**Unit plan: From bees to bandages**

**Overview**

Students investigate the antibacterial properties of Mānuka honey and use their results to produce a dressing that can be used on a wound to kill any bacteria infecting it.

**Purpose**

To investigate how honey can heal wounds. To understand that Mānuka honey contains a special factor, which makes it especially good at healing wounds.

To consider the problems that need to be overcome when making honey into a wound dressing for healing a range of wounds, including burns, ulcers, and surgical wounds.

To make a wound dressing from honey will be the main focus in this unit, as this aspect can be assessed in the classroom more easily than testing the effectiveness of the healing quality of the dressing.

**Background**

**Suggestions for a scenario**

The students are scientists who are producing wound dressings using Mānuka honey. First they need to see and appreciate the antibacterial activity of the honey and then they need to produce a dressing using the honey. The dressing needs to be functional i.e. able to be kept on a (simulated) wound for a significant period of time.

**Where's the Biotechnology?**

Biotechnology involves manipulating organisms or parts of organisms for the use or needs of people. In this unit, honey made from the nectar of Mānuka flowers is used to make dressings to heal infected wounds.

There are two aspects to this unit. The first deals with the science looking at the antibacterial properties in the honey to determine its usefulness. The second is the application or the technology: making the wound dressing out of the honey.

**Curriculum focus**

**Technology**

Students will gather and collate information on the need of wound dressings for hospitals and in the community. They will explore the possible use of active Mānuka honey in making a wound dressing, by considering its effectiveness and functionality.

Students will need to prepare a plan of action, identify and collect resources and produce the selected solution (dressing).

Students will identify the positive and negative effects of the use of Mānuka honey as a wound dressing and the different views and feelings that people have about its use.

Using the knowledge of the properties of honey to produce a dressing that will be effective and functional on people. Consistency of the honey will need to be considered when thinking about the application of the honey. In the past honey used in dressings has oozed out. It has been difficult to keep honey on the wound.

Comvita are now making and selling dressings made out of honey. This technology unit suggests the students also do that trying a range of dressing options to make the honey most effective.

**Science**

Investigating harmful and helpful microorganisms; in particular bacteria and the effects of antibacterial properties (in honey) on bacteria.

Learning about bacteria and the healing properties of Mānuka honey: its high sugar content; production of hydrogen peroxide (a well known antiseptic), and the Unique Mānuka Factor (an unknown antibacterial agent). Honey can control inflammation, reduce wound odour and provide a moist wound environment (to aid healing with minimal scar damage). The main focus of this unit is on the antibacterial action of the honey and can be shown in a crude way through the milk experiment.

**Focus of skill & strategy**

Students will learn what honey is and how it is produced. They will also learn about bacteria and how they can infect wounds and prevent wound healing. Then they will learn about the properties of honey that make it good at helping wounds to heal. Students can do a simple test to demonstrate the antibacterial activity of different honeys. Finally, students will consider the advantages and disadvantages of using honey to heal wounds.

They can learn about recent research around Mānuka honey and its use as a wound dressing by Comvita through the Honey to heal focus story. A simple way to observe the effects of the antibacterial action of active Mānuka honey is to observe the effects of milk with and without honey over a period of time. The milk with honey should take longer to go off (or develop bacteria).

Once the students appreciate that Mānuka honey has antibacterial properties they can proceed to make a honey wound dressing. Students may like to test the effects of this ‘dressing’ in milk again, to check that it still has its antibacterial properties.

**Health and Safety**

Health and safety need to be considered when testing for the antibacterial action in the milk. Bacteria will grow in milk, so students need to handle and dispose of the milk sensibly. Note that due to the unhygienic states of most classrooms and the fact that most Mānuka honey sold is not irradiated (a process that sterilises the honey that is to be used for dressings. It filters out fine particles such as bee pollen and destroys spores that might cause botulism), the dressing made by the students will not be able to be used on any real wounds.

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| UNIT PLAN: FROM BEES TO BANDAGES |
| **Suggested learning intentions** | Suggested learning experiences*The following learning experiences will provide you with starting points for an exploration of this topic. You may decide to narrow your focus to one component, or include most of the ideas in a unit that incorporates science and/or technology themes.*  | **Possible teaching/assessment activities** |
| **Introduction**Understand how honey is made and what it contains. Students also need a basic understanding of harmful bacteria and how it can affect wounds.Learn how honey can heal wounds by preventing the growth of bacteria.  | **Introduction**Learn about how honey is made and how the source of nectar, from flowers like mānuka and clover affect the taste, texture and colour of the honey. Understand that honey can help wounds to heal through both its physical and chemical properties. In particular, mānuka honey which has an additional chemical property, called the unique mānuka factor (UMF), which makes is particularly good at healing wounds. Research the different techniques that doctors and nurses use to prevent infection of wounds with bacteria.  | **Introduction**Use pictures of honey/bees/hives/Mānuka plants and flowers to introduce honey. Have a variety of books on bees and honey. For a short summary of honeys healing properties get article[: How honey heals wounds](https://www.sciencelearn.org.nz/resources/1702-how-honey-heals-wounds) |
| **Introduce the scenario**. They also need to understand the properties of honey that make it good at healing wounds. Understanding the scenario and identifying problems/learning needed | **Introduce the scenario**. **Identify the task.*** Read out scenario
* Brainstorm what we need to find out before we can make a dressing.
* Do a simple demonstration of Mānuka honeys properties, for example sugar content (taste), acidic (pH), thixotropic (pours when agitated). First, we need to find out about the antibacterial properties of the honey and we need to find out how we might go about developing the honey into a wound dressing.
 | **Introduce the scenario**. Pictures/slides of bacteria and infected wounds. Discuss how this could relate to learning about honey. |
| **Developing expertise**It would be appropriate for the students to see something of the antibacterial work of Mānuka honey to appreciate its commercial use and development. The experiment is very simple and crude but can be easily done within the confines of the classroom to show the action of antibacterial properties on bacteria. | **Developing expertise*** Students can explore some history in the use of honey to heal wounds and how honey has been used for wound care over time.
* Explore articles: [Honeybees and Mānuka trees](https://www.sciencelearn.org.nz/resources/1703-honeybees-and-manuka-trees) and [How honey heals wounds](https://www.sciencelearn.org.nz/resources/1702-how-honey-heals-wounds).
* Learn about the Unique Mānuka Factor (UMF®), in Mānuka honey.
* Explore testing for the wound healing properties of honey watch video on testing for wound healing propertiesof honey: [UMF® testing](https://www.sciencelearn.org.nz/videos/1026-umf-testing)
* Learn about how honey can be developed into a wound dressing in the article: [From bees to bandages](https://www.sciencelearn.org.nz/resources/1705-from-bees-to-bandages)and discuss how you might apply honey to a wound – what would work?
 | **Developing expertise**Explore the Hub resources in: [Honey to heal](https://www.sciencelearn.org.nz/resources/1700-honey-to-heal-introduction). Depending on the age group of students, this could be in small groups, independently or, for younger students, as a whole class. Teacher tells the story and shows and discusses videos as appropriate. |
| **Plan of Action** Students need to have some appreciation of the difficulties of getting honey to absorb into a dressing because of its high sugar content. Students should know that the application of honey in the past has been difficult due to its inability to adhere to or be kept on the wound. Comvita use **alginate** a substance extracted from seaweed to make their dressings.Alginate is an extract from **seaweed** cells, it is highly absorbent and can be made into a dressing fibre and impregnated with honey. However, in this form honey is still quite sticky making it difficult to change bandages. The powder form of alginate can be mixed into the honey and baked to reduce stickiness. A bonus of this type of dressing is less pain with the honey application and the honey dressing is able to extract and hold more fluid from the wound. | **Plan of Action** Test for antibacterial action in the honey:The outcome for this experiment could take several days, so it may be expedient to set up the experiment at the beginning of the unit. A basic way to show the antibacterial action of the honey is to compare the effects of the honey in milk that is left at room temperature with a control of milk without honey. Each group could set up 1-2 containers (agar dishes, film canisters, yoghurt containers, or any small containers) of milk. Set up another 1-2 of the same sized containers with a mixture of milk and some active Mānuka honey in them. Leave all the containers in a warm place. Observe over time for the development of bacteria. This could take 2 or 3 days. The milk without the active Mānuka honey should show signs of bacterial growth first (milk solids clumping together, bad – sour smell). The honey and milk mix should not show signs of deterioration for a time significantly longer than the control.• Make a plan for a wound dressing.Students can use different materials to make their chosen honey into a dressing this can include: tissues, cotton wool pads, alginate fibre pads or alginate powder (wallpaper paste can be used as a substitute if alginate is not available, as it contains cellulose an extract from plant cells). If using alginate or cellulose they will need to experiment to get an appropriate consistency that can be handled (like play dough).• Make the dressing -Add active Mānuka honey to the dressing of choice (the students should understand that for real use the honey should be at least UMF®18+ and it needs to be a medical grade (i.e., it has no contaminants in it) -For alginate or cellulose, once the consistency is suitable pour onto non-stick baking paper and roll out using a rolling pin to desired thickness.-Bake the dressing in oven at a low temperature until its texture is more suitable for wound dressing (i.e., it becomes less sticky and more gel like). Students will need to work out time required.-Cut the dressing to a desirable length and shape required for the designated (in the plan) wound.• Test the dressingApply the dressing to a fellow student in the group using an appropriate means (plaster or bandage) to hold it in place. Does it cover the ‘wound’ space designated in your plan? Leave the applied dressing (not an actual wound) for several hours to test that it will stay on and not run or melt off. (As an optional extra students could draw a ‘wound’ on their designated fellow student. They could put some cotton wool that has been dipped into water – containing red food colouring, onto the ‘wound’ before applying the dressing. It would be interesting to see how much of the water (or ‘wound’ seepage) the honey dressing absorbed in the time it was held in place).• Extra for those interestedRepeat the milk experiment, but this time put a piece of the honey dressing (with alginate) into some milk instead of ‘plain’ honey to see if the results are the same. | **Plan of Action** Students could write up the experiment, hypothesising what they think might happen. In small groups (3-4) the students could set up their experiments and set them aside until they ‘see’ some results.Another simple experiment to test the effectiveness of the antibacterial properties of Mānuka honey is to pre freeze some grapes (it helps them go off faster) and then to coat some of them with Mānuka honey. Leave them for a few days, comparing the uncoated ones with the coated ones. In groups or individually students plan their wound dressing. They will need to consider the resources they will need and how they will make their dressing. They will need to consider what wound (size and shape) their dressing is for. Students should write up a step-by-step plan of action for their dressing. They will need some knowledge of what is being done by Comvita; that seaweed fibre alginate can be successfully used to make dressings.  |
| **Assessment**Students should appreciate that their task is to keep the honey covering the ‘wound’ for a significant period of time (several hours). They should realise that in a real situation moisture from the wound would contribute to flushing honey from the wound, which is why the alginate ‘bound’ honey that has been properly prepared is more likely to stay in place. | **Assessment*** After a few hours of someone ‘wearing’ the dressing show your dressed ‘wound’ to the class. Share with the class how you made your dressing (what quantities of ingredients you used and how long you baked it for). Did your dressing keep the honey on the wound? Explain why you think it was successful. If it didn’t hold the honey to the wound explain why you think it didn’t. What would you do differently next time?
* Write a report on the antibacterial action in Mānuka honey and the benefits that Mānuka honey wound dressings have for patients. Describe and illustrate how you would make a dressing to apply honey to a wound.
 | **Assessment**Students should write up a step-by-step plan of action for their dressing. They will need some knowledge of what is being done by Comvita; that seaweed fibre alginate can be successfully used to make dressings. Students make and apply dressings in groups.Group sharing with whole class on the day of the dressing making.Report writing |
| **Considering the ethics**Students need to think ethically about possible outcomes to all concerned in the use of Mānuka honey. | **Considering the ethics*** Using a PMI decide on the pluses (benefits) and minus (harm) and anything interesting that might be worth investigating when considering using Mānuka honey to make wound dressings.
* As an extra activity, the PMI results could be used to form a debate between two teams – one for and one against using Mānuka honey as a wound dressing.
 | **Considering the ethics**The **PMI** could be done in small groups. They could share their findings with the class.Benefits include * wound healing in people
* income for people
* planting of more native forest i.e., Mānuka trees

Harm may include* pain on application
* possible depletion of honey resources (how would this affect the bees? People?)
* possible over pricing of product making it unattainable for some people.

Interesting investigations might include:* Looking to see if Mānuka itself has healing properties and if so how it can be used.
* Could there be other medical applications of Active Mānuka honey?
* Could the Mānuka be set up/planted to produce a consistently high UMF in the honey?
* The Māori perspective. What is the Māori view to the commercial use of Mānuka honey?
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