**Designing a new product from potato starch – unit plan**

**Overview**

Students develop their knowledge to design a disposable product as a sustainable alternative to an existing product.

**Purpose**

To consider the issues of increasing plastics use and understand why this is not sustainable. To understand the challenges of developing more sustainable alternatives.

**Background**

**Suggestions for a scenario**

Disposable products made from plastic take a long time to break down in landfills and are made from depleting petroleum resources. A New Zealand company is making alternative products that are 100% biodegradable and compostable. The company needs ideas for new products that will have high consumer demand because producing more will help bring costs down.

**Where's the Biotechnology?**

Biotechnology research is looking at using material from plants, like cereals and tubers, to make materials that will biodegrade and use renewable resources. They have to formulate the material to have properties that will endure the end use and will not have harmful effects on people or the environment when used and disposed of.

**Curriculum focus**

**Technology**

Technological practice: Students will develop a brief for a new product to be made from potato starch material. They will identify a need or opportunity, develop a conceptual statement and identify attributes or specifications that allow the fitness for purpose of their product to be evaluated. They will refine their brief as they develop knowledge of the material, constraints and stakeholder feedback. Technological knowledge: Students will develop an understanding of how the properties of starch can be manipulated and transformed to create mouldable foam products with different properties that meet changing needs. They will use three dimensional drawings or mock-ups to model, evaluate and justify their product designs. Nature of technology: Students will develop an understanding of how technology can expand human possibilities and result in positive, negative and unanticipated impacts on people and the environment.

**Focus of skill & strategy**

Students will learn about sustainability issues with synthetic plastics and about new materials being developed to address the issues. They will learn how starch can be recycled and transformed into a mouldable foam material and how the material can be disposed of to support growth of future crops. Students will develop designs for new products that could expand the use of this technology, while considering the need for consumer acceptance. They will be able to justify the feasibility of a proposed product.

**Health and Safety**

Health and safety need to be considered when testing the properties of potato plates and plastic plates. Care needs to be taken handling and containing hot and cold liquid and cleaning up the equipment and area used.

|  |
| --- |
| **UNIT PLAN: Designing a new product from potato starch** |
| **Suggested learning intentions** | **Suggested learning experiences** | **Possible teaching /assessment activities** |
| **Introduction**Understand why plastics use has increased so rapidly and appreciate the health and environmental issues.Understand the concept of lifecycle analysis and sustainability. | **Introduction*** Brainstorm and discuss the widespread use of plastics in everyday products.
* Research plastics. What are they made from and how are they produced? What are the issues?
* Introduce potato plates. Discuss ideal properties for a disposable plate. Carry out tests to compare these properties in the potato starch and plastic plates to determine fitness for purpose. Include a cost comparison and lifecycle analysis and present a conclusion.
* Discuss the issues currently affecting the development of environmentally friendly materials.
 | **Introduction**Show pictures of plastic products.Internet/text research.Show video clip: [What are potato plates?](https://www.sciencelearn.org.nz/videos/582-what-are-potato-plates)Set up instructions and resources for testing plates and recording results.For information on lifecycle analysis, see article: [Environmental benefits of potato plates](https://www.sciencelearn.org.nz/resources/1075-environmental-benefits-of-potato-plates).Refer to the sustainability helix at <https://earthpac.co.nz/about/>. |
| **Developing a brief**Understand that material properties need to suit the end use of a product. Appreciate the importance of stakeholder views in product development.Understand how modelling allows ideas to be communicated and evaluated.  | **Developing a brief*** **The issue**: Biodegradable materials using renewable ingredients such as potato starch are a sustainable alternative for disposable products. Waste potato starch in New Zealand currently goes down the drain and could be processed to enable more products to be made from this material. Develop a conceptual design for a new product to be made from this material.
* In groups, discuss the issue and make a plan to research possibilities and develop a concept. What do you know and what do you need to find out? Who are the key stakeholders, and how and when can you communicate with them?
* Consider how Potatopak develops a product.
* Discuss the properties of the material and how this may impact on possible end uses.
* Discuss the manufacturing process and other factors that may affect the design of products from this material, for example, set-up costs, market demand, functionality, environment.
* Brainstorm some possible products that could be made from this material and do a PMI analysis of each. Discuss how benefits of a new product need to outweigh those of the product they are replacing.
* Describe key attributes for a potato starch product based on previous research and discussion.
* Use modelling techniques (such as three dimensional drawings, CAD and/or mock-ups) to discuss and evaluate ideas with the group and key stakeholders.
* Modify as necessary to make a feasible design.
* Present a final brief for the product design
 | **Developing a brief**Show video clip: [Recycling potato plate waste](https://www.sciencelearn.org.nz/videos/583-recycling-potato-plate-waste)Show video clip: [Why import potato starch?](https://www.sciencelearn.org.nz/videos/581-why-import-potato-starch)Provide a simple Gantt chart template and establish timeframe and milestones.Provide guidelines for communicating with stakeholders and completing a survey. Refer to article: [Developing potato plates](https://www.sciencelearn.org.nz/resources/1078-developing-potato-plates)Show video clip: [Potato plate research and development](https://www.sciencelearn.org.nz/videos/585-potato-plate-research-and-development)Show video clip: [Honeycomb structure of potato plates](https://www.sciencelearn.org.nz/videos/580-honeycomb-structure-of-potato-plates)Refer to earlier test results.Make popcorn to simulate the expansion of the starch to a foam. Use interactive: [Potato plate manufacturing process](https://www.sciencelearn.org.nz/image_maps/19-potato-plate-manufacturing-process)Refer to article: [Developing potato plates](https://www.sciencelearn.org.nz/resources/1078-developing-potato-plates) Refer to article: [The biodegradable possum bait station](https://www.sciencelearn.org.nz/resources/1113-the-biodegradable-possum-bait-station)Show video clip: [Biodegradable possum bait station](https://www.sciencelearn.org.nz/videos/604-biodegradable-possum-bait-station)Brainstorm key attributes in groups then share as a class. |
| **Presenting a design proposal**Develop skill in 3D drawing techniques.Appreciate that consumer need and uptake are essential for a product to be successful in the market place.  | **Presenting a design proposal*** Present the design to the class using appropriate drawing techniques.
* Present a convincing argument showing the benefits of making this product from potato starch compared to the original material. Include supporting data from stakeholders.
 | **Presenting a design proposal**Assess development of the final brief and supporting arguments presented to the class. |
| **Considering ethics**Appreciate that there are varying views on using food crops for non-food applications. | **Considering ethics*** Debate the issue of using food crops for non-food applications.
 |  |