STEM Stage 6 – Science (Physics), Technology (Design and Technology), Engineering Studies, Mathematics (General) – *Wearable Technology*

Summary	Duration
Wearable technologies (also called wearable gadgets) are a category of technological devices that can be worn by a consumer. The miniaturisation of technological and electrical components is opening up a whole new market opportunity for the design of wearable technologies. Students are to undertake the design, development and prototyping process to create their own wearable gadget.	6 Weeks

Teacher background information

This unit is an example of the integration of Science, Technology, Engineering and Mathematics (STEM). The unit of work has a theme and focus which draws syllabus content, thinking and skills from all four KLA areas. Students will work collaboratively to research, design and develop a *Wearable Technology* and produce a prototype as well as a documentation folio.
Wearable technologies: https://www.wearable-technologies.com/

Key inquiry questions	Vocabulary
• How is *wearable technology* affecting our lives? • How is technology being applied to wearables? • What new materials are being developed that allow further development of *wearable technology*? • How can mathematical and scientific concepts be used to assist with developing informed design solutions?	ammeter, analysis, circuit, collaboration, components, criteria, device, electrical, electronic, experiment, interviews, investigate, law, miniaturisation, observation, ohms law, parallel, prototype, qualitative, quantitative, questionnaire, series, statistical, survey, technology, test, voltage, voltmeter

Outcomes

Physics
8.3 Electrical Energy in the Home
8.3.2 One of the main advantages of electricity is that it can be moved with comparative ease from one place to another through electric circuits
8.3.3 Series and parallel circuits serve different purposes in households
P7 describes the effects of energy transfers and energy transformations
P11 identifies and implements improvements to investigation plans
P13 identifies appropriate terminology and reporting styles to communicate information and understanding in physics
P14 draws valid conclusions from gathered data and information

Design and Technology
P4.1uses design processes in the development and production of design solutions to meet identified needs and opportunities
P4.2 uses resources effectively and safely in the development and production of design solutions
P5.2 communicates ideas and solutions using a range of techniques
P5.3 uses a variety of research methods to inform the development and modification of design ideas
P6.1 investigates a range of manufacturing and production processes and relates these to aspects of design projects
P6.2 evaluates and uses computer-based technologies in designing and producing

Engineering Studies – Engineered Products: Engineering Electricity/Electronics
P3.1 uses mathematical, scientific and graphical methods to solve problems of engineering practice
P4.1 describes developments in technology and their impact on engineering products
P4.2 describes the influence of technological change on engineering and its effect on people

Mathematics General
MGP-2 represents information in symbolic, graphical and tabular form

MGP-3 represents the relationships between changing quantities in algebraic and graphical form
MGP-5 demonstrates awareness of issues in practical measurement, including accuracy, and the choice of relevant units
MGP-7 determines an appropriate form of organisation and representation of collected data
MGP-9 uses appropriate technology to organise information from a limited range of practical and everyday contexts
MGP-10 justifies a response to a given problem using appropriate mathematical terminology

Content	Teaching, learning and assessment	Student diversity
Physics **8.3. Electrical Energy in the Home** 2. One of the main advantages of electricity is that it can be moved with comparative ease from one place to another through electric circuits • Identify that current can be either direct with the net flow of charge carriers moving in one direction or alternating with the charge carriers moving backwards and forwards periodically • Identify the difference between conductors and insulators • Define and calculate resistance as the ratio of voltage to current for a particular conductor : R = V/I 3. Series and parallel circuits serve different purposes in households. • identify the difference between series and parallel circuits. • compare parallel and series circuits in terms of voltage across components and current through them. • identify uses of ammeters and voltmeters. • explain why ammeters and voltmeters are connected differently in a circuit. • explain why there are different circuits for lighting, heating and other appliances in a house. **P7 describes the effects of energy transfers and energy transformations.** • explain that power is the rate at which energy is transformed from one form to another. • identify the relationship between power, potential difference and current. • discuss the dangers of an electric shock from both 240V AC mains supply and various DC voltages, from appliances, on the muscles of the body. • describe the functions of circuit breakers, fuses, earthing, double insulation and other safety devices in the home. **Design and Technology** **P4.1uses design processes in the development and production of design solutions to meet identified needs and opportunities.** • project analysis • design briefs • appropriateness of design solutions • criteria for evaluation and factors to consider	**Week 1 – Wearable Technologies – How do household electrical products work?** **Criteria for success:** Students should be able to recognise the name and function of electrical components in a household item. • Students define the terms 'series' and 'parallel' circuits. • Create a list of parts in a simple circuit, draw and label them. • Explain that power is the rate at which energy is transformed from one form to another. • Identify the relationship between power, potential difference and current. • Discuss the dangers of an electric shock from both 240V AC mains supply and various DC voltages, from appliances, on the muscles of the body. • Describe the functions of circuit breakers, fuses, earthing, double insulation and other safety devices in the home. Circuit parts: http://www.physicsclassroom.com/class/circuits/Lesson-4/Circuit-Symbols-and-Circuit-Diagrams • Create a classification table with consumer technologies and circuit types. • Think, pair, share activity – split the class into three groups, research the household lamp, a fan heater and a toaster. Compare the function, features and parts that make these items work. How stuff works – toaster: http://home.howstuffworks.com/toaster.htm • Ohms law definition and examples of application. • V=IR, I=V/R, R=V/I LED lights + Ohms law calculator: http://www.ohmslawcalculator.com/led-resistor-calculator http://www.onlineconversion.com/ohms_law.htm • Make a simple circuit, apply ohms law to calculate the mathematical relationship between changing variables. Graph these changes using different LED light and battery products. **Take home tasks**: Create a Glossary of terms for this unit. Physics glossary: http://www.physics.usyd.edu.au/teach_res/db/elgloss.htm Justify the application of ammeters and voltmeters in household products. **Week 2 – Wearable Technologies – How have technological advancements affected wearable technologies?** **Criteria for success:** Students should be able to identify historical developments in technologies that have led to the development in wearable technologies. • Define wearable technology. Wearable technologies resource https://www.wearable-technologies.com/ • Brainstorm wearable technologies that students are familiar with, sort/arrange these into a predicted timeline. Wearable Technology Timeline:	Make a foil circuit, create an experiment – predict and evaluate your findings. **Extension:** Use 123D circuits to create virtual examples of working circuits 123D circuits https://www.microsoft.com/en-us/store/apps/autodesk-123d-circuits/9wzdncrdcx1s Research the potential of flexible batteries: Flexible batteries http://au.pcmag.com/wearable-tech/39384/news/samsung-lg-show-off-tiny-flexible-batteries# Watch *New Inventors* and evaluate the ethical impacts of the shown technologies Wearable Tech *New Inventors* episode http://www.abc.net.au/tv/newinventors/txt/s2416729.htm To read further

Content	Teaching, learning and assessment	Student diversity
• marketing and market research • purpose of market research • sources of data and information gathering techniques • marketing environment **P4.2 uses resources effectively and safely in the development and production of design solutions.** • using materials, tools, techniques and other resources. • characteristics and properties. • functions and uses. • Experimentation. • criteria for selection. • consequences of use. • the realisation of ideas through the manipulation of materials, tools and techniques and other resources. • safety • safety in the use of materials, tools and techniques • legislative requirements including work. **P5.2 communicates ideas and solutions using a range of techniques** • communicating information through a variety of media • visualising solutions • the purpose of prototypes and/or models • presentation techniques suited to the needs of design clients and design projects **P5.3 uses a variety of research methods to inform the development and modification of design ideas** • research methods • qualitative and quantitative research • questionnaires • surveys • interviews • observation • tests and experiments • statistical analysis • information research including print and electronic sources **P6.1 investigates a range of manufacturing and production processes and relates these to aspects of design projects** • manufacturing and production • selection of processes appropriate to a need • development of appropriate skills and techniques **P6.2 evaluates and uses computer-based technologies in designing and producing** • computer-based technologies and their application including: • modelling • research • simulation and graphics • communication	http://images.dailytech.com/nimage/Wearable_Smartwatch_History_Wide.jpg • What impact could flexible batteries have on future designs? • Compare the feature/function of Google Glass to a comparable item like the mobile phone. • What technological advancements propelled a product like Google Glass? Watch Google Glass 2.0 unboxing (duration: 6:27mins) • What are the ethical impacts of a product such as Google Glass? As a class, create a list of positive and negative impacts. **Take home tasks**: Continue with glossary. Find a wearable technology that has positive medical benefit. Research the technologies that power it. **Week 3 – Wearable Technologies – Is there a need in the marketplace for ANOTHER wearable technology design?** **Criteria for success:** Students should undertake research to analyse potential market opportunity. • As a team, create a set of criteria that wearable technologies should be designed and evaluated against. • Compare personal evaluations of Google Cardboard. • In small teams further develop the concept using the information from your evaluations. • Present your drawing, concept or idea to the class. • Students complete further independent research that covers existing wearable products as well as products rumoured to market – utilise work from Week 1. • Students should select a wearable technology category and aim to create a prototype. • Make a set of Google Cardboard. • Use appropriate mathematical methods to research, tabulate and synthesise data (refer to data and statistics content statements) Google Cardboard https://www.google.com/get/cardboard/ **Take home tasks**: Continue with glossary. Evaluate your Google cardboard using criteria to evaluate success. **Week 4 – Wearable Technologies – Move it from concept to concrete** **Criteria for success:** Application of theoretical concepts to create a mood board for all internal components of their chosen wearable, justifying their function. • Students should select a similar/like product and research components. Such as: Google Glass parts lists: http://www.designlife-cycle.com/google-glass/ Apple watch parts list http://si.wsj.net/public/resources/images/BT-AB542A_APPLE_11U_20150430191517.jpg • Create initial design ideas and compile into a mood board that demonstrates concept, features and function. Drawing example: https://u.osu.edu/idvisualization/files/2015/09/Note-2c2pxgf.png	Fashion Geek Book: https://www.dianaeng.com/shop/fashion-geek-book/ Students could work collaboratively to support students with learning needs Create a digital mood board Use Pinterest to help compile ideas 123D Design http://www.123dapp.com/design **Extension:** Film *Getting Frank Gehry*

Content	Teaching, learning and assessment	Student diversity
• presentation. **Engineering Studies – Engineered Products: Engineering Electricity/Electronics** **P3.1 Uses mathematical, scientific and graphical methods to solve problems of engineering practice.** • basic principles • potential difference. • current. • simple circuits and components. **P4.1 Describes developments in technology and their impact on engineering products.** • magnetic induction. • historical development of various engineered products. **P4.2 Describes the influence of technological change on engineering and its effect on people.** • the effects of engineered products on peoples' lives and living standards. **Mathematics** **Data and statistics** DS1 Statistics and society, data collection and sampling • investigate the process of statistical inquiry, and describe the following steps: posing questions, collecting data, organising data, summarising and displaying data, analysing data and drawing conclusions, and writing a report • identify the target population to be investigated DS2 Displaying and interpreting single data sets • create statistical displays using a spreadsheet or other appropriate software • link type of data with an appropriate display, eg continuous quantitative data with a histogram, or categorical data with a divided bar graph or sector graph (pie chart) • interpret the various displays of single data sets **Algebra and modelling** AM2 Interpreting linear relationships • generate tables of values from a linear equation • graph linear functions with pencil and paper, and with technology, given an equation or a table of values • use stepwise linear functions to model and interpret practical situations, eg parking charges, taxi fares, tax payments and freight charges	Mood board example https://s-media-cache-ak0.pinimg.com/736x/c6/82/84/c6828421426b6bb929f0e29c7086b8ee.jpg • Justification of parts, features and function should be on the mood board also. • Students should apply knowledge of electrical components and parts. • Peer evaluation could take place. **Take home tasks**: Continue with glossary. Finish creating mood board. **Weeks 5 & 6 –– Wearable Technologies – Collaborate, make and evaluate** **Criteria for success:** Students should create a model prototype, the devices function is reinforced by the information on their mood board. • Define prototype, categorise the difference between working models and prototypes. • Discuss their place and function in the design process – refer to known example: Playstation controller http://static2.hypable.com/wp-content/uploads/2013/01/playstation-prototype-controllers.jpg Frank Gehry Prototyping http://www.architectureanddesign.com.au/getmedia/8b7508e9-b867-4613-98a9-ff6147563b11/131204_Gehry3.aspx Frank Gehry Time Lapse https://vimeo.com/113353670 • After refining their design to a finished and plausible level of completion, students should create their own prototype • WHS procedures should be followed and appropriate safety instruction (as per school/faculty policy) given before students use the tools and equipment. • Students should justify parts and application of electronic and circuit parts with mathematical calculations.	Printing parts from Thingiverse: https://www.thingiverse.com/ Make the prototyping a collaborative process where students share ideas, tools and have continual opportunity to apply and give feedback

Assessment overview

Assessment should follow BOSTES and school assessment schedules and policies.
This unit should be assessed in terms of:

- Collaborative work practices
- Research and documentation
- Presentation of final design solutions
- Prototype

Evaluation