SHEAR PRECISION:

Technology activities to support the use of SOPI in schools

Ministry for Primary Industries
Manatū Ahu Matua

CONTENTS

CONNECTIONS TO THE NEW ZEALAND CURRICULUM

CURRICULUM PRINCIPLES

The learning activities in this resource have been developed to support these curriculum principles of The New Zealand Curriculum.

Learning to learn: Encourages students to reflect on their own learning processes and learn how to learn.

Community engagement: Enables students to connect to wider aspects of their lives, their families, whānau, and communities.

Coherence: Provides identified links across the learning areas of science, technology, social sciences, and mathematics and statistics to support students to make connections within and across learning areas.

Future focus: Encourages students to look to the future by exploring such significant future-focused issues as sustainability, enterprise, and globalisation.

ACHIEVEMENT OBJECTIVES

The learning activities in this resource support these technology achievement objectives of The New Zealand Curriculum:

Level 4

Nature of Technology

Characteristics of technology

Students will understand how technological development expands human possibilities and how technology draws on knowledge from a wide range of disciplines.

Characteristics of technological outcomes

Students will understand that technological outcomes can be interpreted in terms of how they might be used and by whom and that each has a proper function as well as possible alternative functions.

Technological Knowledge

Technological products

Students will understand that materials can be formed, manipulated, and/or transformed to enhance the fitness for purpose of a technological product.

Technological modelling

Students will understand how different forms of functional modelling are used to explore possibilities and to justify decision making and how prototyping can be used to justify refinement of technological outcomes.

Level 5

Nature of Technology

Characteristics of technology

Students will understand how people's perceptions and acceptance of technology impact on technological developments and how and why technological knowledge becomes codified.

Characteristics of technological outcomes

Students will understand that technological outcomes are fit for purpose in terms of time and context. Understand the concept of malfunction and how "failure" can inform future outcomes.

Technological Knowledge

Technological products

Students will understand how materials are selected, based on desired performance criteria.

Technological modelling

Students will understand how evidence, reasoning, and decision making in functional modelling contribute to the development of design concepts and how prototyping can be used to justify ongoing refinement of outcomes.

KEY COMPETENCIES

These learning activities provide opportunities for:

Thinking

- use creative and critical thinking processes to make sense of information, experiences, and ideas
- ask questions and challenge assumptions
- problem-solve by actively seeking and using knowledge.

Using language, symbols, and texts

- interpret and use number, images, movement, and technologies in a range of contexts
- develop resourcefulness
- confidently and competently use information technologies to access and provide information and to communicate with others.

Managing self

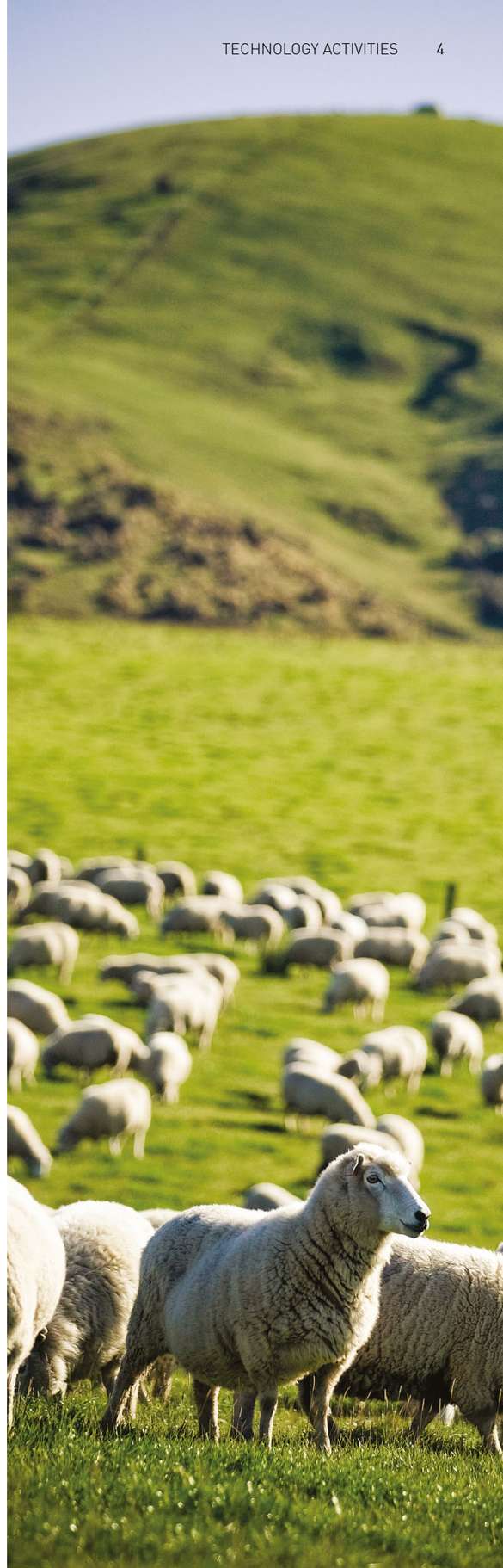
- develop a "can-do" attitude
- make plans, manage projects, and develop strategies for meeting challenges.

Relating to others

- listen actively, recognise different points of view, negotiate and share ideas
- cooperate, and work effectively with others
- come up with new approaches, ideas, and ways of thinking.

KEY UNDERSTANDINGS

- Wool is a major primary industry in New Zealand, which contributes $0.8 billion annually to our economy.
- The value of wool is determined by how it is formed, transformed, and manipulated into products that are valued by global markets.
- Wool has a range of natural properties that when exploited make it a unique and valuable resource.
- Technological innovation and creativity give us opportunities to add value to this natural product before selling it offshore.



TEACHING AND LEARNING PLAN

INTRODUCTION

The postcards of sheep, sheep keyrings, and woolly sheep ornaments that are popular in tourist shops throughout New Zealand exemplify how sheep farming is an iconic industry.

A few bags of wool sent from Wellington for sale in Sydney in 1835 heralded the beginning of the New Zealand wool industry. The wool was produced by a flock of merinos imported from New South Wales. Merinos were farmed extensively in Australia and thousands of these sheep were imported into New Zealand from the 1840s to the 1860s. Merinos, a Spanish breed, thrived in the arid high country of the South Island. They are typically bred for their wool rather than their meat.

As soon as the industry developed however, farmers had to change and adapt their practices to meet environmental conditions, new technology, and the requirements of overseas markets.

Merino sheep are unsuited to the wetter pastures of the lowland plains where they are at risk of developing footrot. The introduction of refrigerated cargo ships vastly increased the market value of meat. Meanwhile, fashion in the Northern Hemisphere led to a demand for long wool with much tensile strength that could be combed by machines without breaking. Prices for short, fine merino wool fell.

In response to these changing conditions farmers introduced new breeds of sheep, such as Romneys, and smaller farms became more viable.

Like all industries the wool industry has continued to change and adapt to political, social and technological change. Wool exports have continued as a significant contributor to the New Zealand economy despite changes in markets and the introduction of synthetic fibres.

Wool export prices are now at the highest level in five years and are expected to be stable for the next five years. In the year ending June 2016 wool exports earned $0.8 billion.

This resource introduces students to the New Zealand wool industry as an example of a primary industry which has huge potential to benefit from the application of technological innovation to add value to a product that this country grows well. These activities have been developed to be taught over several sessions.

The activities can be covered in any order and with any number of students. They can also be taught as individual activities.

FURTHER RESOURCES

- http://www.teara.govt.nz/en/meat-and-wool
- SOPI 2016
- http://www.mpi.govt.nz/funding-and-programmes/primary-growth-partnership/primary-growth-partnership-programmes/the-new-zealand-sheep-industry-transformation-project-nzstx/
- W3: Wool Unleashed https://www.mpi.govt.nz/funding-and-programmes/primary-growth-partnership/primary-growth-partnership-programmes/w3-wool-unleashed/

ACTIVITY 1:

PROCESSING WOOL

This activity is designed to give students experience handling and manipulating wool and trying out the basic, traditional processes required to process this primary product so that it serves particular functions.

The processes will have to be carried out over several sessions. It is likely that most students will have little experience processing wool so a focus on the exploratory nature of these activities is appropriate. Students who have knowledge or experience of the crafts of knitting or felting may choose to start out with a plan to produce a specific product, or students can develop their ideas as they work through these activities.

Obtain a supply of shorn wool from a local supplier. Your local farm supply store or NZ Young Farmers branch can help you to source a small supply. Each of these processes requires specific resources and tools, none of which are difficult to obtain. Consider inviting local crafters to work with your students as they have hands-on expertise to share.

Have the students separate into groups of 4 and allocate a small bundle of wool to each group. All groups will have to scour their wool first but may choose to dye it before or after carding.

There are many instructional videos available online that explain how to carry out these processes. Students can make practical decisions about how to adapt available materials to meet the requirements of each of the processes. Encourage the students to watch a range of videos to develop their ideas about ways they will perform these processes and the materials they will use.

WOOL PROCESSING ACTIVITIES

Scouring

Scouring is washing the fleece to remove the dirt and grease.

Materials required:
- Large plastic tub or basin
- Hot tap water
- Dish washing liquid
- Drying rack.

Instructions: http://bethsmithspinning.com/wool-scouring-simple-and-mostly-quick/

Blending and dyeing

Students can dye the wool to their chosen colours. They can experiment with natural dyes using plant materials, or with synthetic dyes.

Instructions: http://www.dyeyouryarn.com/fleece.html

Carding

Carding is combing the wool to remove any small pieces of vegetation and to align and straighten the wool to form "silvers", which are twisted into strands for spinning.

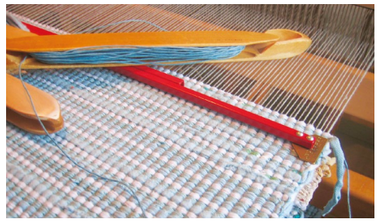
Materials required:
- Two hand carders

Instruction videos:
https://www.youtube.com/watch?v=paT3paR5odA
https://www.youtube.com/watch?v=mTT55C0VsME
https://www.youtube.com/watch?v=FDYmAcGKgsY

Spinning and twisting

Spinning is transforming the wool into yarn.

Invite a spinner from a student's family or whānau or from the local community to demonstrate spinning to the group and to give the students an opportunity to spin on a spinning wheel.



Fabric creation

Students can choose to knit, weave or felt their wool to produce a fabric. They can share their knowledge of these techniques with each other, invite local crafters to class to demonstrate techniques, or follow instructional videos.

FOCUS QUESTIONS

- Did different groups achieve different results for each process? If so, why?
- Did preparation and careful attention to detail result in an improved product?
- If you were to carry out these processes again, what would you do differently? Why?
- Compare the advantages and disadvantages of hand-crafted and machine-made fabrics.
- Compare the costs of handmade and machine-made products.

The groups can vlog their work as a record of the activities, with group members taking turns at videoing and reporting during each of the activities.

ACTIVITY 2:

EXPLORING THE PROPERTIES OF WOOL

Scout your local op shop and collect a range of woollen garments (hand knitted jerseys or hats, woollen blankets, used baby wear, fine singlets or shirts, carpet pieces) that students can cut up to examine the properties of wool.

The useful properties of wool include its durability, moisture and stain repellence, flame resistance, wrinkle resistance, and its ability to felt. This **fact sheet** explains the characteristics of wool.

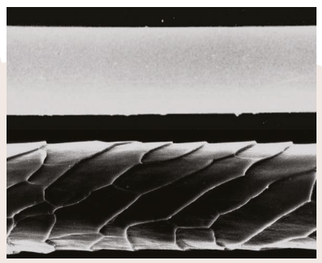
Group the students and have each group develop tests to explore one or two these properties. Tests should cover both subjective (look and feel) and objective characteristics.

Some tests (for example for comfort, warmth, or odour resistance) may need to take place over at least twelve hours. Wearing two socks of different materials over a day can make for good comparisons.

FOCUS QUESTIONS

- Did all the woollen fabrics perform uniformly in your tests?
- What differences in performance were evident? Can you account for these differences?
- What disadvantages of wool did you discover?
- What is a major difference between subjective and objective tests?

This article from the Science Learning Hub explains the properties of wool fibre and models the technical vocabulary that refers to and explains these properties. Prompt the students to use this vocabulary in their discussions.



Students can create graphics and take photographs to illustrate their test results.

VOCABULARY

apparel, coarse and smooth, fibre, yarn, staple, cuticle cells, crimp, texture, tensile strength, producer, merino, Romney, cross breed

EXTENSION ACTIVITY

Students can compare the performance of these woollen fabrics to those of an equivalent range of synthetic fabrics and fabrics that are composites of wool and synthetics.

RESOURCES

In this video from Technology Online, teacher Carol Rimmer talks about understanding the properties of wool and how they are exploited to create a range of products.

http://technology.tki.org.nz/Technology-in-the-NZC/Technological-knowledge/Technological-products/(tab)/Introduction

This excellent article from the Science Learning Hub about the properties of wool includes a short video explaining how different sheep breeds produce different types of wool that make them suitable for different products.

https://www.sciencelearn.org.nz/resources/875-wool-fibre-properties

ACTIVITY 3:

INVESTIGATING INNOVATIVE IDEAS AND FUTURES FOR WOOL

There is increased consumer awareness of the environmental and social costs of producing goods. This has led to increasing consumer demand for greater environmental sustainability, producer traceability, the ethical treatment of animals and quality working conditions for employees.

At the same time technology has enabled us to increase the production and range of products, leading to highly competitive global markets.

New Zealand producers and manufacturers have developed a range of successful initiatives that exploit the qualities of wool and add value to its products. Our scientists and technologists are engaged in a raft of projects to further develop practical uses and marketing opportunities for our wool.

Have the students in small groups or individually explore some of these initiatives. These may include but are not limited to:

- One of the most well-known is the Icebreaker brand of woollen apparel. http://pureadvantage.org/news/2011/08/11/icebreaker/
- Allbirds sneakers are another product developed to take advantage of the natural qualities of wool. https://www.allbirds.co.nz/pages/our-story
- Technology Online includes a case study of projects where masters' students in textile design are working on projects that include using wool waste, eco-friendly wool dyeing and digital embroidery. http://technology.tki.org.nz/Resources/Case-studies/Technologists-practice-case-studies/Resistant-materials-textiles/Developing-eco-friendly-fabrics

- Research into new uses for wool in medical and cosmetic products is being undertaken by Wool Industry Research Ltd. This project is co funded by the Wool Research Organisation of New Zealand and has received strong government investment.
  https://www.beehive.govt.nz/release/84-million-wool-research-partnership
  http://www.sciquest.org.nz/node/41846

FOCUS QUESTIONS

- What was the aim of the initiative?
- What was its target market?
- How were the primary producers (the farmers) involved?
- What attributes of wool did the products exploit?
- What qualities does wool add to the final product?
- Has consumer demand (sustainability, traceability) impacted on the work or product?
- How is the product marketed (where is it marketed, types of images used)?

ADDITIONAL RESOURCES

Hyundai Country Calendar Episode 29, 2016 Maniototo Merino introduces viewers to a high country merino farm where the farmers have developed an ongoing relationship with their Japanese wool buyers. The farm has also developed a small business producing soft wool baby blankets from their wool.

https://www.tvnz.co.nz/ondemand/country-calendar/series-2016 episode-29/01-10-2016

ACTIVITY 4:

CREATING A SMART WOOLLEN PRODUCT

In the future clothing and interior products will be incorporated with intelligent functions to improve people's health and safety or to provide more ready access to household functions or personal entertainment. Woollen textiles are an ideal medium for these "smart" functions.

Researchers are investigating ways that medical functions can be incorporated into clothing, while applications that improve or measure sports performance are now being promoted by manufacturers.

Students can carry out a design enquiry to support their understanding of these wearable technologies.

Background information about smart fibres is available from Technology online:
http://technology.tki.org.nz/Resources/Case-studies/Technologists-practice-case-studies/Resistant-materials-textiles/Smart-Fibres/Electronics

Have the students follow some research on the incorporation of smart technologies into fibres and on sewable electronics. **This report** on an innovative carpet embedded with LED lighting, which was displayed at the Venice Biennale, is a good starting point.

The 2017 C-Prize was focused on wearable technologies. C-Prize is a competition, run by Callaghan Innovation every two years, where competition entrants are challenged to come up with technology solutions that deliver solutions to real industry problems. http://www.cprize.nz/about-c-prize.

FOCUS QUESTIONS

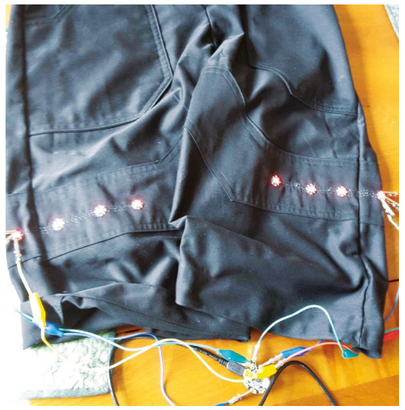
- Why would we add an electronic device to a garment?
- What is the purpose of the integration?
- What are the benefits or value to the wearer?
- Are there benefits to anybody else?

STUDENTS' DESIGN BRIEF

Wearable technology is an exciting, emerging area with the potential to be significant in the way we interact with clothing and electronic technology.

Develop a product that utilises wool textiles for a specific purpose, using digital technologies such as the **LilyPad system**.

- Explore the brief and note what you already know about the context.
- Analyse the practice of a technologist involved in innovative woollen textile design in the industry.
- Explore how emerging digital technologies, such as LEDS and connective thread, are being used in the design of woollen products.
- Explore how components are connected to create circuits.
- Present a one-minute overview of research findings to the class or group.
- Clearly explain what your big idea is and the specific area of need it addresses.
- Record in detail what you are going to make, why you are making it, who your clients are, and how your product fits the requirements of the brief.



IDEATION – Using functional modelling to evaluate ideas

- Develop a mood-board with images that convey the essence of your project.
- Use your research to produce several different ideas for your wearable technology product.
- Annotate your ideas and explain how each idea addresses the specifications of the brief and user requirements.
- Evaluate your initial ideas to assess which is the best idea to develop further.
- Develop your idea by modelling alligator clips to temporarily connect the LilyPad components and test the circuit/code.
- Sketch the diagram of the circuit layout to identify any problems or likely malfunctions in the design.

MANUFACTURING THE PRODUCT

Produce a working drawing, specification chart, and production flow chart that includes unit operations, risk factors, and quality control measures to illustrate the manufacture of the wearable technology.

EVALUATING THE PRODUCT

Write an evaluation to describe how well the wearable technology product meets the specifications of the brief. The evaluation could be formatted as a blog, a vlog, or a slide show.

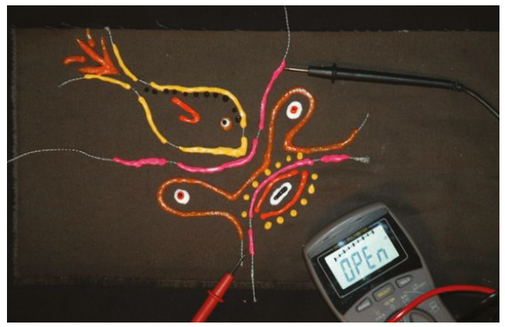
GLOSSARY OF TECHNICAL TERMS AND PROCESSES

Conductive thread – Textile yarn containing metallic elements such as silver or stainless steel. The metallic properties allow for the transmission of electrical signals.

Light emitting diodes (LEDs) – A semiconductor diode that converts applied voltage to light and is used in lamps and digital displays.

Microprocessor – An integrated computer circuit.

Smart fabrics – Textiles capable of sensing and responding to external stimuli, such as changes in light levels or temperature.



ADDITIONAL RESOURCES

Buxton, Jane. (2010). "Making clever clothes" in *Connected 1* 2010. This level 1 text is a useful introduction for students to the topic of smart textiles.