TECHNOLOGY SPECIALIST KNOWLEDGE AND SKILLS

DECEMBER 2009

MATERIALS TO SUPPORT THE DEVELOPMENT OF:

1. **TECHNOLOGY TEACHING AND LEARNING GUIDES, AND**
2. **TECHNOLOGY SPECIALIST AREA ACHIEVEMENT STANDARDS**

Thank you to all those teachers, tertiary and industry technologists who have contributed to the material below.

The material represents the ***Body of Knowledge*** for specialist areas of technology at levels 6, 7 and 8 of the New Zealand Curriculum.

Specialist Areas of Technology – Structured around overarching and levelled Objectives

Design

Graphics

Preservation, Packaging and storage

Process

Manufacturing

Structures and Machines

Construction

Electronics

Digital Information

Digital Infrastructure

Digital Media

Programming and Computer Science

DESIGN

DEMONSTRATE UNDERSTANDINGS OF CONTEMPORARY AND FUTURE FOCUSED ISSUES IN DESIGN

This objective includes a focus on four central issues in design; 1) what is design? 2) what is 'good' design 3) designing for sustainability and 4) innovative design.
This objective applies to all contexts involved in technological endeavour to create products, systems, buildings, landscapes etc.

Curriculum Level 6
Demonstrate understandings of basic issues in design.

Basic issues focus on what is design? and what is good design? Understandings of basic issues include:

- What is design?
  - Design as a verb/design as a noun. ("Design is the term we use to describe both the process and the result of giving tangible form to human ideas.
  - Different views of design – contemporary understandings explored. For e.g. design doesn't just contribute to the quality of life; design, in many ways, now constitutes the quality of life.") **(Peter Lawrence,** founder, Corporate Design Foundation)
- What is 'good' design?
  - Designing pulls together subjective and objective considerations to take human ideas into 'made' outcomes.
  - Subjective considerations are those linked to aesthetics (where aesthetics is understood as it relates to all human senses/sensibilities)
  - Objective considerations are those that can be established in a quantifiable sense
  - Differing opinions about the value of particular designs arise due to differences in how subjective and objective considerations are prioritised.
  - However, designs can be evaluated as 'good' or 'bad' in terms of how they bring together form, function, cost and contextual understandings. ("design is not just about how a thing looks or how it works; it is also about the assumptions on which it rests." Hall, 2009 http://www.metropolismag.com/story/20090318/a-good-argument)

Curriculum Level 7
Demonstrate understandings of advanced issues in design.

Advanced issues focus on sustainability and innovation as currently experienced/understood. Understandings of advanced issues include:

- Designing for lifecycle
  - What does designing for lifecycle mean?
  - What additional considerations are required when designing for lifecycle (e.g. those related to accessing materials/ongoing maintenance and disposal)
  - Implications of additional considerations on how any design can be judged as 'good' or 'bad'.
- The nature of innovative designing
  - What is innovative design?
  - What can inspire innovative ideas – understandings developed through analysing historical and contemporary innovations to identify inspirational drivers –

previous designs (within a similar and dissimilar range of outcomes), art, nature, literature, attitudes, etc.
- What types of things enable innovative designing – (e.g. what environmental factors have been found to support innovation)

Curriculum Level 8

Demonstrate understandings of complex issues in design.

Complex issues focus on future focused themes such as innovative designing for sustainable futures, and principles for good design. Understandings of complex issues include:

- Innovative designing for sustainable futures
  - Possible and probable future scenarios
  - Reliability of projections based on uncertainty
  - Means of mitigating risk through employing currently accepted principles of design
- Principles of good design
  - What are good models of design recognized by design professionals? (Teachers could look at competitions and galleries for examples. E.g. ID and Jerwood competitions. Look to recognized institutions and galleries.
  - Good design must be considered in terms of the application. Good principles differ for different applications. (Teachers could explore, compare and contrast examples of a range of contemporary principles of good design – (e.g. Rams - http://www.vitsoe.com/en/gb/about/dieterrams/gooddesign or Hall - http://www.metropolismag.com/story/20090318/what-is-good-design)
  - How do principles of good design respond to the uncertainty of the future?
  - How can we critique the result of design and design decision making? (e.g. use of analytical framework encompassing desirability, usability, experience, refinement and appreciation.)

DEMONSTRATE UNDERSTANDING OF THE CONCEPTS AND TECHNIQUES RELATED TO HUMAN FACTORS IN DESIGN.

This objective includes knowledge of how initial ideas regarding human factors are developed into designed outcomes; understandings of the difference between important subjective factors such as personal preference, styles and fashion; understandings from ergonomics and anthropometrics – enabling understanding of objective human factors; understandings of relationships between 'body, objects, materials and space' and 'people, products, structures, systems and environments', and the significance of ethical and socio-cultural contexts.

Curriculum Level 6

Demonstrate understandings of basic concepts and techniques related to human factors in design.

Basic concepts related to human factors in design include:

- How humans communicate, manipulate and refine initial design ideas into final designs
- What the terms personal preference, style, and fashion refer to, and how they differ to each other (subjective factors).
- Ergonomic factors in design - using 'economy of work' understandings and

formula to ensure a product, system or environment enables users to exert minimal work/experience minimal negative force (Objective factors).
- Anthropometric factors in design – using human body measurement data to ensure a product, system or environment 'fits' the body of intended users (Objective factors).

Basic techniques related to human factors in design include:
- Drawing as an analytical and idea generation tool
- Exploring personal preference through such things as story boards, theme boards, mood board, staged and reflective experiences etc
- Modification of existing patterns to ensure individualised fit
- Using ratios to calculate such things as rise and tread of stairs, kitchen layout – work triangle, chair dimensions etc

Understanding basic concepts and techniques would include explaining:
- Basic concepts
- Basic techniques (what the technique involves and how it works)
- When basic techniques would be suitable to use. This would include understandings of how contexts influence suitability.

Curriculum Level 7

Demonstrate understandings of advanced concepts and techniques related to human factors in design

Advanced concepts related to human factors in design include:
- Ethical and economic parameters as human factors
- Socio-cultural impacts on personal preference, style and fashion.
- The role of pattern making in enabling individualised 'fit'
- The role of statistics and probability in establishing guiding ratios and ergonomic aids

Advanced techniques related to human factors in design include:
- Using mannequins to create patterns for individualised fit
- Using ergonomes to establish spatial relationships between people, objects and environments
- Using rough mockups and test rigs to assess possible impacts on individuals
- Establishing personal preference using a range of survey questions and stimulus such as story boards, theme boards, mood boards, visualisation boards and other presentation aids, sensory testing.

Understanding advanced concepts and techniques would include explaining:
- Advanced concepts
- Advanced techniques (what the technique involves and how it works)
- When advanced techniques would be suitable to use. This would include understandings of relationships between 'body, objects, materials and space' and/or 'people, products, structures, systems and environments'.

Curriculum Level 8

Demonstrate understandings of complex concepts and techniques related to human factors in design.

Complex concepts related to human factors in design include:

- How personal preference, style and fashion can influence design decisions with positive/negative/unforeseen effects (e.g. fashion influences such as Sante Fe architecture (from desert environment) influencing NZ design (temperate/wet climate) leading to leaky buildings)
- Understanding relationships between body, materials and space and the implications for clothing and interior design
- Understanding relationships between people, objects, materials, structures and environments and the implications for designed environments (including safety and physical and emotional comfort).

The complex techniques related to human factors in design. Complex techniques include:

- Digitised body scanning to create digitised patterns for ease of manipulation and enhanced accuracy of fit
- Modelling to explore and establish potential design applications
- Analytical techniques to determine style and fashion influences and impacts.
- Computer aided techniques to explore and analyse subjective and objective relationships between body, materials and space.
- Computer aided techniques to explore and analyse subjective and objective relationships between people, objects, materials, structures and environments.

Understanding complex concepts and techniques would include explaining:

- Complex concepts
- Complex techniques (what the technique involves and how it works)
- When complex technique would be suitable to use. This would include understandings of relationships between 'body, objects, materials and space' and/or 'people, products, structures, systems and environments' and the significance of ethical and socio-cultural contexts.

GRAPHICS

DEMONSTRATE UNDERSTANDING OF CONCEPTS AND PRACTICES RELATED TO GRAPHIC DESIGN

Curriculum Level 7

Gain knowledge of design principles and approaches and influential designers

Demonstrates knowledge of the work of influential designers and their practice;

- Understand that graphics practice involves the selection of processes and techniques when generating and developing design ideas
- demonstrates understandings of the two principles of design (aesthetics and function) and of their derived elements;

Curriculum Level 7

Gain knowledge of design heritage and specialist fields.

Demonstrates knowledge of design movements or eras (including designers);

- Understand that graphics practice involves the selection and adaptation of processes and techniques when generating and developing design ideas
- demonstrates understandings of specialist design knowledge within design fields (spatial and product);

Curriculum Level 8

Gain knowledge of the nature of design.

Develops and justifies a personal view of design that demonstrates understanding of the interactions between design and the world;

DEMONSTRATE COMPETENCY IN DRAWING TECHNIQUES FOR VISUAL COMMUNICATION

Curriculum Level 6

Gain knowledge and skills in fundamental drawing techniques

Demonstrates:

- competency in fundamental 3D drawing techniques (e.g., oblique, isometric, and planometric, which includes freehand and/or instrumental)
- competency in fundamental 2D drawing techniques (e.g., multi-view orthographic, hidden detail, surface development, and geometric construction, which includes freehand and/or instrumental)
- understanding of how media and drawing equipment are key for presentation.

Curriculum Level 7

Gain knowledge and skills in complex drawing techniques and in presenting visual information

Demonstrates:

- competency in complex 3D drawing techniques (e.g., one- and two-point perspective projection and isometric projection, which includes freehand and/or instrumental);
    - Demonstrates competency in complex 2D drawing techniques (e.g., auxiliary views, sectional views, and assembly, which includes freehand and/or instrumental).
    - Demonstrates understanding of how media, drawing equipment and layout are key for effective presentation.

Curriculum Level 8

Gain knowledge and skills in synthesising and organising visual information for effective presentation

- Understand the organisation and selection of 2D and 3D drawing techniques to effectively communicate complex and high quality visual information;
- Demonstrates understanding of how composite techniques present layers of visual information

DEMONSTRATE ABILITY TO UNDERTAKE GRAPHICS PRACTICE TO PRESENT A CONCEPTUAL OUTCOME.

Curriculum Level 6

Apply drawing and design knowledge and techniques to visually communicate the development of design ideas and present a conceptual outcome to address a brief

- Applies Design knowledge and Drawing techniques to address a brief;
- Generates, develops and communicates design ideas informed by research and testing;
- incorporates qualitative judgements in the development and ongoing evaluation of a conceptual outcome
- presents a conceptual outcome to an audience
- evaluate the conceptual outcome against the brief informed by feedback

Curriculum Level 7

Select and apply drawing and design knowledge and techniques to visually communicate the development of design ideas and the presentation of a conceptual outcome to address a brief

- selects and applies Design knowledge and Drawing techniques to address a brief;
- Generates, develops and communicates design ideas informed by appropriate research and relevant testing;
- incorporates relevant qualitative judgements in the development and ongoing evaluation of a conceptual outcome
- presentation of a conceptual outcome to a target audience
- evaluate the conceptual outcome's potential fitness for purpose against the brief informed by feedback

Curriculum Level 8

Integrate drawing and design knowledge and techniques to visually communicate the development of design ideas and the presentation of a conceptual outcome to address a brief

- integrates Design knowledge and Drawing techniques to address a brief;
- Generates, develops and communicates design ideas analysed and informed by in-depth research and testing;
- selects appropriate qualitative judgements that inform the development and ongoing evaluation of a conceptual outcome
- presentation that promotes a conceptual outcome(s) to a target audience
- justify the conceptual outcome's potential fitness for purpose against the brief informed by feedback

PRESERVATION, PACKAGING AND STORAGE

DEMONSTRATE UNDERSTANDING OF CONCEPTS AND TECHNIQUES USED IN THE PRESERVATION, PACKAGING AND STORAGE OF PRODUCTS

Curriculum Level 6

Demonstrate understandings of basic concepts and techniques used in the preservation, packaging and storage of products

Basic concepts involved in preservation, packaging and storage of products include:

- Why we need to preserve/package/store products in terms to maintain product integrity over time.
- How (principles upon which they are based) preserving/packaging/storing ensure products maintain integrity over time and in a known environment (such as the home).

Basic techniques involved in preservation, packaging and storage of products include:

- Air chilling
- Air and plate freezing
- Air drying of solids
- Heating
- Chemical additives
- Basic containers for hygiene, containment - protection from cross contamination.
- Weight loss prevention (moisture barriers)
- Bottling
- Filling
- Labelling for mandatory purposes

Understanding basic concepts and techniques would include explaining:

- Basic concepts
- Basic techniques (what the technique involves and how it works)
- When basic techniques would be suitable to use. This would include understanding the properties and implications of the materials used in the product and what is required of the product in terms of withstanding changes of time and environment.

Curriculum Level 7

Demonstrate understandings of advanced concepts and techniques used in the preservation, packaging and storage of products

Advanced concepts involved in preservation, packaging and storage of products include:

- The type of changes needed in the preservation/packaging/storage of products to withstand changing environments and/or over extended times (e.g. preservation during transportation, storage in warehouses, packaging for safe handling etc.)
- How (principles upon which they are based) preserving/packaging/storing ensure products maintain integrity over extended times and variable physical environments.
- The implications of, and for, global markets for the preservation/packaging/storage of products.

Advanced techniques involved in preservation, packaging and storage of products include:

- Spray drying of liquids
- Canning, retortable pouches
- Shelf-life/storage temperature trade-off
- Intermediate moisture (e.g. high sugar)
- Gas flush packages
- Controlled atmosphere storage
- Sealing mechanisms
- Ultra violet reaction inhibition
- Permeable packaging films
- Liquid immersion freezing and chilling

- Portion control
- Labelling for point of difference (eco, heart tick, etc)

Understanding advanced concepts and techniques would include explaining:

- Advanced concepts
- Advanced techniques (what the technique involves and how it works)
- When advanced techniques would be suitable to use. This would include understanding the properties and implications of the materials used in the product and what is required of the product in terms of withstanding significant changes of time and environmental conditions.

Curriculum Level 8

Demonstrate understandings of complex concepts and techniques used in the preservation, packaging and storage of products

Complex concepts involved in preservation, packaging and storage of products include:

- How preservation, packaging and storage of products have been influenced by changes in distribution chains. This includes ways products can be made suitable for a range of consumers who may live in different political and social environments to where the product originated.
- How (principles upon which they are based) preserving/packaging/storing ensure products maintain integrity over extended times and variable physical, social and political environments.
- How the preservation/packaging/storage of products has changed cultures/society (needs, desires, the way life is experienced) in the past and present and how they may change cultures/society in the probable future.

Complex techniques involved in preservation, packaging and storage of products include:

- Crush protection
- Freeze-drying
- UHT sterilisation
- Aseptic filling
- Irradiation
- High Pressure sterilisation
- Modified atmosphere packs
- Accelerated storage life trials
- Cryogenic freezing
- Dosage control
- Brand value packaging

Understanding complex concepts and techniques would include explaining:

- Complex concepts
- Complex techniques (what the technique involves and how it works)
- When complex techniques would be suitable to use. This would include understanding the properties and implications of the materials used in the product and what is required of the product in terms of complex distribution chains. That is withstanding significant changes of time and environmental conditions including changing social, cultural and ethical dimensions.

PROCESSING

DEMONSTRATE UNDERSTANDING OF TECHNIQUES USED TO PROCESS MATERIALS

NB: Materials in this objective is inclusive of any substance to be processed – often referred to as a raw material or an ingredient. It is expected this objective would be suitable for use in food, chemical technology, biotechnology, agritechnology and textile contexts within secondary schools. This objective includes consideration of the primary production of materials.

Curriculum Level 6

Demonstrate understanding of basic techniques involved in processing materials

Basic techniques involved in processing materials to develop and/or manufacture a product include techniques associated with:

- **mixing** such as
  - batch liquid mixing,
  - batch powder blending
- **separating** such as
  - filtration, sieving,
  - crystalisation
  - washing
- **heating/cooling** such as
  - batch liquid heating
  - heating a solid
- **sizing/structuring/forming** such as
  - grinding, slicing, dicing,
  - felting, moulding, pleating,
  - laminating
- **transporting** such as
  - simple pumping
  - conveying
- **sampling/testing** such as
  - sample heterogeneous materials,
  - testing for PH, colour, size, mass
- **reacting** such as
  - acidification, enzymatic browning control, mechanical cleaning
- **process integration** such as
  - outlining composition and method

Understanding basic techniques would include explaining:

- Basic techniques (what the technique involves and how it works)
- How materials have changed due to the technique
- When the technique would be suitable to use

Curriculum Level 7

Demonstrate understanding of advanced techniques involved in processing materials

Advanced techniques involved in processing materials to develop and/or manufacture a product include techniques associated with:

- **mixing** such as
  - emulsification
  - enrobing
  - dyeing
- **separating** such as
  - centrifugation/cyclones,
  - adsorption
  - gravity settling
  - leaching
- **heating/cooling** such as
  - melting
  - setting
  - steaming
- **sizing/structuring/forming** such as
  - precision/laser cutting
  - aggregation,
  - granulation
  - fibre making
- **transporting** such as
  - air conveying
  - simple piping
- **sampling/testing** such as
  - testing for viscosity, density, surface structure
- **reacting** such as
  - fermentation
  - non-enzymatic browning control
  - chemical cleaning
- **process integration** such as
  - flow charting – block diagrams
  - HACCP/HAZAN procedures for high risk

Understanding advanced techniques would include explaining:
- Advanced techniques (what the technique involves and how it works)
- How materials have changed due to the technique
- When the technique would be suitable to use

Curriculum Level 8
Demonstrate understanding of complex techniques involved in processing materials

Complex techniques involved in processing materials to develop and/or manufacture a product include techniques associated with:
- **mixing** such as
  - coating,
  - encapsulation
  - surface modification, resurfacing
- **separating** such as
  - membrane (UF/RO/MF)
  - electrical charge
  - distillation

        - gas absorption
        - liquid/liquid extraction
    - **heating/cooling** such as
        - microwaving
        - frost protection
        - scraped/wiped surfaces
    - **sizing/structuring/forming** such as
        - extrusion/pultrusion,
        - printing, imprinting,
        - lamination, pleating
    - **transporting** such as
        - metering/filling,
        - pump and pipe combination
    - **sampling/testing** such as
        - plating/typing organisms
        - strength/performance testing
    - **reacting** such as
        - enzymes as tools/catalysts
        - enzymatic cleaning
    - **process integration** such as
        - flow charting – process symbols
        - comprehensive HACCP/HAZAN procedures
        - mass balance.

Understanding complex techniques would include explaining:

- Complex techniques (what the technique involves and how it works)
- How materials have changed due to the technique
- When the technique would be suitable to use

IMPLEMENT PROCESSES TO MAKE A PRODUCT

It is expected this objective would be suitable for use in food, chemical technology, biotechnology, agritechnology and textile contexts within secondary schools.

Curriculum Level 6

Implement basic processes to make a product

Basic processes are those that require the student to perform a linear sequence of operations (carrying out techniques as instructed, including measuring) to make a product. The specifications of the product, the materials to be processed, and a step-by-step guide of operations required to be undertaken, will all be provided to the student.

Examples that could be used that would require students to demonstrate basic processes include:

- Making and storing a fermented beverage
- Making and packaging soap
- Making and labelling a cleaning agent
- Undertaking plant propagation and storage
- Creating a felted product
- Dyeing fibres and weaving into a new fabric

Curriculum Level 7

Implement advanced processes to make a product

Advanced processes are those that require the student to perform a range of operations involving parallel processing (requiring scheduling of techniques, and accurate measuring) to ensure a successful product. The specifications of the product, the materials to be processed and the techniques to be undertaken, will be provided to the student, but timing of the range of operations to be undertaken will not be provided.

Examples that could be used that would require students to demonstrate advanced processes include:

- Establishing a worm farm for the ongoing provision of specified products
- Creating a frozen prepared meal with specified nutritional value
- Making and packaging a health product (topical application to comply with school codes) with guaranteed concentration of ingredients
- Making a filled enrobed biscuit.
- Making a textile garment with guaranteed proportions of fibre types
- Fabricating new textiles from divergent raw materials

Curriculum Level 8

Implement complex processes to make a product

Complex processes are those that require the student to perform a diverse range of operations involving parallel processing and feedback (requiring scheduling and carrying out techniques as based on results of measuring/testing) to achieve a successful product. The specifications of the product, the starting materials to be processed and initial techniques will be provided to the student, but any additional techniques required and the timing of all operations will be determined by feedback gained by the student as they work towards making the product.

Examples that could be used that would require students to demonstrate complex processes include:

- Making and packaging a 'medium risk food' product (would include pulling together range of more sophisticated HACCP related techniques)
- Making and storing a 'functional' food product (would need to include testing techniques to determine nutritional value over shelf life, safety assurance techniques etc)
- Creating and labelling a biological control product (would need to include efficacy testing techniques, ethical techniques)
- Making multiple food products of the same shape, colour, texture and measurable nutritional value.
- Making a thermal blanket (an enhanced textile product with increased function) (would need to include the manipulation and/or creation of materials, efficacy testing techniques)
- Making and protecting an upholstered product (demonstrating competency in resurfacing fabrics and the use of specialized fibres).

MANUFACTURING

DEMONSTRATE UNDERSTANDING OF MODERN MANUFACTURING PHILOSOPHIES, STRUCTURES, TECHNIQUES AND TOOLS.

Curriculum Level 6

Demonstrate understanding of basic manufacturing concepts and techniques

Basic concepts involved in manufacturing include:

- There are three divisions of manufacturing – Heavy, Light and Hi-tech
  - Heavy manufacturing has a high raw material reliance – normally geographically constrained to source, e.g. refinement of minerals or smelting of metals. Not so relevant to NZ
  - Light and High-tech manufacturing is less constrained by location as they have a lower reliance on raw materials, resulting in low weight/high value products, which are easier to transport. These are very relevant to NZ
- There are different types of manufacturing systems including custom manufacturing, intermittent and batch manufacturing, continuous manufacturing and flexible manufacturing.
  - One-off custom design manufacturing aims to create a single unique product.
  - Intermittent manufacturing allows for multiple copies of the same product to be created.
  - Continuous manufacturing is also know as 'assembly line manufacture' and usually is developed to produce multiple copies of the same product through an approach where parts of the product are completed by different people at different stations.
  - Flexible manufacturing uses computer controlled machines to 'assemble' products.
  - Batch manufacturing is where different parts of a product are produced in discrete runs or lots.
- The concepts of standardization, tolerance and quality control in mass production.

Basic techniques involved in manufacturing include techniques that do not deal with change over time, but are associated with:

- communicating production processes via flow diagrams
- predicting and calculating yield
- calculating efficiency and productivity

Understanding basic concepts and techniques would include explaining:

- Basic concepts
- Basic techniques (what the technique involves and how it works)
- When basic techniques would be suitable to use.

Curriculum Level 7

Demonstrate understanding of advanced manufacturing concepts and techniques

Advanced concepts involved in manufacturing include:

- The factory as a system – matching purpose with manufacturing division and type
- The impact of computer numerical controlled (CNC) machine tools, electronics assembly;

automation and control.

- Safety and risk issues in manufacturing – in terms of workers, customers and the wider society.
- The advances in mass customisation - the use of flexible computer-aided manufacturing systems to produce custom output. Such systems combine the low unit costs of mass production processes with the flexibility of individual customisation. "Mass Customization" is the new frontier in business competition for both manufacturing and service industries. At its core is a tremendous increase in variety and customization without a corresponding increase in costs. At its limit, it is the mass production of individually customized goods and services. At its best, it provides strategic advantage and economic value. (http://en.wikipedia.org/wiki/Mass_customization) Mass Customization is the method of "effectively postponing the task of differentiating a product for a specific customer until the latest possible point in the supply network." (Chase, Jacobs & Aquilano 2006, p. 419)
- Total quality management (TQM) - a manufacturing process to help improve your businesses processes, including your manufacturing processes. TQM is designed to help make your manufacturing better by making it more efficient and improving the quality of the manufactured products and processes. Focuses on 8 elements to do this:
  - Ethics
  - Integrity
  - Trust
  - Teamwork
  - Training
  - Leadership
  - Communication
  - Recognition

Advanced techniques involved in manufacturing include:

- Total quality management (TQM) techniques that ensure safe/ethical/efficient accessing, handling and disposal of materials within manufacturing plans aimed at managing quality and change over time.
  - Pareto chart – improve overall quality
  - Process mapping and flow charting to aid analysis– improve manufacturing processes
  - Force field analysis to identify forces that can help or hinder manufacturing plants from achieving success in changing or improving processes.

Understanding advanced concepts and techniques would include explaining:

- Advanced concepts
- Advanced techniques (what the technique involves and how it works)
- When advanced techniques would be suitable to use.

<u>Curriculum Level 8</u>

Demonstrate understanding of complex manufacturing concepts and techniques

Complex concepts involved in manufacturing include:

- Understanding manufacturing philosophies and associated strategies.
  - How competitive or lean and 'continuous improvement' manufacturing ideals and

sustainable/ecologically aligned strategies are linked to specific techniques and tools – e.g. design for disassembly and recycling.

- Six sigma as an alternative quality management approach when implementing lean manufacturing.
  (http://businessknowledgesource.com/manufacturing/six_sigma_an_overview_028548.html#more)
  - Both Six sigma and TQM aim are designed to improve product quality by improving your business processes - eliminating defects from products and manufacturing processes.
  - Six sigma looks at improving quality standards, not just improving compliance to them as in TQM. The definition of quality within six sigma methodology is derived from customer consideration of the value of products and the manufacturing processes.
  - In six sigma data is extremely important. Numbers, ratios, percentages and other data are what drives the entire system. The theory is that the data can reveal the defects in the process and steps can be taken to improve. The use of statistics is important as calculations for improvement are derived from statistical representations of how a process is performing.
- Designing manufacturing processes for consumers, industrial markets, and future scenarios.
  - The factory as a dynamic place – how the rise of practical artificial intelligence has impacted on philosophies and strategies. (e.g understandings of mechatronics and robotics; machine vision.)
  - Whole process systems – e.g. milk powder manufacture, pulp and paper, brewing, urea from gas.
  - Globalisation, value chains and green manufacturing

Complex techniques involved in manufacturing include:

- Techniques associated with handling the dynamic nature of manufacturing for changing and unknown futures.
  - Programmable logic control (PLC) and Supervisory Control and Data Acquisition (SCADA) control systems.
  - Rapid prototyping, lithographic techniques.
- Techniques associated with six sigma methodology
  - DMAIC process (define, measure, analyze, improve, control) - an improvement system for existing processes that fall below what an acceptable expectation is and that can be improved incrementally.
  - DMADV process (define, measure, analyze, design, verify) - an improvement system used to develop new processes or products, rather than simply fixing existing substandard processes. It can also be employed if a current process requires a complete change and reinstatement of a new process is required.

Understanding complex concepts and techniques would include explaining:

- Complex concepts
- Complex techniques (what the technique involves and how it works)
- When complex techniques would be suitable to use.

STRUCTURES AND MACHINES

DEMONSTRATE UNDERSTANDING OF STRUCTURES AND MACHINES

Curriculum Level 6

Demonstrate understandings of basic structures and machines

Understandings of basic structures include:

- Knowing that capacity≥load
- Knowing the causes and effects of internal forces within structures. That is the relationships between tension, compression, bending, shear and torsion and material suitability.
- Knowing about load paths for gravity loads.
- Understanding the difference between pinned and fixed joints
- Identifying structural elements that allow for stability associated with gravity load (equilibrium of vertical forces only).
    - Posts, beams and pin joints

Understandings of basic machines include:

- Identifying the three types of machines - lever, inclined plane and screw.
- Knowing how machines alter forces, work (energy) and motion
    - Lever - increase/decreases force while decreasing/increasing range of movement
    - Inclined plane - changes kinetic energy to potential energy or vice versa
    - Screw - changes linear to rotational movement or vice versa

Curriculum Level 7

Demonstrate understandings of advanced structures and machines

Understandings of advanced structures include:

- Understanding of loads as vectors – having a magnitude and direction
- Understanding bending as a product of distance and force.
- Knowing about load paths for wind and earthquakes separately for determinant (pin jointed) structures)
- how wind and earthquakes result in lateral loads and how these impact on structures.
- Describing types of determinant (pin jointed) structural systems (systems of combined structural elements) and how these systems work together to resist load to allow for stability (equilibrium of horizontal vertical and forces separately)
    - Bracing systems and pin joints

Understandings of advanced machines include:

- Describing how simple machines make up compound machines
    - E.g Lifting devices – cranes and hoists, piano keyboard, bicycles etc
    - Understanding relationships between the mechanical advantage of compound machines and their components
    - Knowing that mechanical advantage is the magnitude by which the required force is reduced.
- Describing the purpose of bearings and gears
    - Bearings allow constrained relative motion between two or more parts
    - Gears change the speed and/or direction of transmitted motion.

- Describing types of bearings and gears and how they work within compound machines.
- Describing how pneumatic and hydraulic machinery use gas/fluid respectively to transfer and alter forces and motion.

Curriculum Level 8

Demonstrate understandings of complex structures and machines

Understandings of complex structures include:

- Knowing about structural dynamics and how earthquakes impact as a dynamic load.
- Knowing about dynamic load paths.
  - How dynamic loads act differently on a structure compared to static loads
- Understanding systems that can resist both lateral and vertical loads
  - How gravity and lateral loads are resisted by separate determinant systems
  - Portal frames, cantilevers and fixed joints
- Knowing about material choice and structural system selection
  - Understanding the role of ductile and elastic materials
  - Understanding the role of composites e.g. reinforced concrete, fibreglass etc
  - Understandings of the relationship between stiffness and earthquake loads.
  - Understanding of how pinned or fixed joints are made in different materials

Understandings of complex machines include:

- Explaining how different motors/engines (energy driven machines) work
  - Electric motors - converting electrical energy to motion, (or generators vice versa)
  - Steam engines and turbines - use pressure developed by heating water to produce reciprocating or rotational motion
  - Gas turbines - use pressure developed by combustion to produce rotational motion and/or thrust
  - Internal combustion engines – converting potential energy in fuel by releasing heat in chemical reaction to reciprocating and hence rotational motion
- Describing the importance of cooling in heat engines.
- Explaining machines that comprise of combinations of machine types and mechanical systems for overall function.
  - E.g. pumps/fans etc
- Explaining how efficiency of energy driven machine function can be increased as based on combustion efficiency, friction losses (effect of lubrication), and transmission losses.

CONSTRUCTION

DEMONSTRATE UNDERSTANDING OF TECHNIQUES USED TO BUILD OR MAKE OBJECTS

(where objects include products, devices, structures, garments, furnishings etc)

NB It is expected this objective would be suitable for use in 'resistant' and 'flexible' material contexts.

Curriculum Level 6

Demonstrate understanding of basic techniques used to build or make objects

(Where objects include products devices, structures, garments, furnishings etc)

Basic techniques involved in building or making an object include those associated with:

- **Measuring/pattern making** such as
  - Techniques associated with measuring - marking out, using tape, rulers, calipers
  - Techniques for using and modifying existing patterns – layout, transfer of markings
- **Sizing/shaping/forming** - basic techniques focused on removing bulk amounts - and other techniques requiring limited control and accuracy, such as
  - Use of a lathe - single axis (facing, parallel turning, taper turning, drilling, knurling)
  - Milling (rebate/slot),
  - Sawing, chiseling, filing, cutting (scissors, snips, guillotine etc)
  - Laminating,
  - Basic folding
  - Knitting, knotting, looping, weaving like fibres
  - Pleating, tucking, gathering, smocking, structural seams
- **Joining/ Assembly** such as
  - Gluing, clamping
  - Stapling, nailing, screwing, bolting
  - Soldering (soft and hard i.e. braze, silver solder, lead/tin),
  - Using a jig
  - Seaming
  - Fusing
- **Finishing** such as
  - Dyeing, simple printing
  - Brushing, tentering
  - Foiling, embossing
  - Painting, oiling, staining
  - Buffing, polishing

Understanding basic techniques would include explaining:
- Basic techniques (what the technique involves and how it works)
- The impact of the technique on materials involved
- When the technique would be suitable to use

Curriculum Level 7

Demonstrate understanding of advanced techniques used to build or make objects
(Where objects include product,s devices, structures, garments, furnishings etc)

Advanced techniques involved in building or making an object include those associated with:
- **Measuring/pattern making** such as
  - Techniques associated with measuring area and volume
  - Techniques associated with creating flat patterns
- **Sizing/shaping/forming** - advanced techniques focused on removing and retaining material, and other techniques requiring medium levels of control and accuracy, such as
  - Set up a lathe
  - Use a lathe – combination of axis - (tapering, screw threading)
  - Milling (to create symmetrical shapes)
  - Gas/plasma cutting, routing
  - Tap and die
  - Advanced folding

        - Inlaying
        - Weaving unlike fibres
    - **Joining/ Assembly** such as
        - Dovetailing
        - Welding – Gas and Arc
        - Setting up a jig
        - Fastening (for joining/connection)
        - Layering
        - Quilting
    - **Finishing** such as
        - Bull-nosing, beveling
        - Layered dyeing, screen printing
        - Application of protective coatings – single substance/purpose (waterproofing, UV protection, antioxidation etc)
        - Texturing for purpose

Understanding advanced techniques would include explaining:

- Advanced techniques (what the technique involves and how it works)
- The impact of the technique on materials involved
- When the technique would be suitable to use

Curriculum Level 8

Demonstrate understanding of advanced techniques used to build or make objects
(Where objects include products, devices, structures, garments, furnishings etc)

Complex techniques involved in building or making an object include those associated with:

- **Measuring/pattern making** such as
    - Complex pattern manipulation
    - Techniques associated with draped patterns
- **Sizing/shaping/forming** - complex techniques requiring high levels of control and accuracy/ specialised sizing/shaping/forming for 'assembly', such as
    - Compound machining/3D milling (to create organic/asymmetrical shapes)
    - Complex folding, bending
    - Casting
- **Joining/ Assembly** such as
    - Welding – MIG/TIG
    - Constructing a Jig
    - Fastening for structure (critical structural element)

Finishing such as

- Creating protective coatings – multiple substances/applications/purpose (e.g. powder coatings, annodising, galvonising, bluing)
- Embedding/reinforcing for purpose (structural, functional or aesthetic)

Understanding complex techniques would include explaining:

- Complex techniques (what the technique involves and how it works)
- The impact of the technique on materials involved
- When the technique would be suitable to use

IMPLEMENT PROCEDURES TO BUILD OR MAKE AN OBJECT

(where objects include products, devices, structures, garments, furnishings etc)
NB It is expected this objective would be suitable for use in 'resistant' and 'flexible' material contexts.

Curriculum Level 6
Implement basic procedures to build or make an object
(Where object include products devices, structures, garments, furnishings etc)

Basic procedures are those that require the student to perform a linear sequence of operations (carrying out techniques as instructed, including measuring) to make an object. The specifications of the object, the materials to be used, and a step-by-step guide of operations required to be undertaken, will all be provided to the student.

Examples that could be used that would require students to demonstrate basic procedures include:

- Making a sawhorse
- Turning a bowl on a lathe
- Building a skateboard
- Making parts and assembling a 'gadget'
- Modifying a pattern to make a fitted garment

Curriculum Level 7
Implement advanced procedures to build or make an object
(Where object include products devices, structures, garments, furnishings etc)

Advanced procedures are those that require the student to perform a range of operations involving parallel procedures (requiring scheduling of techniques, and accurate measuring) to ensure a successful object. The specifications of the object, the materials to be used, and the techniques to be undertaken will be provided to the student, but timing of the range of operations to be undertaken will not be provided.

Examples that could be used that would require students to demonstrate basic procedures include:

- Making a laminated chair
- Set up a lathe and making a mixed material object
- Making an electric guitar
- Building a recreational vehicle (land yacht etc)
- Making a surfboard
- Creating a pattern and making a tailored jacket

Curriculum Level 8
Implement complex procedures to build or make an object
(Where object include products devices, structures, garments, furnishings etc)

Complex procedures are those that require the student to perform a diverse range of operations involving parallel procedures and feedback (requiring scheduling and carrying out techniques as based on results of measuring/testing) to achieve a successful object. The specifications of the object, the starting materials to be used and initial techniques will be provided to the student,

but any additional techniques required and the timing of all operations will be determined by feedback gained by the student as they work towards making the object.

Examples that could be used that would require students to demonstrate basic procedures include:

- Set up a lathe to turn matching table legs
- Making an acoustic guitar
- Building a powered vehicle (powered by battery/simple motor)
- Recover a lounge suite ensuring it has anti-staining properties

ELECTRONICS

DEMONSTRATE AN UNDERSTANDING OF THE DEVICES, CONCEPTS AND STANDARDS UNDERLYING THE DESIGN AND CONSTRUCTION OF ELECTRONIC AND EMBEDDED SOFTWARE SYSTEMS.

Curriculum Level 6

Demonstrate an understanding of simple concepts and devices

Simple Concepts:

- Conductors & insulators
- Concept of Circuit
- Voltage, Current, Resistance
- Circuit and component symbols
- Simple schematics
- Input, process and output
- Programming language
- System design given scenario

Simple Devices-

- Recognition of and function of:
    - Simple components (e.g. battery, switch, resistor, LED etc)
    - Simple systems (voltage divider, transistor switch)
    - 'Kitset micros' e.g. lego, fisher-technic or simple PICAXE

Curriculum Level 7

Demonstrate an understanding of concepts and devices

Concepts:

- Power and heat dissipation
- n- and p-type semiconductor
- Time constant
- Schematics & layout diagrams Binary notation
- Amplification
- Truth tables
- Programme structure e.g. flow-charting
- Variables (analogue and digital)
    - System design given scenario
- Devices-

- Component function in situ (resistor, capacitor)
    - *Note: a component may differ in its function depending on how it is used in a circuit*
- Sensors/transducers
- Simple microcontrollers e.g. PICAXE

Curriculum Level 8

Demonstrate an understanding of more complex concepts and devices

More Complex Concepts:

- Conduction in semiconductor components (diode, npn transistor, LED)
- Signal processing (amplification, filtering)
- I2C and RS232
- Boolean logic (gates)
- Subroutines
- Macros
- System design given scenario

More Complex Devices-

- 555 in astable and monostable mode
- Opamps as inverting and noninverting amplifier
- Opamp as a comparator
- Component function in situ (diode, transistor)
- Microcontrollers e.g PICAXE, Atmel, Microchi

BE ABLE TO ASSEMBLE, PROGRAM, TEST, DEBUG AND MODIFY ELECTRONIC AND EMBEDDED SOFTWARE SYSTEMS

Curriculum Level 6

Be able to assemble, program, test, debug and modify simple electronic and embedded software systems

Simple systems:

- Projects involving basic components, sensors and a microcontroller

Project complexity:

- Simple programme based on basic commands and supplied programme structures
    - typically characterized by simple sequences, system responding to only one input at a time, fixed time delays, on or off states
- e.g. barrier arm- detect vehicle, push button, arm lifts, delay, motor reverses, arm drops, motor turns off.

Curriculum Level 7

Be able to assemble, program, test, debug and modify electronic and embedded software systems

Systems:

- Projects involving components, sensors and a microcontroller

Project complexity:

- Programme will employ modified programme structures increased range of commands,

stored variables, at least one subroutine
    - may include multiple sensors and the system may have to respond to combinations of sensor states
- e.g. dual elevator, two floors, four call buttons, call discrimination, motors on/off and reverse

Curriculum Level 8

Be able to assemble, program, test, debug and modify more complex electronic and embedded software systems

More complex systems:
- Projects involving more complex components, sensors, actuators and microcontrollers

Project complexity:
- Programme with several subroutines and variables and an extended range of commands
    - typically the system may have to prioritise its response to combinations of multiple sensor outputs
- e.g. three wind turbine wind farm, monitoring turbine temperature, wind speed and turbine speed and making the appropriate control response.

BE ABLE TO DESIGN, CONSTRUCT AND POPULATE FUNCTIONAL PCB CIRCUITS

Curriculum Level 6

Be able to design, construct and populate simple functional PCB circuits

Simple PCB circuits:
- Copper tape or basic CAD software for circuit layout
- Pen and etch boards
- Discrete components
- Soldering up

Fault-finding:
- visual inspection and voltmeter

Curriculum Level 7

Be able to design, construct and populate functional PCB circuits

PCB circuits:
- Basic CAD software circuit design tool
- Photo-etch or engraver technique
- Design with at least one device requiring multiple evenly and closely spaced pads and precise soldering
- Soldering up

Fault-finding:
- visual inspection and multimeter (voltmeter, continuity, component integrity)

Curriculum Level 8

Be able to design, construct and populate more complex functional PCB circuits

More complex PCB circuits:

- Fully functional CAD software circuit design tool
- Board may require advanced design such as clever routing, vias (or hole-through) to allow complex circuitry on a single-sided board
- Soldering up

Fault-finding:

- visual inspection, multimeter, oscilloscope, signal tracing (where appropriate)

BE ABLE TO DESIGN AND ANALYSE SYSTEMS TO SOLVE PROBLEMS USING ELECTRONIC AND SOFTWARE ELEMENTS

Curriculum Level 6

Be able to design and analyse systems to solve simple problems

Simple problems:

- Problems involving basic components, sensors and a microcontroller

Analysis:

- Voltage and current calculations for real applications e.g. simple series and parallel circuits, value of resistor needed with an LED etc

Problem complexity:

- Monitor two independent conditions
- Adjust one control variable
- System design through scenario- limited complexity e.g. circuit and programme to control bridge traffic lights.

Curriculum Level 7

Be able to design and analyse systems to solve problems

Problems:

- Problems involving components, sensors and a microcontroller

Analysis:

- Voltage and current calculations for real applications e.g. Power (IxV) for bulbs/ resistors, resistor values for a potential divider, amplification in a single transistor stage etc.
- Use of datasheets
- Interpret component markings and tolerances

Problem complexity:

- Monitor three interdependent conditions
- Adjust control variables
- System design through scenario- intermediate complexity e.g. circuit and programme to control simple elevator situation

Curriculum Level 8

Be able to design and analyse systems to solve more complex problems

More complex problems:

- Problems involving components, sensors, actuators and microcontrollers

Analysis:

- Time constant calculation e.g. for 555

- Amplification calculation e.g. for opamps
- Boolean logic (for gates)

Problem complexity:

- Monitor three interdependent conditions remotely
- Adjust one control variable remotely
- System design through scenario- increased complexity e.g. circuit and programme to control small wind farm

DIGITAL INFORMATION

DEMONSTRATE AN UNDERSTANDING OF THE ROLE OF DIGITAL TOOLS AND SYSTEMS FOR MANAGING INFORMATION.

Curriculum Level 6

Identify the role of digital tools and systems for managing information

The fundamental concepts of common software applications such as a word processor, spreadsheet, database, desk top publishing. [Note: students will be expected to have a reasonable level of digital literacy by year 11, and this will build on that background]

Curriculum Level 7

Be able to understand how data organisation tools and systems are integrated to manage complex information

For example:

- Web 2.0 tools
- Mail merge using spreadsheets and/or database with word processed document
- Common applications integrated into an electronic presentation

Curriculum Level 8

Demonstrate an appreciation of the field of information management and systems

- Knowing about the discipline of information management and systems
- Role of information systems in a functioning organisation system
- Management structures

BE ABLE TO USE DIGITAL TOOLS TO DESIGN AND CONSTRUCT SYSTEMS TO MANAGE INFORMATION FOR A SPECIFIC PURPOSE

Curriculum Level 6

Be able to competently, efficiently and responsibly use digital systems and tools to manage information

Includes:

- Appropriate document layout

- Formatting techniques
- File management

Curriculum Level 7

Be able to understand data organisation and management to design and construct systems for a specific purpose

For example:

- Common database models consisting of two related tables
- Data integrity techniques
- Templates
- Logical operators and functions
- Databases and web pages
- Integrated digital information
- Handle complex data

Curriculum Level 8

Be able to analyse, construct and develop integrated systems to manage information for a specific purpose

For example:

- Relational Databases
- Webservers
- Prediction and analysis using spreadsheets
- Creating styles and Table of Contents
- On-screen forms
- Macros
- Managing multiple worksheets
- Managing long documents
- SQL

DIGITAL INFRASTRUCTURE

DEMONSTRATE AN UNDERSTANDING OF DIGITAL INFRASTRUCTURE: HARDWARE, SOFTWARE, NETWORKS, AND THEIR COMPONENTS

Curriculum Level 6

Demonstrate an understanding of the function of common individual components of digital infrastructures

- Know the purpose and key characteristics of desktop computer components [PSU, motherboard, CPU, storage etc.]
- Know the purpose and key characteristics of simple storage devices [disks - magnetic and optical, solid state - RAM, flash etc.]
- Know the purpose and key characteristics of network components for a LAN [NIC, routers, cabling etc.]
- Know the purpose and key characteristics of system software [printer drivers, virus checkers, disk defrag, etc.]

Curriculum Level 7

Demonstrate an understanding of how the components of a digital infrastructure are connected and interact

- Understand the role of operating systems and their features that relate to configuration of components and networks (major operating systems including command-line systems, automatic configuration, drivers)
- Understand the characteristics of the physical connections of hardware components [e.g. buses, SATA, ethernet]
- Understand the role of common network and communication protocols and standards for desktop systems and local area networks [such as TCP/IP, DHCP, subnet masks, LAN technologies, USB, wireless]

Curriculum Level 8

Demonstrate a broad understanding of the structure and functioning of digital infrastructures, from personal systems to wide area networks

- Know the purpose and key characteristics of large-scale networks [e.g. internet, public wireless networks, phone networks] and a range of specialist devices [e.g. portable devices such as cellphones, PDAs, MP3 players, digital cameras etc. as they are used to connect to or transfer files from networks.]
- Understand the purpose of common network protocols, components and standards [e.g. TCP/IP, DHCP, subnet masks, OSI 7-layer model, LAN and WAN technologies, wireless systems, bluetooth, DNS, ISP], and advanced storage systems [e.g. SAN, RAID].
- Understand the purpose of virtualisation, emulation and cloud computing
- Understand security issues in networks
- Be aware of trends in computing, and the purpose, and limitations of hardware components, storage and network technologies, operating systems, and peripherals
- Understand issues surrounding upgrading and disposing of computing equipment [including increasing storage, upgrade vs. replace, and environmental issues with disposing of equipment]

BE ABLE TO DESIGN, AND EVALUATE THE PERFORMANCE OF, A DIGITAL INFRASTRUCTURE

Curriculum Level 6

Be able to choose components for a desktop computer for a specified purpose

- Choose components [e.g. memory capacity, graphics cards, peripherals] to have sufficient capacity to meet the needs of specified software

Curriculum Level 7

Be able to choose the components and parameters for a local area network for a specified purpose

- Choose network components and their parameters [e.g. LAN speed, routers/switches] to have sufficient capacity for a specified purpose [such as file sharing, file storage, shared services].

Curriculum Level 8

Be able to choose the components and topology of a network of computers and their access to a Wide Area Network

- Estimate the capacity of a design for a network of computers and their access to a Wide Area Network. [note: for example, estimate how many simultaneous streaming video feeds a network could support, or estimate the number of minutes of music that could be stored on a file system]

BE ABLE TO BUILD, CONFIGURE AND MAINTAIN DIGITAL HARDWARE AND NETWORKS, INCLUDING INSTALLING SOFTWARE

Curriculum Level 6

Be able to install and configure hardware components, software and peripherals for a desktop computer

- Installing software, hardware [e.g. disks, memory, video cards and drivers], and peripherals [e.g. webcams, printers]

Curriculum Level 7

Be able to install, configure and maintain hardware, software and networking components for a small Local Area Network

- Installing switches/routers [to the level of making minor parameter settings for a router]
- Configuring a server (print/file)
- Configure and maintain a small LAN to support given policies [e.g. file access, backup, user accounts – this would typically be on a dummy network]

Curriculum Level 8

Be able to install, configure and maintain hardware components, software and networking components for a network of computers and their access to a Wide Area Network

- Install software on a server [e.g. application server, web server, mail server]
- Able to install and configure firewalls
- Solve problems and maintain a computer/network/system, including providing help desk services to users. [e.g. resolving (fault finding and troubleshooting), documenting problems and communicating with users]

DIGITAL MEDIA

DEMONSTRATE AN UNDERSTANDING OF THE TYPES OF DIGITAL MEDIA, AND HOW THEY ARE CREATED.

Curriculum Level 6

Identify digital media types and describe their distinguishing characteristics

Understand the purpose of digital media tools including but not restricted to:

- Video production,
- Audio production,
- Layout and design,
- Graphics and images,
- Animation and modelling,
- Interactive media (eg. game design).
- Web development and design.

Curriculum Level 7

Understand characteristics of digital media types and explain what they can be used for.

Understand the need for standards compliant technology e.g.:

- layout conventions,
- mark-up language,
- w3 consortium,
- tags,
- accessibility standards.

Understand the importance of effective and appropriate file management procedures.

Curriculum Level 8

Understand the underlying standards and structures of digital media types.

Depending on the digital media:

- Investigate and identify a variety of content management systems for developing and maintaining websites
- Awareness of the digital tools /technologies of static, 2D and 3D graphics

BE ABLE TO CREATE AND PUBLISH A QUALITY DIGITAL MEDIA PRODUCT USING APPROPRIATE MEDIA TOOLS

Curriculum Level 6

Be able to confidently, efficiently and responsibly use digital media tools to create a quality digital media outcome

- Demonstrate technical expertise with digital media tools [at this level, expertise will be the measure of quality]
- Can apply an understanding of digital media to design and create a number of different outcomes using a variety of digital media technologies.
- Can interpret the needs of a situation to publish a successful and appropriate digital media outcome
- The digital media is introduced and explored in a variety of virtual situations.

Curriculum Level 7

Be able to use digital tools and techniques appropriate to the medium to create and publish a quality media project

- Can identify and apply the appropriate file management techniques required to successfully publish digital media content.
- Can input and manipulate and test digital media data to comply with current web standards or other digital media compliance requirements.
- Can apply the appropriate processes for media input, editing and publishing.
- The digital media can be used for a virtual solution or an incomplete real new or existing solution.

Curriculum Level 8

Be able to integrate multiple digital media types to publish a quality digital media product in a suitable output format.

Depending on the digital media:

- Can effectively separate content and styling features
- Can publish digital media in an appropriate format for the purpose
- Can install and manipulate webserver based digital media and the associated server side functionality and requirements.
- Can apply and test digital media to ensure that it is standards compliant.
- The digital media is real and can be practically applied to a new or existing situation.

PROGRAMMING AND COMPUTER SCIENCE

DEMONSTRATE AN UNDERSTANDING OF CONCEPTS ACROSS COMPUTER SCIENCE AND SOFTWARE ENGINEERING

Curriculum Level 6

Demonstrate an understanding of the distinguishing concepts of algorithms and programming languages from Computer Science and Software Engineering

- Understand the concept of an algorithm (vs. a program), and that there are different costs for different algorithms for the same task. {This could be illustrated with searching (linear and binary) and/or sorting.}
- Understand the Programming Language concepts of high level languages, machine languages, interpretation and compilation, and the idea that programming languages are precise.

Curriculum Level 7

Demonstrate an understanding of fundamental concepts across Computer Science and Software Engineering

- Appreciate the concepts of complexity, tractability and the notion of computability – the idea that some problems are inherently difficult or impossible to solve on a computer.
- Understand how coding for compression, error control or encryption enable remarkable technologies e.g.
    - mp3 players,
    - reliable storage and communication,
    - e-commerce

- Understand that programming languages can be specified using formal grammars or formal diagrams
- Understand the need for Software Engineering methodologies, and appreciate the steps in the Software Development Life cycle.

Curriculum Level 8

Demonstrate an appreciation of the field of Computer Science and Software Engineering

- Investigate defining questions and issues from a number of areas such as Algorithms and Complexity, Architecture, Discrete Structures, Graphics and Visual Computing, HCI, Information management, Intelligent systems, Net-centric Computing, Operating Systems, Programming Languages, Social and Professional Issues, Software Engineering.

BE ABLE TO UNDERSTAND, SELECT AND DESIGN DATA TYPES, DATA STRUCTURES, ALGORITHMS, AND PROGRAM STRUCTURES FOR A PROGRAM TO MEET SPECIFIED REQUIREMENTS, AND EVALUATE USER INTERFACES.

Curriculum Level 6

Be able to identify and select data types, and program structures for a program to meet specified requirements, and perform informal evaluation of user interfaces

- Be aware of primitive data types in the chosen programming language (e.g. integer, real, Boolean, character, string) and be able to select the appropriate one for a task.
- Understand sequence, selection and iteration.
- Be able to informally critique user interfaces [Note: informal means based on personal experience rather than using heuristics, but nevertheless making a clear explanation of the problem; for example, identify a frustrating user interface and explain why it was difficult to use]

Curriculum Level 7

Be able to understand and select data structures, design program structures for a program to meet specified requirements, and evaluate user interfaces

- Understand more advanced representations of data (such as arrays, lists or user-defined types), and select the appropriate data type or structure for a task.
- Understand and design programs with methods (or functions, procedures or subroutines as appropriate to the context)
- Be able to evaluate a Human-Computer interface in terms of simple usability heuristics [note: for example, Nielsen's usability heuristics would be a suitable framework to use]

Curriculum Level 8

Be able to understand and select data types, design data structures and program structures, and implement algorithms, for a program to meet specified requirements; and demonstrate an understanding of user interface evaluation

- Understand the properties and limitations of data types by understanding binary, decimal and hexadecimal representations, including floating point representations, simple binary arithmetic, and character representation.
- Design programs to manipulate data stored in arrays or lists.
- Understand and design programs with methods with parameters and return values (or

functions, procedures or subroutines as appropriate to the context).
- Be able to understand the concept of persistent data (such as files or a database) and program structures for interacting with them.
- Understand and apply Human-Computer Interaction principles (usability, design methodologies and models of interaction). [note: principles would normally be applied to the evaluation of existing interfaces, although students could design and evaluate their own simple interfaces]

BE ABLE TO READ, UNDERSTAND, WRITE, AND DEBUG SOFTWARE PROGRAMS USING AN APPROPRIATE PROGRAMMING LANGUAGE, TOOLS, AND SOFTWARE DEVELOPMENT PROCESS.

Curriculum Level 6

Be able to read, understand, write, and debug simple software programs

- Be able to develop a simple program using variables, expressions, selection, and loops.
- Be able to develop programs using meaningful variable names, appropriate layout and comments.

Curriculum Level 7

Be able to read, understand, write, and debug software programs using an appropriate programming language

- Be able to develop a program using variables, expressions, selection, loops and methods (or functions etc.).
- Use effective programming style including simple documentation (which may be comments in the program).
- Be able to test a simple program to identify errors and correct them.

Curriculum Level 8

Be able to read, understand, write, and debug software programs using a general purpose programming language, tools, and software development process

- Be able to carry out problem analysis for simple requirements
- Be able to develop a program using variables, expressions, selection, loops and methods (or functions etc.) to process data in files.
- Be able to use a software development tool for a general purpose programming language [note: only a simple tool is required e.g. Visual Studio (VB, etc.), BlueJay, Greenfoot, IDLE, simple IDE, etc. but not plain editor and command-line compiler]
- Be able to use a simple software development process, such as a simplified agile programming process with several cycles, test-driven development with separate testers