**Effects of silage on a rural stream – unit plan**

**Overview**

Students investigate silage production and test a stream to see if run-off from silage is polluting it. Students then produce a pamphlet of their findings to educate the community.

**Purpose**

To investigate the making of silage and any long-term environmental impacts associated with possible silage run-off. To investigate actions that land owners can take to reduce the effects of run-off from silage.

This unit has been trialled with two Year 4 classes.

The case study, [Effects of silage on a rural stream – case study](https://www.sciencelearn.org.nz/resources/2556-effects-of-silage-on-a-rural-stream-case-study), explores with teachers why this was an effective unit and what made it work well.

## Background

### Suggestions for a scenario

A local stream has become blocked and the trees are dying. Some locals believe that run-off from silage (both new bales and pits positioned around the catchment area, and an old silage storage dump not far from the stream) is the reason for the pollution. The students try to find out if the locals’ theory about the cause of the pollution is correct and, if so, what farmers needed to do in order to prevent further pollution - and restore the stream to its original healthy condition.

### Where's the Biotechnology?

In order to begin to address the problem of the polluted stream, the students need to find out what silage is, how it is made and how it should be stored.

The next step is to discover whether there can be run-off from the bales of silage into the stream as local residents had suggested, and if so, the effect that this could have on nitrate levels, plant growth and the ability of animals to live in the water.

## Curriculum focus

### Technology

* Silage is made by bacteria, which 'pickle' pasture grasses.
* The bacteria modify some of the sugars in the grasses into lactic acid.
* Silage needs to be carefully stored, or the run-off (which is high in nitrogen) can pollute local waterways.
* People may prioritise differently the use and care for waterways and surrounding areas.

### Science

* Stream life is a fragile, balanced eco-system that can be sensitive to pollution.
* Some water organisms are more tolerant of pollution than others (for example leeches, water boatmen, mosquito larvae); whereas others require a relatively clean aquatic environment (for example caddisfly larvae, mayfly nymphs and freshwater shrimps).
* Water pollution may be caused by several contributing factors.
* A range of indicators can be used to evaluate the health of a stream.

### Focus of skill & strategy

**Biotechnology:**

* Sequence the main stages in silage-making (see the activity - [Making your own silage](https://www.sciencelearn.org.nz/resources/2005-make-your-own-silage)).
* Understand and use the language associated with biotechnology and silage-making (for example preservation, microorganisms).

**Science:**

* Carry out documented observations of the 'affected' stream and compare these with a healthy stream.
* Use appropriate instruments to enhance observations (for example to test turbidity, pH, nitrate levels and identify organisms living in the streams).
* Accurately record and interpret observations.
* Understand and use the language associated with the scientific investigation of the 'health' of a stream.

**Information and communication technology:**

* Use Microsoft Publisher to access pamphlet templates.
* Search for appropriate images to import into the templates; create and use text boxes.
* Effectively present information acquired during the unit.

|  |  |  |
| --- | --- | --- |
| **UNIT PLAN: What are the effects of silage on a small rural stream?** | | |
| **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 |
| Students will understand that:   * People may have different views about the production and storage of silage. * People may prioritise differently the way they use and care for waterways and surrounding areas. | **Introduction**  Students are introduced to the unit. Silage making is a biotechnological process that provides high quality food for stock. However, people in the local area believe that this process may be damaging the environment and that run-off from silage may be the reason for the pollution of a popular fishing and eeling stream. |  |
|  | **Existing knowledge about silage**  The students write statements about their current understandings of silage and how they think it is made. These statements are displayed on the classroom wall and help guide the teacher when planning learning outcomes for the unit. The statements are also a good point of comparison later on in the unit. | Student statements describing their existing knowledge. |
| Students will understand that:   * Silage is made from pasture grasses which have been partially fermented and preserved. * Silage is preserved or ‘pickled’ by microorganisms which we can only see through a high powered microscope. * The bacteria change sugars in the grasses into lactic acid, which preserves the grasses. | **Researching the problem**  Students begin to carry out independent research about silage, what it is and how it is made. Some pictures of the bacteria involved in silage making can be used.  **Consulting the community of practice**  The students prepare questions for a visit from a farming expert. During this visit, the farmer explains the reason for making silage and the process of making it. Coloured photographs and some flow charts will help the students understand the process more easily. A bag of silage will give the students an opportunity to smell and handle silage. | Students’ questions. |
|  | **Developing expertise**  Students set up their own apparatus to make silage on a small scale.  Get activity: [Making your own silage](https://www.sciencelearn.org.nz/resources/2005-make-your-own-silage) | Silage stacks. |
| Students will be able to:   * Sequence the main stages of silage making using prepared illustrations. | **Processing the new information**  Based on their new understandings, students develop a flow chart that describes the stages involved in creating high quality silage. This allows them to assimilate their knowledge and gives an opportunity for the teacher to clarify any aspects of the process that may have been misinterpreted by the students. | Students’ flow charts showing the process involved in making silage. |
| Students will understand that:   * Stream life is a fragile eco-system that can be sensitive to pollution. * There are indicators of a healthy and unhealthy stream which students can identify. | **Planning the investigation**  After discussing the problem of the polluted stream, students plan how they can find out if silage is responsible for the damage. In small groups they brainstorm ideas, and then share these with the rest of the class. Together they construct a class plan. As part of this they decide to invite an expert from the local regional council to come and speak to them. During this visit, the expert describes water tests that are available and can guide the students in planning the next stage of their research for example ‘How do scientists identify a healthy stream?’ |  |
| Students will be able to:   * Identify different measures of a healthy/unhealthy stream. | Preparing the equipment  The teacher introduces the students to some water testing equipment. The local regional council may also help. Include, for example:   * turbidity test * pH tests * nitrate level test * animal identification guides. |  |
| Students will be able to carry out:   * turbidity tests * pH tests * nitrate tests * animal identification. | **Testing the equipment**  The students try out their testing equipment by using trough water and tap water brought in from a local farm. This provides an opportunity to carry out the tests in a supervised situation and to ensure that the tests are being used correctly. | Teacher observations and check list. |
| Students will be able to:   * Use appropriate instruments to enhance their observations of the two streams i.e. the turbidity tube test, nitrate test paper, animal identification dial, pH litmus paper test. * Carry out and interpret tests. * Record observations and measurements on provided work sheets. | **Two field trips**  **i) Visit to a healthy stream**  The students visit a clean, healthy stream (the regional council contact may help identify an appropriate one). After discussing the general catchment area and how to proceed with their testing, students carry out a range of tests. In addition, they carry out observations of the general environment, including plant growth, the condition of the stream banks, pathways, animal access to the stream and any signs of damage that may have occurred.  **ii) Visit to an unhealthy stream**  The students visit the polluted stream that is the focus of the study. Students repeat the testing and observations and begin to identify indicators of a healthy or unhealthy stream. |  |
| Students will understand that:   * Water pollution may be caused by several contributing factors rather than a single cause.   Students will be able to:   * Use results of observations and tests to formulate strategies to keep waterways healthy. * Understand and use the language associated with scientific investigation and the pollution of the stream e.g., turbidity test. | **Analysis of tests and observations**  Students discuss their findings for the water tests with their teacher and the regional council expert, including the indicators of a healthy and unhealthy stream and how this information relates to the results they had collected.  [The students in the case study realised that there was little difference in the nitrate levels of the two streams and concluded that runoff from the silage dump was most likely not the only cause of the pollution. They realised that a whole range of other indicators in combination was the probable cause of the water damage. They continued these discussions in groups and began to record their conclusions and also consider how to best format the information in their pamphlets.] |  |
| Students will understand that:   * The purpose and function of a pamphlet is to communicate information to a specific group of people in a concise and straightforward way. * It is important to consider the purpose, the message, the target audience and the content when creating a pamphlet. * A good pamphlet may contain the following features: an eye catching and interesting headline, simple language, factual information, easy to read font, attractive pictures, logos or some empty spaces. | **Thinking about pamphlets**  Ask students to look for examples of pamphlets at home and bring them to school. Have a colourful display already set up and add to it. This provides a resource for students to refer to as they think about their own pamphlets. Ask the students to choose one pamphlet that they particularly like and to describe why they like it. Use this discussion to generate a list of features describing a ‘good’ pamphlet. A helpful online resource is “[A Guide to Making Posters and Pamphlets](http://www.etu.org.za/toolbox/docs/organise/webposter.html)”.  Students work in groups of three, sketching some ideas for their pamphlet, thinking about visual appeal, the messages they want to provide, and which photographs they want to include. They can also refer back to the class collection of pamphlets to get further ideas, e.g., about font size and colour. When they are satisfied with their draft they share their ideas with their teacher and then make any modifications that they think are necessary. |  |
| Students will be able to:   * Describe the important features of a pamphlet. * Use Microsoft Publisher to create a pamphlet that summarises the findings of their investigation and provides information and guidance in the care of waterways. | **Making pamphlets to summarise students’ findings**  The students use Microsoft Publisher to select a template onto which they construct their pamphlets. The classroom teacher and the school’s ICT expert can guide students in the use of this programme. The pamphlets will summarise their understandings of silage, silage making, and advice to land owners about how to manage waterways and prevent pollution and damage occurring to these delicate areas. A first copy can be printed in black and white, checked it for errors and then printed again in colour. | The information pamphlet, summarising students’ learning. |

**Special delivery!** At the completion of this task as it was first carried out, the students’ pamphlets were delivered to the Education Officer at the local regional council who had been so helpful for the duration of the unit.