 Sustainability STEM program

12 weeks 1 to 2 hours per week

Unit overview

In this unit, students explore the topic of sustainability and how it impacts our world. Students design and construct products aimed at having greater or total sustainability. Students develop research journals, information reports, and models of their chosen product.

Students investigate the concepts of sustainable design, where products come from, how they are created, recycled and reused or wasted. They also investigate the impact products have on the environment. During the unit students will have the opportunity to attend a partnership school (Ermington West PS) to share and gain ideas of how to create a more sustainable future through products and innovation.

Summary

Students:

* Create an item or project that will assist with sustainability.
* This can be in the form of a website/movie etc that spreads awareness of the issue of waste and the importance of sustainability
* Students investigate sustainability and why it is important

Key inquiry questions

* What is sustainability?
* How can we reduce our waste and become more sustainable?
* What is a journey mapping and how is its beneficial to our planning?
* How are products made?
* Where do products end up? (renewed, recycled or waste)
* How does waste affect our environment?
* Why is it important to be more socially aware of the effects of waste?
* Why is it important that we are aware of the benefits of being sustainable?

Syllabus references

Outcomes and syllabus content referenced in this document are from:

* [Science (incorporating Science and Technology K-6) K-10 Syllabus](http://syllabus.nesa.nsw.edu.au/science/science-k10/) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2012.
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Outcomes

Science and Technology

* ST3-2VA demonstrates a willingness to engage responsibly with local, national and global issues relevant to their lives, and to shaping sustainable futures
* ST3-4WS investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanations
* ST3-5WT plans and implements a design process, selecting a range of tools, equipment, materials and techniques to produce solutions that address the design criteria and identified constraints
* ST3-13MW describes how the properties of materials determine their use for specific purposes
* ST3-16P describes systems used to produce or manufacture products, and the social and environmental influences on product design

English

* EN3-1A communicates effectively for a variety of audiences and purposes using increasingly challenging topics, ideas, issues and language forms and features

Mathematics

* MA3-2WM selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations
* MA3-9MG selects and uses the appropriate unit and device to measure lengths and distances, calculates perimeters, and converts between units of length
* MA3-12MG selects and uses the appropriate unit and device to measure the masses of objects, and converts between units of mass
* MA3-14MG identifies three-dimensional objects, including prisms and pyramids, on the basis of their properties, and visualises, sketches and constructs them given drawings of different views

Vocabulary

sustainability

physical conditions

impacts

survival

living things

conditions

light

energy

restricted

diagram

climate

characteristics

environmental conditions

commercial

scale

depth

height

processed

consequence

life cycle

life span

journey mapping

scientific report

renewable

non-renewable

environment

living

non-living

infrastructure

waste

landfill

expense

repurpose

data

| Content | Teaching, learning and assessment | Evaluation/assessment |
| --- | --- | --- |
| Stage 3 – Working Scientifically  Students question and predict by:   * with guidance, posing questions to clarify practical problems or inform a scientific investigation (ACSIS231, ACSIS232) * applying experience from similar situations in the past to predict what might happen in a new situation * constructing and using a range of representations, including tables, graphs (column, picture, line and divided bar graphs) and labelled diagrams * drawing conclusions and providing explanations based on data and information gathered first-hand or from secondary sources * their own and others' conclusions | Lessons 1 – What is Sustainability?   * Show students a variety of stimulus’ (pictures, words, phrases in a fast PowerPoint flash cards format) that relate to our problem of rubbish and waste. * Images may include rubbish bins, tips, powerplants, pollution, litter, school kids, clean up Australia day and other initiatives. * Students write down words and phrases that come to mind when they see the picture. * Introduce sustainability to the students. * Students brainstorm the meaning of sustainability. * View the YouTube clip, 'What is sustainability?” –<https://www.youtube.com/watch?v=gTamnlXbgqc> * Discuss and identify the key points of sustainability as defined in the clip. * Brainstorm why sustainability is important and produce ‘I wonder questions’ beginning with who, what, when, where, why? * The questions will focus on the images they have been shown eg Rubbish bin; who is using the rubbish bin, why/why not, what is its purpose, when is it being used, where is it being used, what would happen without the bin?, what improvements could you make? | * Formative assessment - understanding of concepts and content through class discussions and feedback from students. * Verbal responses provided during peer sharing and class discussion. * Written responses recorded on each of the images during the brainstorming session. |
| Stage 3 – Working Technologically   * selecting and using creative thinking techniques, including mind-mapping, brainstorming, sketching and modelling * selecting and using techniques for documenting and communicating design ideas to others, eg drawings, plans, flow charts, storyboarding, modelling and presentations, using digital technologies * identifying the strengths and limitations of the process used   Stage 3 – Mathematics   * MA32WM selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations | Lesson 2 – What is journey mapping and how is its beneficial to our planning?   * Students are introduced to the concept of journey mapping, learning terms like cradle to grave, lifespan/lifecycle of a product or item with comparisons drawn to living things and objects that are manmade. * Teacher uses a SMART presentation to demonstrate a basic journey map to the students of an everyday item eg bottle, food packet. The presentation will show how a product begins, where it goes in its lifecycle and where it ends. * The teacher then discusses with students about the various ways in which products are created introducing the concept of construction methods, renewable products vs non-renewable - energy production. * Students develop their own journey map based on something that can be found in a lunch box/playground or school bag. * Students explore environment for their chosen product and are given time to research this product. They are asked to consider whether their product is environmentally friendly and what materials are required to make it. * What are some considerations when designing products? Students start compiling criteria as they generate and define ideas. | * Formative assessment - understanding of concepts and content through class discussions and feedback from students. * Examining student ability to research and develop a journey map and successfully determine the lifecycle of a product from “cradle” to “grave”. * Completed journey map identify each of the stages of a product's lifecycle. |
| Stage 3 – Working Scientifically   * with guidance, posing questions to clarify practical problems or inform a scientific investigation (ACSIS231, ACSIS232) * predicting what the findings of an investigation might be (ACSIS231, ACSIS232) * applying experience from similar situations in the past to predict what might happen in a new situation * with guidance, planning appropriate investigation methods to test predictions, answer questions or solve problems including surveys, fieldwork, research and fair tests (ACSIS086, ACSIS103, ACSHE081, ACSHE098) * collaboratively and individually selecting suitable methods for gathering data and information first-hand and from reliable secondary sources   Stage 3 – Mathematics   * MA32WM selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations | Lesson 3 – Redesigning/Repurposing a product   * Students are tasked with redesigning or repurposing a product to make it more environmentally friendly. * A YouTube video on how to repurpose tin cans <https://www.youtube.com/watch?v=ORVJuz8EbM0> * Students are encouraged to use the product that they have previously selected for their journey map. * Repurposing/Redesigning the product can include changing the materials used in construction, changing its use, increasing its use, changing how it is created if pollutant etc. Students follow the scientific process as they work scientifically to find answers to these questions. * Students use the information gained through the investigation to plan their proposed ideas of adjustment. Students are able to use a range of materials to construct a prototype of their redesigned/repurposed product. | * Formative assessment - understanding of concepts and content through class discussions and feedback from students. * Student ability to verbalise their understanding of the concepts of repurposing and redesigning products as well as the reasons why these processes are necessary. * Student ability to apply the concepts learnt to repurpose/redesign an existing product. * Completed redesigned/repurposed product produced during the STEM session to improve the sustainability of the product. |
| Stage 3 – Products   * investigate a system to produce or manufacture a product, eg using an assembly line to produce a food product for sale in the school canteen, or the use of robotics in manufacturing a product   Stage 3 – Physical World   * describes how scientific understanding about the sources, transfer and transformation of electricity is related to making decisions about its use   Stage 3 – Working Scientifically   * with guidance, posing questions to clarify practical problems or inform a scientific investigation (ACSIS231, ACSIS232) * predicting what the findings of an investigation might be (ACSIS231, ACSIS232) * with guidance, planning appropriate investigation methods to test predictions, answer questions or solve problems including surveys, fieldwork, research and fair tests (ACSIS086, ACSIS103, ACSHE081, ACSHE098) * suggesting improvements to the methods used to investigate a question or solve a problem (ACSIS091, ACSIS108)   Stage 3 – Mathematics   * MA32WM selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations * MA33WM gives a valid reason for supporting one possible solution over another | Lesson 4/5 – How are products made?   * Students are introduced to the idea of production and creating a product. They are reminded of the key question to ask, “can I do this forever?”. * Students are shown an example of the Prius (hybrid car) and look at how its environmental benefits are lost through waste (battery) and unsustainable coal powered production. * A YouTube video on testing the miles per gallon of a Toyota Prius and a BMW M3 – <https://www.youtube.com/watch?v=F04MXepYiBs> * Show quote about battery pollution production. * Teacher highlights to students that although the vehicle is cleaner and more sustainable than normal cars, the process used to create the car is far more pollutant and less sustainable. * Teacher highlights the concept of a by-product and how this is something created as a result of another thing being made eg nuclear power has a by-product of nuclear waste. * Students are split into groups of 3 max and investigate a form of energy/product production eg wind, solar, coal, nuclear. * Questions look at; what is it?, how does it impact the environment? is it sustainable? 3 reasons why or why not. * Students investigate the positive and negatives of their given energy/production source and recording their information on butchers paper. * In 3 groups the class discusses the points they have learnt. Each group then votes on the form they think is most sustainable and justify why. The groups finally reform and share their responses as a class. | * Formative assessment - understanding of concepts and content through class discussions and feedback from students. * Student ability to research and identify the reasons for and against sustainable/unsustainable energy sources. * Student ability to make a judgement as to whether the form of energy production should be used and to justify their responses with research and content knowledge. * Involvement and feedback through group-based and class-based discussions. |
| Stage 3 – Products   * investigate a system to produce or manufacture a product, eg using an assembly line to produce a food product for sale in the school canteen, or the use of robotics in manufacturing a product * research the environmental impact of an everyday product from its production through to its use and disposal, eg a PET bottle, a car or newspaper   Stage 3 – Working Scientifically   * with guidance, posing questions to clarify practical problems or inform a scientific investigation (ACSIS231, ACSIS232) * predicting what the findings of an investigation might be (ACSIS231, ACSIS232) * with guidance, planning appropriate investigation methods to test predictions, answer questions or solve problems including surveys, fieldwork, research and fair tests (ACSIS086, ACSIS103, ACSHE081, ACSHE098) * suggesting improvements to the methods used to investigate a question or solve a problem (ACSIS091, ACSIS108)   Stage 3 – Mathematics   * MA3-2WM selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations | Lesson 6 – Environmental Cost, Is it worth it?   * Students were provided with examples of products that were developed to be more environmentally friendly. These included:   + Toyota Prius/Hybrid and electric cars   + recycled paper   + rechargeable batteries   + LED bulbs/lighting   + home solar panels * Students research and identify the environmental impact of the products and whether they have been successful in their aims of reducing waste. * The processes and materials required to create the products are also considered in order for students to examine the pros and cons of the products. * Students were asked to make a judgement on the sustainability of the product based upon their scientific investigations. Students compared their product to the item it had replaced in order to consider its usefulness. | * Formative assessment - understanding of concepts and content through class discussions and feedback from students. * Student ability to research and identify the pros and cons of the product innovations. * Student ability to make a judgement as to whether these new products should be used and to justify their responses with research and through examining their environment impact. * Involvement and feedback through group-based and class-based discussions. |
| Stage 3 – Products   * research the environmental impact of an everyday product from its production through to its use and disposal, eg a PET bottle, a car or newspaper   Stage 3 – Working Scientifically   * comparing gathered data with predictions, and using as evidence in developing explanations of events and phenomena (ACSIS218, ACSIS221, ACSHE081, ACSHE098)   Students question and predict by:   * with guidance, posing questions to clarify practical problems or inform a scientific investigation (ACSIS231, ACSIS232) * applying experience from similar situations in the past to predict what might happen in a new situation * with guidance, planning appropriate investigation methods to test predictions, answer questions or solve problems including surveys, fieldwork, research and fair tests (ACSIS086, ACSIS103, ACSHE081, ACSHE098) * collaboratively and individually selecting suitable methods for gathering data and information first-hand and from reliable secondary sources   Stage 3 – Working Technologically   * developing a design brief individually and in collaboration with others * developing design criteria that considers, where relevant, function, aesthetics, social and environmental considerations * selecting and using creative thinking techniques, including mind-mapping, brainstorming, sketching and modelling * selecting and using techniques for documenting and communicating design ideas to others, eg drawings, plans, flow charts, storyboarding, modelling and presentations, using digital technologies   Stage 3 – Speaking and listening   * plan, rehearse and deliver presentations, selecting and sequencing appropriate content and multimodal elements for defined audiences and purposes, making appropriate choices for modality and emphasis (ACELY1700, ACELY1710) * use interaction skills, for example paraphrasing, questioning and interpreting non-verbal cues and choose vocabulary and vocal effects appropriate for different audiences and purposes (ACELY1796) * use interaction skills, varying conventions of spoken interactions such as voice volume, tone, pitch and pace, according to group size, formality of interaction and needs and expertise of the audience (ACELY1816)   Stage 3 – Mathematics   * MA3-2WM selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations * MA3-9MG selects and uses the appropriate unit and device to measure lengths and distances, calculates perimeters, and converts between units of length * MA3-12MG selects and uses the appropriate unit and device to measure the masses of objects, and converts between units of mass * MA3-14MG identifies three-dimensional objects, including prisms and pyramids, on the basis of their properties, and visualises, sketches and constructs them given drawings of different views | Lesson 7-12 – Developing a Sustainable Product   * Students are tasked with developing a sustainable product. This product can focus on anything man-made from a house to transportation, waste management process, energy sources, etc. * Students are able to develop their product which aims to reduce waste from 3 sources; a new product from scratch, redesign an existing product to improve it, and repurpose an existing product to provide it with another use or lifecycle. * Students draw on the knowledge gained throughout the term as well as utilise research to and investigation to determine a product and how it can be improved or changed. * They are then introduced to their STEM booklet resource in which they record their project ideas, the methods used to develop it, how it will be presented, and the weekly progress of its completion. * All students must provide some form of written or displayed information as well as a model of their product as part of their final project. * These projects will then be displayed in a showcase following the completion of the program, allowing the students to present their ideas and discuss methods of waste reduction with their peers. | * Presentation of a sustainable product that is designed to meet the success criteria. * Products must reflect design elements of sustainability that reflect the learning that has occurred throughout the STEM program. * Student knowledge and understanding of the content through their models and supporting information is utilised as an indicator of STEM learning from the program. * Evaluation will also be achieved through formative assessment through discussions with students and the projects and through summative assessment of their final product. * Student will record and evaluate their progress weekly, in their STEM booklet. Their evaluations will require them to record what they have learnt, what modifications they needed to make to their project and what steps they need to take to progress forward and complete their project. |

Program evaluation/assessment

Throughout the program, students will record and evaluate their plans, sketches and drawings, reflections and progress in a STEM booklet. Their reflections will require them to record what they have learnt each week and what they would do differently. These STEM booklets will be utilised as an ongoing measurement of their progress and content knowledge and provide evidence for assessment.

At the completion of the 12 weeks, the students will hold a STEM showcase. This will provide them with the opportunity to demonstrate their knowledge and understanding of the content covered in class. It also will allow them to reflect their ability to apply this knowledge to their own personal interests. Students will present their projects through a scale model of their product and through differentiated forms of information eg report, display, verbalisation through a speech etc.