

Providing opportunities for Science and Technology to work together

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A report on the Science with Technology Project, which aims to bring closer together the teaching of these subjects for pupils aged 14–19

The Association for Science Education (ASE) and the Design and Technology Association recognise the close relationship between their respective subject areas. The SATIS Science with Technology Project intends to foster effective collaboration between technology and science teachers.

The National Curriculum acknowledges the educational need for closer subject links and the nature of the relationship has been made clearer in successive documents. The original terms of reference for the Design and Technology Working Group, chaired by Lady Parkes, were clear: 'The working group should assume that pupils will draw on knowledge and skills from a range of subject areas, but always involving science or mathematical'.

Paragraph 3.3 of the *Non-Statutory Guidance* that accompanied the Technology orders in 1990 develops the idea further: 'It may be difficult to distinguish between scientific activities and those in design and technology... With scientific knowledge, pupils are better

able to develop solutions for design and technology problems'.

Technology 5–16, the revised proposals, published in December 1992, outlines how pupils will satisfy the statements of attainment and is more specific: 'They should also apply their knowledge, skills and experiences from comparable levels in other subjects, particularly mathematics, science and art'.

An industry definition of technology will always include a reference to the application of science and the importance of mathematical skills. This has been referred to as a 'seamless web'. This is in contrast with the situation in many schools, where separate departments will exist for these three subjects and very little co-operation occurs between them. This project will provide opportunities for students to work in a way which more closely reflects good industrial practice of multi-disciplinary teams.

Reference : Data News SwT Article Graphic 1

The Science with Technology Units

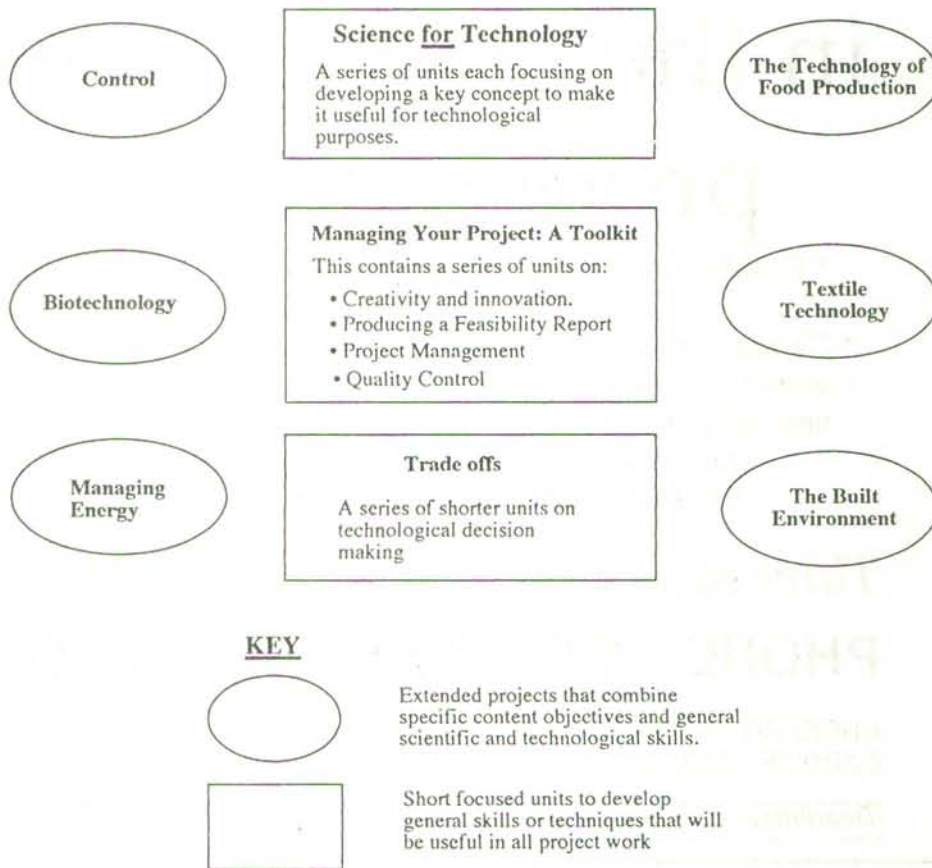
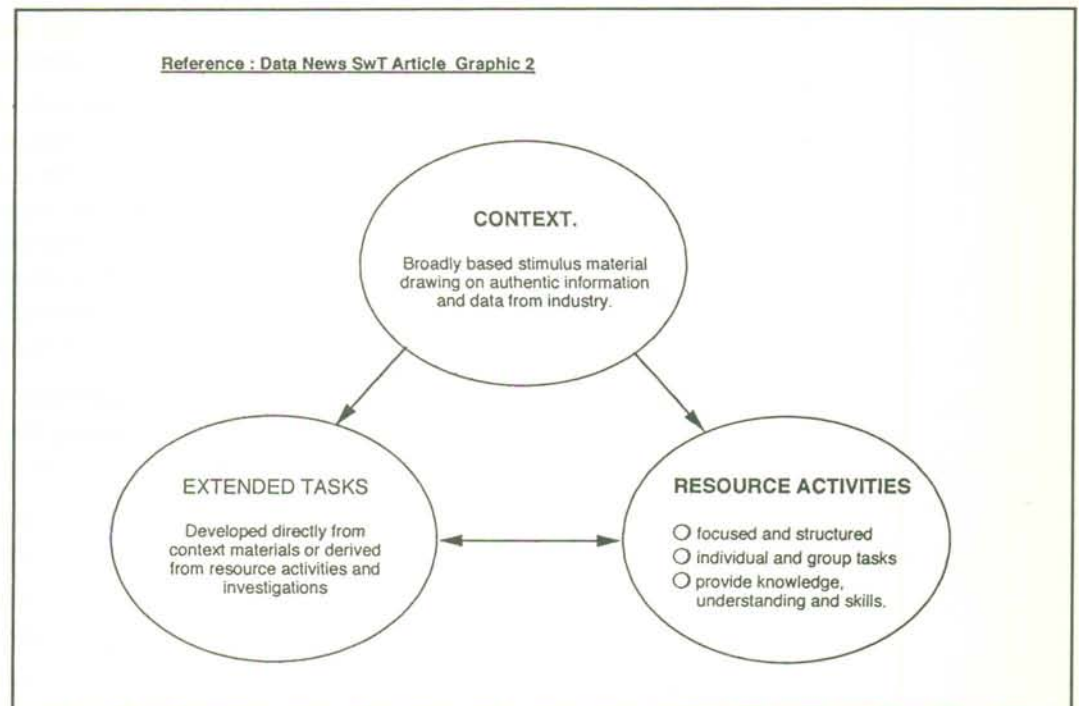


Figure 1

Figure 2



The Science with Technology Project, set up in 1991, is producing curriculum resources to enable students to develop a wider understanding of the complex relationship between science and technology in the world beyond school.

This is to be done through the production of a series of units providing resource materials to support students' work in science and technology and also to make links with mathematics. Each unit will provide students with authoritative data and information drawn from a range of science-based industries.

The units will:

- offer a range of strategies for linking science and technology
- use authentic industrial contexts to demonstrate the close relationship between science and technology
- develop scientific understanding for use in technology
- provide relevance and motivation in science through technological tasks
- develop transferable skills in the areas of project management, innovation and group work
- offer accreditation opportunities for GCSE courses and A/AS level courses in science and technology as well as the proposed GNVQ courses.

■ The Curriculum Materials

See Figure 1.

■ Using the curriculum resources

See Figure 2.

■ Flexible Ways of Using the Materials

These materials offer students a more flexible way of working:

- Work in science and technology can be co-ordinated and sequenced to provide coherence using a common context.
- Work can be freely taken from science to technology and vice versa as part of a common course that uses team teaching as one of the methods of delivery.
- Activities can be integrated during Project Days or Weeks or, more normally, extended project work.

The Process Control Unit

This flexibility can be illustrated by looking at the Process Control Unit. In this unit we are tackling two key areas in science and technology education:

- The difficulties teachers have in teaching students about control and in particular, that work is closely linked to industrial process control.

- The development of a more rigorous approach to biotechnology, which emphasises its importance as a key science-based industry.

The unit has been deliberately written in three parts:

Part 1 introduces students to the 'language' and the principles of control through practical activities. Examples from industrial process control are used to provide relevance and demonstrate a systematic design approach. This part is matched most closely to the requirements of the Technology orders so that it can be used either on its own or as resource for the Biotechnology part of the unit.

Part 2 provides students with practical investigations to learn about the control of pumps, valves, heaters, pneumatic systems, electric motors and solenoids. This section will enhance the National Curriculum elements and goes on to cover some of the A Level and GNVQ requirements.

Part 3 guides students through the design and making of a small fermenter. They carry out investigations to determine the optimum conditions to achieve maximum yields and design and build monitoring and control systems to maintain these conditions. They are then asked to consider some issues concerned with scaling up production. This part will provide practical activities to satisfy assessment requirements across the 14–19 range of courses.

The Managing Energy Unit

Managing Energy is an example of one of the longer content-based units. The main focus of this unit involves students in developing energy strategies for their school. They investigate the use of energy in the school, identify problems and recommend solutions. Some of these could lead to students designing and making devices to help with the implementation of their strategy.

Through this process students will:

- develop a deeper understanding of the use of energy, energy transfer and efficiency
- learn about the importance of energy management to reduce the operating costs of buildings and plant
- understand the importance of environmental, as well as financial, audits

and learn how to carry out an evaluation of environmental impact.

This unit specifically involves use of information technology and collection and analysis of data from the students' own school. Students devise and apply energy efficiency strategies based on analysis of authentic data and application of national standards. This then leads to the identification of energy-related design and make tasks.

Unit topics

Hitting the hot spots

Researching in their own situation, students:

- produce a temperature map of their school
- compare temperatures with DFE and published national standards
- identify energy-related problems and outline some solutions.

A Model of Efficiency?

Working from information about a given school, the students:

- calculate the annual fuel bill, energy consumption and carbon dioxide emissions
- identify energy-related problems
- suggest solutions and evaluate them.

Developing an Energy Strategy for your own school

Students investigate their own school, identify problems and develop an energy efficiency strategy.

Energy and You

This section gives students structured levels of guidance to help them identify technology projects related to energy.

Technology Of Food Unit

This unit:

- develops a scientific understanding of nutritional requirements
- covers the development of food products to meet specific requirements
- includes the technology of food production
- is based on Tofu, a soya bean product.

See Figure 3.

Although the place of 'food' in the National Curriculum for Technology is under debate we are convinced of the importance of food technology both as part of the education of students and as an important science-based industry. In this unit students learn about food technology as well as issues concerned with scaling up production, meeting quality standards and the importance of developing close relationships with customers and maintaining customer satisfaction. In particular students will:

- learn about the importance of indispensable amino acids in diets and how soya bean products such as tofu, can meet this requirement, particularly in a range of vegetarian and low fat diets
- make tofu following a process provided for them and carry out a series of investigations to understand the science behind this process
- design and make a range of dishes for small- and large-scale production
- consider the issues concerned with scaling up production including applying their understanding of the manufacturing process, considering health and hygiene

issues and technological and engineering problems to be solved to meet all relevant standards

- develop a planning framework that can be applied to the development of other food products.

The Project Toolkit

The Project Toolkit is a series of units written to be used as 'stand-alones' to cover specific technological processes, skills and techniques. The areas covered are those which are not generally well supported in terms of science and technology.

Tools for Developing the Technological Mind

See Figure 4.

Using the Project Toolkit Units as part of a longer project

Each unit will be cross-referenced to, and can be used as part of, the longer units such as the Commercial Applications of Textiles Technology: The Skopos Project.

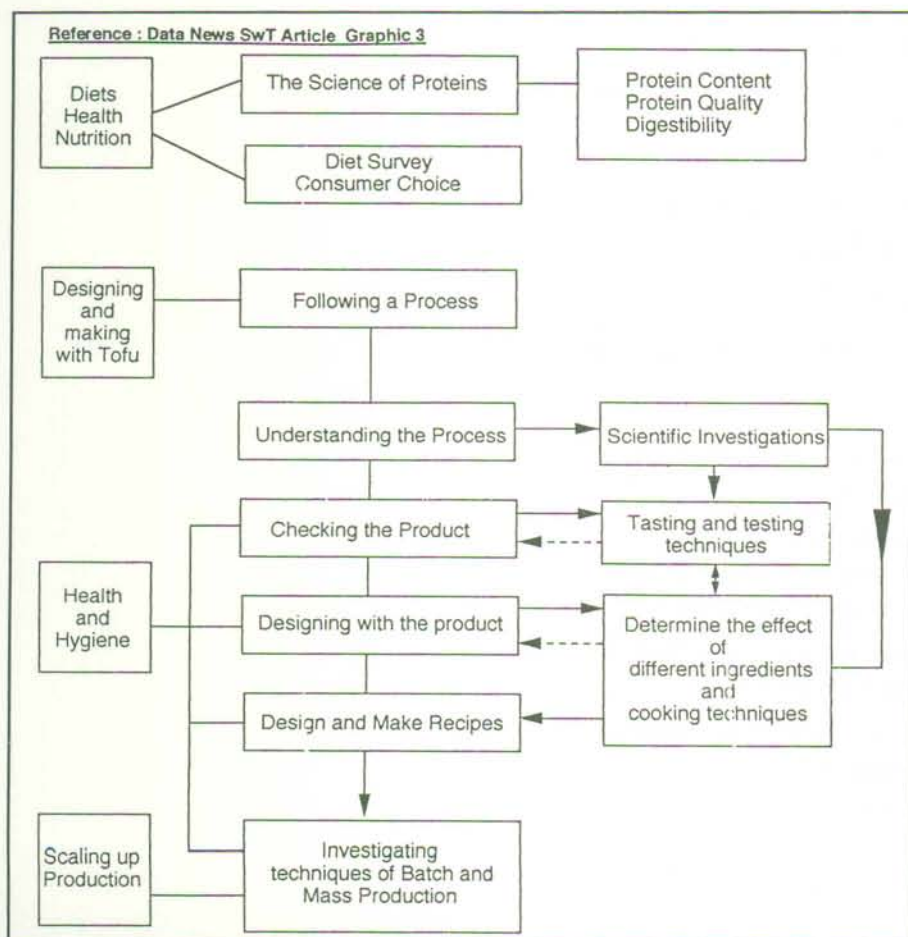
The aim of this unit is to provide students with an experience that is an alternative to clothing-based textiles projects and provide a realistic commercial application related to interior design and the use of furnishing fabrics.

Students will be given options within the unit but a core activity will be the application of British Standards Testing procedures during the stages of design development.

This part of the unit can be linked the 'Quality Control' materials in the Project Toolkit. The activities the student undertakes in the Project Toolkit can be related to the activities in the rest of the unit which will include:

- a series of scientific investigations to understand the properties and structure of textiles materials
- a commercial textiles design case study focusing on issues such as balancing a number of variables in commercial design, devising and meeting a specification including quality criteria, consumer choice and the selection of materials
- an activity involving students in the designing and making of a furnishing fabric
- computer-aided design and manufacturing equipment.

Figure 3



Reference : Data News SwT Article Graphic 4

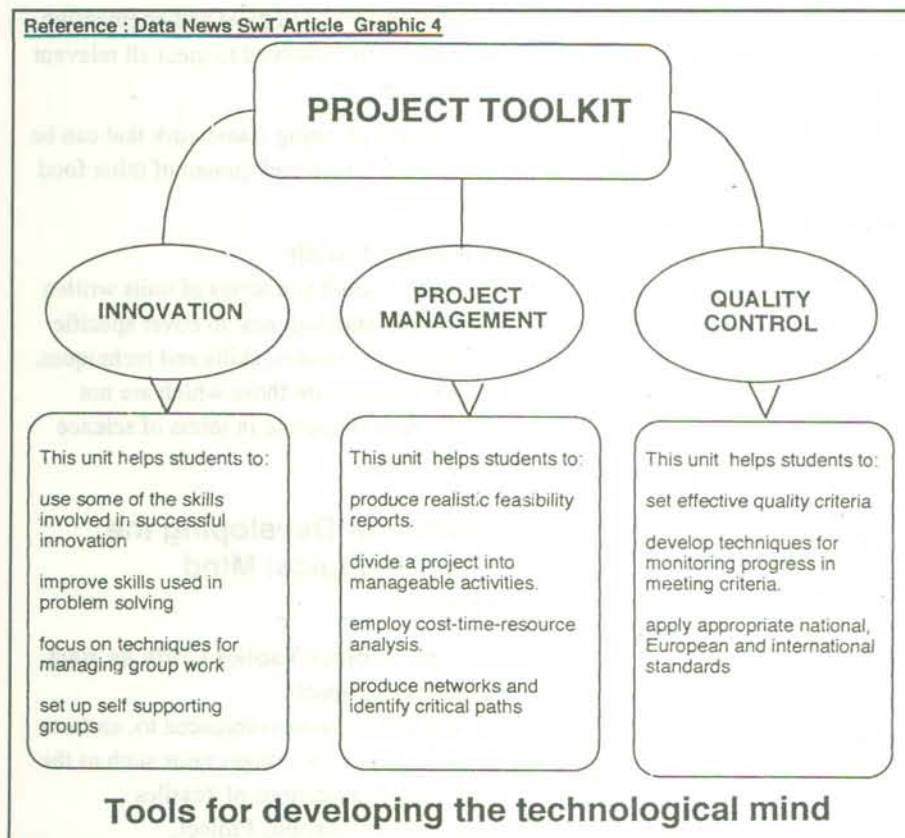


Figure 4

Trade-Offs

This is one of a range of short innovative units that will show students how:

- technological decision making involves more than deciding what to make
- all decisions involve a series of trade-offs in order to balance a range of constraints
- specific decisions are made within industry in order to develop products.



Areas to be covered include:

- Renewable Energy e.g. deciding where to site wind turbine generators
- Environmentally Friendly Vehicles e.g. balancing environmental impact and operational requirements
- Environmental Management Systems e.g. waste management
- Product Development e.g. market led or technology led?

Accreditation Routes

GCSE

Science
Design and Technology
Technology

GNVQ

Science

A and AS

Physics
Design and Technology

Joining the Science with Technology Project

You are welcome to take part in the project at any level. We are compiling a database of teachers and schools wishing to trial and develop the Units. We are also looking for people who want to be involved in the writing of specific units. If you feel able to offer your help please contact one of the team at either of the addresses given below.

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