the broad issues raised by the proposed framework. These were integrated into the report under relevant headings.

The main points to emerge from the consultation were as follows.

- In some of the responses concern was expressed with the term 'Technology Education' included in the title of the consultation document, with some respondents indicating that this might have been perceived to mean the subject Technology, and thus may have impacted negatively on the number of responses submitted.
- All respondents welcomed the opportunity to present their views and it was also clear from the numerical data that most individual respondents were positive towards the proposals, while at the same time many expressed reservations about some aspects as was evident from their comments.
- There was general consensus that the introductory elements, including the rationale, aims and objectives, were clear and acceptable. There was also general agreement on the key components of technology education whilst, at the same time, some respondents expressed the view that less emphasis should be given to some of these, including energy and control, and technology, society and the environment. 'Design and make' was seen by all as important, while some expressed the view that it was often difficult for students to develop their projects from a written design brief only.

- A view was expressed strongly that the weighting given to each of the key components would need to be carefully balanced, in order to reflect the emphasis of the three existing 'practical' technology subjects.
- The proposed elements in the Core were seen by many as being too theoretical, and some expressed the view that this would diminish the practical activity that was a hallmark of these subjects. The content of the Core was seen as too demanding; some considered that it could constitute a full course in its own right.
- There was wide consensus for the three Options proposed and most respondents could see their own subjects clearly in these, acknowledging their practical emphasis. Most respondents expressed a desire that the craft skills, which are central to the existing subjects, should be central in the future development of syllabuses for these subjects.
- The resource implications, including human and physical resources, were viewed as significant and must be quantified and delivered on if the new proposals are to be implemented effectively through the respective syllabuses.
- There was broad agreement amongst the partners for the core and options framework, while some respondents expressed reservations with particular aspects, especially the positioning of, and emphasis and weighting given to, the key components.
- A number of new proposals emerged for naming the new syllabuses/subjects, but it was agreed that these might evolve further when final syllabuses were being prepared. Further proposals for new options were also suggested.

The Board of Studies discussed the draft report and expressed disappointment that only a small number of individuals had returned the questionnaire and that many of the education partners did not make any submission. The Board agreed that the list of key components should be delivered through a Core and Extension framework and that the weightings and balance of the key components would reflect the dominant materials and processes, as these emerged through the development of individual subject syllabuses.

The Board agreed that in-service to support the revised provision for technology education should be extensive and should precede the implementation of the revised syllabuses. This would also present an opportunity for the development and promotion of these subjects.

Reporting to Council on the consultation framework

A report on the consultation process and its outcomes was presented to the Council of the NCCA in October 2003. Concern was expressed by Council at the low level of response and with regard to the views of the subject associations not being made explicit in the report. The matter was referred back to the Board of Studies, with a recommendation that further consideration be given to the detailed submissions from the subject associations to determine whether these had been adequately reflected in the report. Council was informed that a request had already been made for permission to circulate these detailed submissions to all members of the Board of Studies.

Following agreement on this, the detailed submissions from the subject associations were discussed at a subsequent meeting of the Board of Studies. Following consideration of these and a review of the report to Council, there was unanimous agreement by the Board that the views expressed in those submissions had been adequately taken into account and reflected in the consultation report.

8 Concluding the work of the review

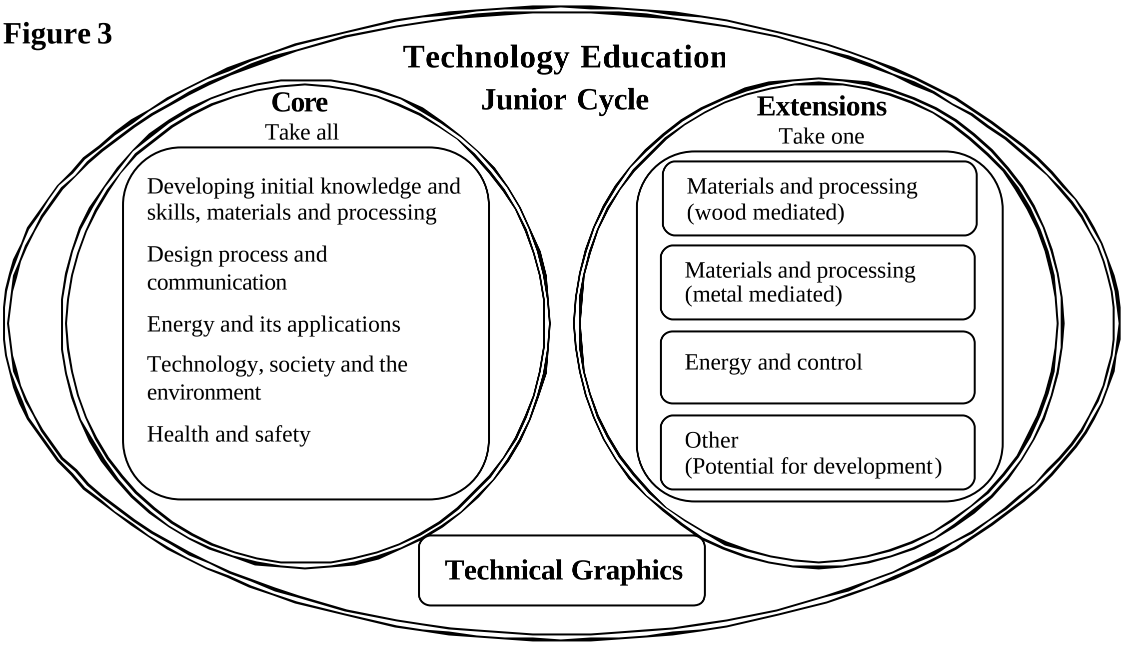
Based on the feedback from the consultation process, an amended framework of Core and Extensions (figure 3) has been agreed In this arrangement, the Core is not a full subject but must be combined with any one Extension to satisfy a full subject requirement. This also preserves the identity of the existing technology subjects:

- Materials Technology (Wood) - Core + Materials and Processing (wood mediated)
- Metalwork - Core + Materials and Processing (metal mediated)
- Technology - Core + Energy and Control.

The configuration also makes provision for other Extensions to be added as they evolve and become relevant in the future.

Technical Graphics can be taken as a single subject, or as a second/third subject in this area.

Figure 3



While the Core for all combinations is common, the Extension will mediate the Core topics differently. Thus, for example, where a student chooses the Materials and Processing (wood mediated) Extension, the Core will be taught with wood as the dominant material. The main topics in the Core will thus focus principally on wood, and sub-topics such as design, knowledge and skills, materials and processes, technology society and the environment will have a focus associated with this dominant material. A corresponding, but different, focus would prevail were the Option of Materials and Processing (metal mediated) taken in combination with the Core.

Technical Graphics

The Board of Studies decided at an early stage that the subject Technical Graphics was significantly different from the materials based technology subjects and that it should be revised in its own right. Its strong focus on design and communications should be taken into account, where many of the recommendations with regard to the proposed configuration of core and extensions can also be applied to the revision of the Technical Graphics syllabus. Since this subject was last revised, the use of ICT has advanced on a large scale and can be expected to play a significant role in the new syllabus.

Developments at Leaving Certificate

The Board of Studies is mindful of the syllabus revision that has taken place for the current three Leaving Certificate technology subjects and the introduction of a new Leaving Certificate subject, Technology. It was agreed that the changes necessary to room layout as a result of the new proposals at senior cycle will be significant and should address and complement many of the changes that will be required as a result of the current review at junior cycle. However, the extent of the changes necessary as a result of this review can only be quantified when revised Junior Certificate syllabuses for the technology subjects are complete and ready for implementation.

An implementation plan has been prepared in respect of the revised and new Leaving Certificate syllabuses in the technology subjects, and the experience gained from this could contribute significantly to similar work in respect of the technology subjects at junior cycle. This implementation plan comprehensively addresses the issues of in-career development and the resources required to underpin the implementation of the four Leaving Certificate technology subjects.

Preparation of syllabus documents

The configuration proposed by the Board of Studies (figure 3), along with the content and learning outcomes developed in its initial framework proposals (Appendix 2), should inform the specification of the brief to be given to Course Committees and should expedite the process of revision.

Course Committees based on the four existing junior cycle technology subjects: Materials Technology (Wood), Metalwork, Technical Graphics, and Technology should be established. The work of the Board of Studies should inform the thinking and direction of the Course Committees in applying the framework of core and extensions to their respective subjects.

To ensure that the vision of the Board of Studies is carried forward, and that there is a consistency in approach across the technology subjects, the syllabus revision process should be co-ordinated by an over-arching or steering group, such as that which co-ordinated the development of the new and revised syllabuses for the Leaving Certificate technology subjects.

9 Recommendations and Conclusion

Framework

In the context of the three materials-based subjects, the key components of technology education include Health and Safety, Design and Communication, Materials and Processing, Energy and Control, and Technology, Society and the Environment. While the key components are spread across and listed in separate sections in the framework, it should be noted that within any activity-based technology subject the key component of materials and processing will be a major element and should have significant weighting.

The Board of Studies recommends that

- the Core and Extensions framework provides an ideal mechanism for the configuration and delivery of the key components and forms the basis for the revision of syllabuses in the technology subjects
- the weighting given to each of the key components should be carefully balanced, in order to reflect the emphasis of the three existing 'practical' technology subjects
- the craft skills, which are central to the existing subjects, should be central in the future development of syllabuses for these subjects.

Inclusion of other technology topics

The inclusion of alternative extensions was discussed and the Board of Studies expressed satisfaction that the proposed configuration of core and extensions is an ideal mechanism for the incorporation of further areas of technology, as these become relevant or evolve in the future. The model provides a means of including other aspects of technology, e.g. biotechnology, or other modern/emerging technologies, within its common framework The configuration has the potential to accommodate ongoing change, which is a natural and frequent occurrence in technology education internationally.

The Board of Studies recommends that

- active consideration should be given by syllabus committees to the inclusion of modern and emerging technologies, along with other areas that are not currently catered for, within their respective subjects
- each extension could have an internal choice, or options, thus making provision for new areas of study without content overload.

Course Committees

The Board of Studies has looked at many broad issues in relation to the existing technology subjects at junior cycle. The work of the Board of Studies and the recommendations contained within this report should provide each Course Committee with an advanced starting point for syllabus preparation. The consultation document *'A Framework for Provision'* sets out the aims and objectives of technology education. It further presents a model template where the Core and Options (Extensions) have content and learning outcomes advanced to a high level of specification. This template, along with content and learning outcomes, should expedite the syllabus preparation work of Course Committees.

The Board of Studies recommends that

- Council convene course committees with a brief to revise their respective technology syllabuses in accordance with the agreed core and extension framework
- course committees should be brought together, as a group, prior to starting their work and briefed on the work of the Board of Studies with regard to the new configuration
- each committee should decide how the key components of technology education are to be weighted in order to reflect the particular emphasis of their dominant materials, processes and systems.

Assessment and assessment criteria

There was agreement that the detail with regard to assessment would be worked out as syllabus documents were fully developed for each subject. The specified learning outcomes should inform any decision on the most appropriate form of assessment, project/practical or theory, or a combination of both.

The Board of Studies recommends that

- the most appropriate means of assessment is through a project/practical and written examination
- the specification of learning outcomes within the new syllabus template will inform the assessment criteria to be applied.

Implications for other subjects

The Board of Studies considers that the proposed arrangements would not have negative implications for other subjects, since a student could still choose a number of technology subjects. However, a significant increase in the number of students taking technology subjects would have implications for the numbers studying other (non-core) subjects, particularly in light of the overall decline in the junior cycle cohort.

Participation, aptitude, gender and promotion

There is widespread recognition across education, government and business, of the strategic importance of science and technology, although the emphasis is often placed solely on the science subjects, with little reference to the technologies. This lack of emphasis on the technology side needs to be tackled if the imbalance is to be redressed.

There is a need to look at the broad issues that contribute to imbalances in the uptake and participation in the technology subjects. The findings of research into how schools allocate subjects to students, the influence of school policy and school timetabling on subject choice, societal influences, the nature and availability of role models, etc. will be particularly relevant for these subjects. While it is acknowledged that these are broad and far-reaching issues, which extend beyond the technology subjects, the Board of Studies recommends to Council that the attention of course committees undertaking syllabus revision should be drawn to the findings of such research. A strong view was expressed that there should be positive discrimination to enable provision of technology education in single-sex, girls' second-level schools.

The Board of Studies is of the view that the promotion of the technology subjects is critical to their success and that a national effort needs to be made to raise awareness of the contribution that these subjects make to our continued growth and prosperity. The revision of technology subjects at both junior and senior cycle provides an opportunity to undertake a comprehensive promotional campaign, which can be supported from within as well as from outside the education arena.

The Board of Studies recommends that

- technology education should be available to all students who wish to avail of it and the outcomes of research out into participation rates, aptitude and gender in respect of the technology subjects, and the influences that impede and promote participation, should inform the revision of syllabuses in these subjects
- a marketing strategy be devised for the promotion of technology subjects. This strategy should be aimed at all relevant groups, including parents, teachers, students, guidance counsellors, principals, Government, etc.

Short courses

Taster courses are prevalent in many schools and the time allocated to these ranges from about three months to a full school year. The issue of taster courses, that enable students to make a more informed choice as to which optional subjects to pursue to Junior Certificate, was considered by the Board of Studies. However, while considering these as generally a worthwhile experience, the Board of Studies affirms that, of itself, a short course in a technology subject does not fulfil the requirements of a technology education for students. That is to say, students could not be considered 'technologically educated' as a result of participating in such short courses in a taster programme.

The Board of Studies recommends that

as part of its review of the junior cycle, The NCCA should give consideration to the idea of developing first-year taster courses in all the (non-core) junior cycle subjects provided in schools; this arrangement would allow students to make more informed choices of subjects for their Junior Certificate.

Resources

The Board of Studies identified the lack of resources as a significant barrier to participation in the technology subjects. The resource implications for inclusive room re-design, tools, equipment and processing will need to be addressed adequately if these proposals are to be implemented effectively. In particular, great care should be taken when re-designing room layout for each subject to take account of the current review. The use of ICT as a teaching and learning tool, along with its use as a design and presentation resource, has implications for the resourcing of the technology subjects.

The Board of Studies recommends that

- suitably equipped rooms are provided for schools that wish to introduce technology subjects and all schools should be brought up to an appropriate and equal standard of resources prior to the implementation of any revised technology courses
- best practice should be adopted, when reconfiguring rooms, particularly with regard to use of space, colour, inclusive design and accessibility. Consideration should be given to the provision of design and manufacture areas that are modern and attractive places to teach and learn in, whether as integrated or separate areas
- the provision of modern technology in the form of ICT and its use as both a teaching and a learning tool should be part of the new arrangements. A competence in the use of ICT is recommended, where appropriate, to assist in control, manufacturing, or to enhance portfolio production and presentation.

Professional development

The issues of adequate provision of qualified teachers and appropriate professional development (pre-service and in-service) will need to be addressed in the context of these syllabus revisions.

The Board of Studies recommends that

- a sufficient number of suitably qualified graduates be made available to meet the requirements of schools to enable them to provide technology subjects
- in-service should be extensive and should precede the implementation of syllabuses; this will also present an opportunity for the development and promotion of the subjects.

Conclusion

The Board of Studies has looked broadly at technology education and the significant impact and contribution it has made to our education system. This review has focused on many factors that impact on the place of technology education within the changing curriculum.

The four existing technology subjects at junior cycle, Materials Technology (Wood), Metalwork, Technical Graphics and Technology have grown and evolved from the vocational system to be more widely available in the majority of our second level schools. The constructivist approach, which is the cornerstone of the activity-based environment common to all technology subjects, is recognised as an ideal mechanism for contributing significantly to the attainment of high educational ideals, and to the decision-making and problem-solving skills that are required in today's world.

The Board of Studies believes that the proposals and recommendations contained in this final report will consolidate these subjects and provide a framework to promote greater uptake. The proposed framework is sufficiently flexible to accommodate the ongoing change which is a feature of technology generally and technology education in particular.

Appendix 1

Options for Curriculum Frameworks

presented in the Interim report to Council

March 2000

Appendix 1

Options for Curriculum Frameworks

The brief for the review required that following consideration of the aims and key components of technology education the Board would propose how the aims and key components specified should be structured and provided for in the curriculum area of technology and suggested that in this context a range of options should be considered and prioritised, including full and short courses.

Before outlining the various options for curriculum frameworks discussed, it is important to clarify the context in which these options emerged with particular reference to the range of subjects that it was decided comprised the technologies as a group of subjects. It was agreed that the subjects Art, Craft, Design and Home Economics should not be included in any optional frameworks developed at this time.

Furthermore, while Technical Graphics was considered to be one of the technology subjects, it was agreed that in the context of any optional framework developed involving a realignment of the content of the technology subjects, it should remain a stand-alone subject. While Technical Graphics contributes significantly to the aims of technology education it places a greater focus on the key components of design and communication than other subjects and equally is less focussed on components such as manufacture, materials and energy and control. However, it was recommended that a review of the Junior Certificate syllabus for Technical Graphics should commence as quickly as possible as part of the review of technology education at junior cycle.

It was on the basis of the decisions outlined above that optional frameworks were proposed.

Option 1 – Retention of the existing subjects

Under this framework, the existing four subjects, Materials Technology (Wood), Technical Graphics, Metalwork and Technology would remain as independent stand-alone subjects. The NCCA would activate course committees for each subject with a brief to update and modernise each subject. Commonality of approach towards the development of syllabuses could be a feature of the review.

Option 2 – A core and extensions framework

Several variations of this framework were discussed. All provided a foundational, core technological experience and optional extensions related to the core. The central features of this option are -

- Any student taking subjects in the curriculum area of technology education would be required to undertake the core as a pre-requisite to any extensions
- The core could be wood, metal or technology biased, depending on the circumstances surrounding school provision, teacher availability and expertise and student choice
- The core would provide a common technological experience for all students that would incorporate engagement with the key components outlined
- The core might comprise part of or a full-subject equivalent
- This framework provides for a student choosing to undertake the equivalent of three technology subjects.

Option 3 – Merging some existing subjects

A number of frameworks were suggested which involved the merging of existing subjects.

- The subjects Metalwork and Technology could be reviewed simultaneously with the intention of forming one new subject called Junior Engineering Technology. Furthermore, the real potential for the new subject Junior Engineering Technology and Materials Technology (Wood) being based on an agreed common core could be explored. This framework would result in three stand-alone technological subjects at junior cycle: Junior Engineering Technology, Materials Technology (Wood) and Technical Graphics.
- The subjects Materials Technology (Wood) and Metalwork could be merged to form a new materials-based technology subject
- The three existing subjects Materials Technology (Wood), Metalwork and Technology could be merged to form one new subject.

Other considerations

It was proposed that the adoption of any optional curriculum framework should be predicated upon agreement that technological education comprise a core area of experience at junior cycle and that all schools have the facilities and resources to provide technological education for their students.

It was agreed that the various frameworks discussed were not mutually exclusive. In reaching decisions, it would be important to retain what is best in our existing arrangements and build on it to develop and reinforce an inclusive curriculum that would be attractive to all students.

Furthermore, consideration should be given to whether in arriving at an agreed curriculum framework for technology education it might be appropriate over a transitional period to operate more than one of the options above simultaneously.

Finally, any progressive curriculum framework should have built-in potential for the introduction of 'new' technologies such as those of food technology and biotechnology to the framework and to schools.

Appendix 2

Core and Options framework presented in the discussion document: A Framework for Provision

CORE

Appendix 2

CORE ¾ DEVELOPING INITIAL KNOWLEDGE AND SKILLS

The purpose of developing initial knowledge and skills is to ensure that, at an early stage, students experience a good foundation that will empower them to adopt a design-and-make approach in their subsequent study of the subject.

Initial tasks should be of a simple, closed nature and take account of the student's stage of development. Their purpose is to develop appropriate knowledge and understanding of materials and their properties, in the context of their chosen option, and the procedures to be followed for the safe use of tools and equipment in the work area. It is envisaged that these skills will be developed through the medium of one or more materials, depending on the resources and facilities available to the teacher. Students should develop the ability to integrate knowledge, understanding and skills in devising solutions to problems, and they should appreciate the need for the careful planning of project work.

CONTENT

Main topic	**Expanded topic details**
Project work and design process	Project planning; basic analysis of brief; research into existing and proposed solutions; communication, design and realisation; testing and evaluation of simple artefacts/projects
Materials	Identification, classification, properties and uses of common materials; appropriate selection of materials
Tools and machines	Identification, and correct and safe use of hand and machine tools appropriate to the materials and processes selected
Processing skills	Measuring and marking out; cutting, shaping, forming, joining, and finishing materials
Safety considerations	Good practice and proper procedures; awareness of potential dangers and health hazards; safety and first aid equipment; regulations and symbols; protective clothing; evacuation procedures

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- identify a range of common materials and list the properties of these with relevance to their use
- measure a number of objects of varying size and shape
- use appropriate hand and machine tools to mark out, cut, shape, form, join and finish given materials
- apply knowledge and skills to communicate design ideas and in the realisation and evaluation of simple artefacts/projects
- select materials, tools and processes appropriate to a given task
- demonstrate an awareness of health and safety issues describing and observing correct procedures and safety precautions in relation to tools, machines, processes and materials (including their disposal),.

CORE ¾ DESIGN PROCESS AND COMMUNICATION

A process of design and realisation is central to technology education in that it provides the mechanism through which problems can be analysed and solved to satisfy human needs. It stimulates the imagination, and creative thought, develops critical thinking in a tangible way. Skills of visualisation and spatial reasoning are developed through communication of thoughts and ideas in visual images in the form of sketches, drawings and reports.

CONTENT

Main topic	Expanded topic details
Design and communication	Sketching and drawing (conventions, use of instruments, schematic and working drawings, symbols, circuit diagrams, shading and texturing, use of colour to enhance sketches and drawings); measuring and dimensioning; modelling; use of information and communication technologies (ICT) for appropriate research and to enhance the presentation of reports and portfolios: word-processing, database, CD-ROM, internet, CAD; safety and environmental considerations in product design and realisation.
Project work	Analysis and interpretation of a brief: ergonomic considerations, investigation, and research of existing and/or possible solutions; sketches/drawings/models of initial design ideas (freehand, using instruments, computer-aided); evaluation of initial ideas against identified criteria; development of a selected design idea (model and/or working drawings); selection of materials and processes appropriate to the chosen idea, with due regard for safety and environmental considerations; manufacture and final assembly of artefact; testing and evaluation of the finished product; folio production and presentation.

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- critically evaluate existing artefacts and/or design ideas according to identified criteria, and propose possible alterations or improvements where appropriate
- recognise and use standard symbols and notation in sketches and working drawings and interpret relevant information from given drawings and data
- describe and follow a design process when undertaking project work
- interpret and analyse a given brief and establish appropriate criteria
- investigate and research possible solutions to a given problem or brief
- develop design ideas and present these by means of sketching, drawing or modelling
- evaluate design ideas against identified criteria and select an appropriate solution
- communicate the chosen solution through appropriate drawings and/or models (*including scaled drawings/models*), and the use of colour, shading or rendering, and present data in graphic, tabular and other forms
- have due regard for safety and environmental considerations when undertaking a project
- list the appropriate stages, processes, and materials required for the design and manufacture of an artefact
- manufacture and assemble an artefact in accordance with the chosen solution
- test and evaluate a finished product against established criteria
- prepare and present a project folio
- use ICT to research, prepare, present, or enhance their work as appropriate, at various stages of a project
- integrate and apply previous knowledge and skills in multi-component projects.

CORE ¾ ENERGY

There are many sources of energy, which can be used and changed to enable the operation and control of simple devices and machines in the safe and efficient performance of tasks and in the enhancement of projects. In the design and realisation of artefacts as solutions to given tasks or briefs, an understanding of how energy can be used, transmitted and transformed should lead to an awareness of the need for the conservation of energy.

CONTENT

Main topic	Expanded topic details
Energy forms/ conversions	Renewable and non-renewal sources of energy; forms of energy: energy conversions (input-output model); use of devices that transmit and transform energy and motion
Electric/electronic circuits	Investigation of the relationship between voltage, current and resistance; simple components and circuits; assembly and testing of electric/electronic circuits; integration of components as required with projects; recognition and use of standard symbols
Mechanisms	Gears, pulleys, linkages, cams, belts and chains; assembly and investigation of simple models involving one or more mechanisms; basic calculations of speed
Control	Selection and use of a range of electric/electronic components and mechanisms to provide simple control devices and systems

LEARNING OUTCOMES

As a result of their study of energy and control, students should be able to

- identify and describe different forms of energy transmission used in the construction and operation of projects
- select and manufacture appropriate energy transmission and control systems
- integrate a variety of mechanisms with suitable structures for given situations
- investigate the basic function and principles of common electrical and electronic components and circuits
- assemble simple circuits and components by temporary and permanent methods
- use electrical and electronic components and circuits to power and enhance the functionality of projects
- manufacture and assemble the component parts of mechanisms used in projects.

CORE ¾ TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

There is a need to understand how people influence and interact with technology, and how it affects our lives and the environment. Students should consider how materials, machines, processes and communications impact on society, and should demonstrate innovative approaches to design that take this into account. They should demonstrate awareness of environmental and ergonomic factors in the design and manufacture of projects.

CONTENT

Main topic	**Expanded topic details**
Technology, society and the environment	Impact and effects of technology in the home, in school and in the workplace, and on transport, industry and leisure; forms of pollution and control
Design considerations	Selection of materials, tools, process and systems with regard to their impact on society; the impact of good design practice on waste generation and disposal
Case study	Examination of the structure, development and use of everyday objects, machines, appliances and systems (washing machine, motor car, central heating, CD player, mobile phone, computer)
Control	Selection and use of a range of electric/electronic components and mechanisms to provide simple control devices and systems

LEARNING OUTCOMES

As a result of their study of the relationship between technology and society, students should be able to

- investigate and explain how familiar technological activities and products impact on our lives and on the environment
- develop an awareness of, and list the limitations and appropriate use of technology
- give examples of how people have influenced the development of technological products and services
- identify and describe the positive and negative effects of design considerations
- investigate and report on the social and economic impact of common everyday objects, machines and appliances.

OPTIONS

STUDENTS MUST STUDY ONE OF THE OPTIONS IN CONJUNCTION WITH THE CORE

OPTION 1 ¾ MATERIALS AND PROCESSING (WOOD MEDIATED)

In the study of this option, students will be required to follow a process of design. There will be increased emphasis on the development of skills in relation to both the selection and the processing of the material, and this should be reflected in student project work.

CONTENT

Main Topic	Sub-topics
Materials: properties and classification	Properties: physical (mechanical, thermal); chemical/biological; performance Classification: identification of wood types and products; thermoplastics and thermosetting plastics; ceramics, composites, and metals Use of timber and timber products Adhesives: properties and suitable applications Selection of materials appropriate to a task; specification of desirable properties as a result of service requirements
Processing of materials	Measuring and marking out: use of measuring and marking out tools; accurate transfer of drawing plans Tools and equipment: hand tools; sharpening tools; power tools (band saw, scroll saw, sanding machine); CNC and other equipment Processing: cutting; drilling; boring; shaping/forming (planing, carving, routing, turning, inlaying, steam bending); laminating, sanding Joining and fastening materials: common joints, dowelling, screws and nails, adhesives Assembly of components: selection and integration of standard components to increase functionality: motors, linkages, chains, gears, pulleys and belts; common electronic components Surface and applied finishes (painting, varnishing, polishing, waxing, veneering, use of preservatives, pyrography, marquetry) Safety procedures: handling, use and storage of materials and equipment; fire extinguishing and evacuation; personal protection and hygiene Impact and effects of materials and processes on people and their environment: waste management; waste reduction; awareness of environmental impact of waste products, and the recycling of materials.

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- investigate and describe the properties and resultant uses of a variety of materials
- identify and classify wood types and wood products, plastics, ceramics, composites and metals
- describe the use of timber and timber products
- know the properties and suitable applications of common adhesives
- specify desirable properties of materials, recognising constraints imposed by these, and select materials and processes appropriate to a task
- show awareness of safety considerations in respect of the selection, use and storage of materials, tools or equipment and have due regard for personal safety and the safety of others when working individually or in groups
- demonstrate skill in selecting and using a variety of tools, machines and equipment to cut, shape, and finish a range of materials appropriate to a task
- use tools accurately to measure and mark out selected materials and transfer information from design sketches and drawings
- use appropriate computer applications (CAD/CAM) to prepare and manufacture component parts in order to enhance their work
- measure and check components and parts for accuracy and finish, within pre-determined parameters
- join selected materials using permanent and semi-permanent methods, using appropriate techniques and processes
- select and integrate standard components to increase the functionality of projects
- know and adopt correct safety procedures in the event of fire or evacuation, and take responsibility for personal protection and hygiene
- demonstrate awareness of the effects of materials and processes on people and their environment, and recognise the benefits of waste reduction and the recycling of materials
- take steps to minimise the waste produced in the manufacture of an artefact and dispose of materials, including waste, in a safe manner.

OPTION 2 ¾ MATERIALS AND PROCESSING (METAL MEDIATED)

In the study of this option students will be required to follow a process of design. There will be increased emphasis on the development of skills in relation to both the selection and the processing of the material, and this should be reflected in student project work.

CONTENT

Main Topic	Sub-topics
Materials: properties and classification	Properties: physical, mechanical, thermal, electrical, chemical/biological (including biodegradability) Classification: ferrous (plain carbon) and non-ferrous metals; alloys; thermoplastics and thermosetting plastics; wood; ceramics; composites Production of iron and steel; heat-treatment of high carbon steel Selection of materials appropriate to a task: specification of desirable properties as a result of service requirements
Processing of materials	Measuring and marking out: use of marking out and measuring tools (rule, scriber, try-square, surface plate and surface gauge, vernier callipers) Tools and equipment: saws, files, shears, pistol and pedestal drills, manual and CNC lathes Processing: cutting; drilling; shaping/forming; hot and cold bending; twisting; beaten metalworking; engraving; scrolling; vacuum forming Joining and fastening materials: machine screws, rivets, soldering, brazing, adhesives, sheet metal joints Assembly of components: selection and integration of standard components to increase functionality; motors, linkages, chains, gears, pulleys and belts, common electronic components Surface and decorative finishes: polishing; painting; etching; dip-coating; enamelling Safety procedures: handling; use and storage of materials and equipment; fire extinguishing and evacuation; personal protection and hygiene Impact and effects of materials and processes on people and their environment: waste management; waste reduction; awareness of environmental impact of waste products, and the recycling of materials

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- investigate and describe the properties and resultant uses of a variety of materials
- identify and classify ferrous and non ferrous metals and alloys, plastics, woods, ceramics and composites
- describe the production of iron and steel
- specify desirable properties of materials recognising the constraints imposed by these, and select materials and processes appropriate to a task
- show awareness of safety considerations in respect of the selection, use and storage of materials, tools or equipment, and have due regard for personal safety and the safety of others when working individually or in groups
- demonstrate skill in selecting and using a variety of tools, machines and equipment to cut, shape, and finish materials appropriate to a task
- use tools accurately to measure and mark out selected materials and transfer information from design sketches and drawings
- use appropriate computer applications (CAD/CAM) to prepare and manufacture component parts in order to enhance their work
- measure and check components and parts for accuracy and finish, within pre-determined parameters
- join selected materials using permanent and semi-permanent methods using appropriate techniques and processes
- select and integrate standard components to increase the functionality of projects
- know and adopt correct safety procedures in the event of fire or evacuation, and take responsibility for personal protection and hygiene
- demonstrate awareness of the impact and effects of materials and processes on people and their environment, and recognise the benefits of waste reduction and the recycling of materials
- take steps to minimise the waste produced in the manufacture of an artefact and dispose of materials (including waste) in a safe manner.

OPTION 3 ¾ ENERGY AND CONTROL

In the study of this option students will be required to follow a process of design. There will be increased emphasis on the selection of appropriate components/circuits and their incorporation into control systems, and this should be reflected in student project work.

CONTENT

Main Topic	**Sub-topics**
Energy	Forms of energy; common sources of energy; energy conservation; energy transformation as simple input-output systems; units of energy Basic electricity and electric circuits; electric current (conventional), unit of current (ampere), measurement of current (ammeter or multimeter); use of electric current to provide heating, lighting, sound; polarity in circuits; potential difference (voltage), unit of voltage, measurement of voltage (voltmeter or multimeter); resistance, unit of resistance, colour coding of resistors, measurement of resistance; Ohm's law expressed as $V = I \times R$; series and parallel circuits; potential divider using fixed and variable resistors; simple electronic components and their use in circuits; circuit assembly and testing
Control	Types of motion and motion change (linear, rotary, reciprocating) with everyday applications of these Mechanisms: levers, pulleys, gears, linkages; mechanical advantage; friction and its effects; DC motors; electrical/electronic control; automatic switching; pneumatics; robotics; systems approach (input, process, output) Safety procedures: handling, use and storage of materials and equipment; fire extinguishing and evacuation; personal protection and hygiene Impact and effects of use of energy, materials, systems and processes on people and their environment: waste management; waste reduction; awareness of environmental impact of waste products, and the recycling of materials

LEARNING OUTCOMES

As a result of their study of these topics, students should be able to

- describe a variety of forms and sources of energy, and explain, using an input-output model, how energy is converted from one form to another
- recognise and describe the benefits of energy conservation
- identify and describe linear, rotary and reciprocating motion, and give examples of everyday applications of these
- prepare or assemble models to illustrate changes of motion from one form to another
- recognise and use standard symbols for electronic, electrical and mechanical control components
- understand and explain the functioning of control components and simple control systems
- demonstrate appropriate knowledge and skill in selecting and checking components and parts for suitability within pre-determined parameters
- skilfully assemble (by permanent and semi-permanent methods), and test simple mechanical or electronic control devices and systems using appropriate materials, tools and processes
- show awareness of safety considerations in respect of the selection, use and storage of tools or equipment, and have due regard for personal safety and the safety of others when working individually or in groups
- know and adopt correct safety procedures in the event of fire or evacuation, and take responsibility for personal protection and hygiene
- demonstrate awareness of the impact and effects of the use of energy, materials, systems and processes on people and their environment, and recognise the benefits of waste reduction and the recycling of materials
- take steps to conserve energy and to minimise the waste produced in the manufacture of an artefact, and dispose of materials, including waste, in a safe manner.