# Tea-Composition

## Suggested Lesson Plans
## Stage 4 Science

## Lesson plan format for lesson 1

<table>
<tr><td colspan="2">Class: Stage 4</td><td>Date: Lesson plan 1</td><td>Time: Start: _____<br>Finish: _____</td></tr>
<tr><td colspan="2">Key Learning Area: Science</td><td colspan="2">Lesson topic: Soils aren't just dirt.</td></tr>
<tr><td>Syllabus outcome(s):<br><br>ES3 Scientific knowledge influences the choices people make in regard to the use and management of the Earth's resources<br><br>-<br><br>-</td><td colspan="3">Indicators of learning for this lesson:<br><br><u>By the end of this lesson, the students will be able to:</u><br><br>- ES3 a. classify a range of the Earth's resources as renewable or non-renewable<br><br>- ES3 b. outline features of some of non-renewable resources, including metal ores and fossil fuels<br><br>-</td></tr>
<tr><td colspan="2">Any safety issues to be considered:<br>Agar plates need to be sealed and disposed of correctly.</td><td colspan="2">Resources:<br>A range of non-renewable and renewable objects, e.g. Aluminium cans, plastic bags, paper bags, sand, soil.<br><br>Agar plates that have been inoculated with microbes from a variety of sources, e.g. food or swabs from soils and different surfaces.</td></tr>
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## Lesson sequence for lesson 1

| **Lesson content / indicators of learning (*what* is taught):** | **Timing *(mins)*** | **Teaching strategies / learning experiences (*how* it is taught):** | **Resources and organisation:** |
|---|---|---|---|
| **INTRODUCTION** | | | |
| Resources can be classified as renewable and non-renewable.<br><br>Non-renewable resources are precious and have a limited supply.<br><br>Renewable resources can be broken down by natural processes to produce new resources. | 10 mins | Students (in groups) examine a range of resources and classify them as renewable or non-renewable.<br><br>Students develop (through brainstorming) a definition of renewable resources. | Aluminium cans, plastic bags, paper bags, sand, soil, fabric of various types, fruit, vegetables, grain. |
| **DEVELOPMENT** | | | |
| Renewable resources can be broken down by natural processes to produce new resources.<br><br>For recycling to occur, certain conditions must be met. Oxygen, moisture, warmth and microorganisms all play a role.<br><br>Microorganisms require certain conditions to live and thrive.<br><br>Different types of organic matter take longer to be broken down. It largely depends on the part of the plant. Stems take longer than leaves. | 25 mins | Teacher poses the question "How does recycling work?" and links recycling with renewable resources.<br><br>Students copy the nutrient cycle from *Dynamic Agriculture 7*-10, page 66, and highlight the need for microorganisms.<br><br>Students examine agar plates prepared from a variety of conditions and identify bacteria and fungi. This will be the stimulus for thinking about how decomposition occurs in compost bins and/or worm farms.<br><br>Students examine compost bins and/or worm farms, noting the breakdown of | <br><br>Brown, Hindmarsh and McGregor (2005) 3rd Edition *Dynamic Agriculture years 7-10*.<br><br>Agar plates are prepared beforehand, exposed to soil and incubated.<br><br>Compost bins or worm farms run at the school, ideally with a see-through panel. |

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| | | food waste, noting which conditions are working best. Note smell, warmth and moisture content. Students should note that some things decompose faster than others.<br><br>Students place lunch scraps in see-through compost bins / worm farms. | |
| The Tea Bag Index project aims to measure the health of soils across New South Wales (see experiment protocol included with the kit). | 15 mins | Introduce the Tea Bag Index project to students, including the aims and what the data will be used for. Discuss the importance of soil with students, and thus why it is important to monitor the health of soils. Relate the indicators of the health of the worm farm to the health of soils. | |
| **CLOSURE** | | | |
| Students use SurveyMonkey efficiently to carry out and collate a survey.<br><br>Students acknowledge their high level of consumption. | 10 mins | Students carry out a survey to see who uses recycling.<br><br>Students carry out an assessment of their environmental impact using the online Earth Day quiz. | SurveyMonkey.<br><br>https://www.earthday.org/take-action/footprint-calculator/ |

## Lesson plan format for lesson 2

<table>
<tr><td colspan="2">Class: Stage 4</td><td>Date: Lesson plan 2</td><td>Time: Start: _____<br>Finish: _____</td></tr>
<tr><td colspan="2">Key Learning Area: Science</td><td colspan="2">Lesson Topic: Rocks to soil</td></tr>
<tr><td>Syllabus outcome(s):<br><br>- CW4 In a chemical change, new substances are formed, which may have specific properties related to their uses in everyday life.<br><br>-<br><br>-</td><td colspan="3">Indicators of learning for this lesson:<br><br><u>By the end of this lesson, the students will be able to:</u><br><br>- CW4 c. investigate some examples of chemical change that occur in everyday life, e.g. photosynthesis, respiration and chemical weathering<br><br>-<br><br>-</td></tr>
<tr><td colspan="2">Any safety issues to be considered:<br><br>Dangers of heating and cooling rocks. Use safety glasses, heat proof mats.</td><td colspan="2">Resources:<br><br>Glass jars, freezer, plastic specimen container, 1M hydrochloric acid, Berlese Funnel, electronic scales.<br><br>Lech, M E and Trewin, C L 2013, Weathering, erosion, landforms and regolith teacher notes and student activities, 2nd Edition Record 2013/16. Geoscience Australia: Canberra.</td></tr>
</table>

## Lesson sequence for lesson 2

| **Lesson content / indicators of learning (*what* is taught):** | **Timing *(mins)*** | **Teaching strategies / learning experiences (*how* it is taught):** | **Resources and organisation:** |
|---|---|---|---|
| **INTRODUCTION** | | | |
| Soils are made up of many things, non-living and living. Soils can be broken down by chemical and physical means. | 35 mins | Teacher shows students a glass jar that has been filled completely with water, double wrapped in plastic bags and frozen. Students brainstorm ideas as to why the bottle has cracked. | Glass jar wrapped in plastic bags, left in the freezer prior to the lesson. |
| | | Students treat a variety of rocks with dilute (1M) hydrochloric acid by placing the rocks in small plastic specimen containers. Students may calculate % lost (especially with limestone). Observe initial, 20 minute and overnight changes. | A range of rocks from the local area, 1M hydrochloric acid, pipettes, plastic specimen containers, gloves, safety glasses. |
| | | Students use samples of soil to observe the water holding capacity of various soils. Students may weigh samples before and after drying (this can be done in an oven, on a tray near heating, or on a tray in the sun) and calculate % moisture. Relate this to the cracked bottle at the beginning – it was unable to expand with the water, but soils can expand and contract to different extents depending on their composition. | Scales, a range of soils from the local area. These may be 'made up' – high % sand, high % clay, high % organic matter. |
| | | Students set up a Berlese Funnel to capture soil organisms. | Berlese Funnel: http://www.instructables.com/id/Berlese-Funnel/ |

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| **DEVELOPMENT** | | | |
| Ideal soils are made up of about 40% clay, 40% sand, 15% silt and 5% organic matter. | 20 mins | Students collate information using e.g. Google Docs and compare the soil samples using soil hand texturing. | http://www.soil-net.com/sm3objects/activities/Activity_HandTexturing1.pdf |
| **CLOSURE** | | | |
| | 5 mins | Students predict the 'growing ability' of their soil – how close to 'ideal' are the soil samples? If there were organisms living in the soil, is this a reliable indicator of soil health? | |

## Lesson plan format for lesson 3

<table>
<tr><td>Class: Stage 4</td><td>Date: Lesson 3</td><td>Time: Start: _____<br>Finish: _____</td></tr>
<tr><td>Key Learning Area: Science</td><td colspan="2">Lesson Topic: Exploring the livestock in the soil</td></tr>
<tr><td>Syllabus outcome(s):<br><br>- LW5 Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems<br><br>-</td><td colspan="2">Indicators of learning for this lesson:<br><br><u>By the end of this lesson, the students will be able to:</u><br><br>- LW5 b. describe interactions between organisms in food chains and food webs, including producers, consumers and decomposers (ACSSU 112)<br><br>-</td></tr>
<tr><td colspan="2">Any safety issues to be considered:<br><br>Mustard powder – use PPE including safety glasses and gloves.<br><br>Be aware of possible irritation from compost and worm farms especially for asthmatics. Exclude if necessary.<br><br>Handling compost indoors may require masks depending on dust levels, and gloves.</td><td>Resources:<br><br>Worm farm - see www.youtube.com/watch?v=J3hWIZsm4z0 Ideally use one with a clear side.<br>Compost bin<br>Thermometers, data loggers<br>Time lapse camera or adaptor, tripod.</td></tr>
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## Lesson sequence for lesson 3

| **Lesson content / indicators of learning (*what* is taught):** | **Timing *(mins)*** | **Teaching strategies / learning experiences (*how* it is taught):** | **Resources and organisation:** |
|---|---|---|---|
| **INTRODUCTION** | | | |
| Students predict the effect of an absence of decomposers on plant growth.<br><br>Students develop skills in the use of technology.<br><br>Students develop skills in graphing. | 40 mins | Students examine the worm farms and compost bins and observe the changes that have occurred since lesson 1.<br><br>Group may be split into two.<br>Students set up time lapse camera to observe further changes.<br><br>Students set up thermometers or data loggers to record the changes in the temperature of the compost bin after more material is added. Compare to ambient temperature. Graph over time. If possible, add a moisture probe. | Worm farm, compost bin.<br>https://www.youtube.com/watch?v=9ZHTerOJYMA<br><br>Time lapse camera<br><br>Data loggers, probes |
| **DEVELOPMENT** | | | |
| | 15 mins | Teacher leads discussion about changes to the worm farm since last observation.<br><br>Students test various areas for estimated numbers of worms. | Students pour 1.5 litres of water mixed with 2 tablespoons of mustard powder to bring the worms to the surface:<br>https://www.learner.org/jnorth/tm/worm/WormHunt.html<br>The mustard irritates the worms' skin but does not cause them any harm.<br>Safety glasses, gloves |

| **CLOSURE** | | | |
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| | 5 mins | Students collate worm estimates and add them to their Google Docs on soils.<br><br>Students revise their estimates of 'growing ability'. | |

## Lesson plan format for lesson 4

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| **Class:** Stage 4 | **Date:** Lesson 4 | **Time:** Start: _____<br>Finish: _____ |
| **Key Learning Area:** Science | **Lesson Topic:** Fine tuning | |

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| **Syllabus outcome(s):**<br><br>- LW5 Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems<br><br>-<br><br>- | **Indicators of learning for this lesson:**<br><br>*By the end of this lesson, the students will be able to:*<br><br>**- LW5 f.** describe how scientific knowledge has influenced the development of practices in agriculture, e.g. animal husbandry or crop cultivation to improve yields and sustainability, or the effect of plant-cloning techniques in horticulture.<br><br>-<br><br>- |

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| **Any safety issues to be considered:** | **Resources:**<br><br>https://www.dpi.nsw.gov.au/agriculture/soils/structure/cultivation<br><br>http://www.cilr.uq.edu.au/UserImages/File/Legumes%20and%20Nitrogen%20Cycle_web.pdf<br><br>http://www.cilr.uq.edu.au/UserImages/File/What%20are%20Legumes_web.pdf |

## Lesson sequence for lesson 4

| **Lesson content / indicators of learning (*what* is taught):** | **Timing *(mins)*** | **Teaching strategies / learning experiences (*how* it is taught):** | **Resources and organisation:** |
|---|---|---|---|
| **INTRODUCTION** | | | |
| Soils vary because of their temperature, composition, plant and animal life, aspect and level of cultivation. | 5 mins | Teacher draws together the idea that soils differ in many ways. Students brainstorm the reasons for these differences, hopefully coming up with things such as cultivation (or lack thereof), the types of plants that are there and the temperature experienced by the area. | |
| **DEVELOPMENT** | | | |
| Plants can be simply divided into legumes and non-legumes. Legumes can put nutrients back into the soil. | 15 mins | Teacher introduces the concept of legumes and non-legumes using the PowerPoint presentations from the University of Queensland. Students construct a nitrogen cycle diagram. | http://www.cilr.uq.edu.au/UserImages/File/Legumes%20and%20Nitrogen%20Cycle_web.pdf<br><br>http://www.cilr.uq.edu.au/UserImages/File/What%20are%20Legumes_web.pdf |
| Technology has enabled humans to devise cultivation techniques that better suit soils.<br><br>Temperature is important in soil development. | 10 mins | Teacher introduces the concept that cultivation can vary. Students complete a worksheet describing the machinery commonly used, adding pictures and evaluating the desirability of each machine. | https://www.dpi.nsw.gov.au/agriculture/soils/structure/cultivation |
| Teabags of different composition will degrade at different rates | 30 mins | Students examine samples of different types of tea, noting the 'softness' of green tea and the 'hardness' of red tea and predict that the green tea will decompose faster than red tea. Discuss the purpose of the experiment, soil health and our dependence on soil, and discuss what could | Tea bags, plastic cylinders (plastic bottles), waterproof marking pens (red and green).<br><br>Tea-Composition protocol and equipment. |

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| | | happen to soils with climate change. Students 'plant out' teabags in different areas according to the Tea-Composition protocol. You may choose to include one or more replicates with 'hot house' cylinders (optional). | |
| **CLOSURE** | | | |
| | *5* mins | Revise what was done during the lesson, particularly the importance of the Tea-Composition project – why the students are completing the project and what the data will be used for. | |

## Lesson plan format for lesson 5

<table>
<tr><td colspan="2">Class: Stage 4</td><td>Date: Lesson 5</td><td>Time: Start: _____<br>Finish: _____</td></tr>
<tr><td colspan="2">Key Learning Area: Science</td><td colspan="2">Lesson Topic: Digging up the evidence<br>This lesson will occur ~90 days after the previous lesson.</td></tr>
<tr><td>Syllabus outcome(s)<br><br>LW5 Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems<br><br>-<br><br>-</td><td colspan="3">Indicators of learning for this lesson:<br><br><u>By the end of this lesson, the students will be able to:</u><br><br>- LW5 f. describe how scientific knowledge has influenced the development of practices in agriculture, e.g. animal husbandry or crop cultivation to improve yields and sustainability, or the effect of plant-cloning techniques in horticulture<br><br>-<br><br>-</td></tr>
<tr><td colspan="2">Any safety issues to be considered:</td><td colspan="2">Resources:<br><br>Teatime4science website</td></tr>
</table>

## Lesson sequence for lesson 5

| **Lesson content / indicators of learning (*what* is taught):** | **Timing *(mins)*** | **Teaching strategies / learning experiences (*how* it is taught):** | **Resources and organisation:** |
|---|---|---|---|
| **INTRODUCTION** | | | |
| Soil activity and health can depend on many factors.<br><br>The Tea Bag Index assists in developing an indicator of soil health and may help us see the effects of climate change. | 15 mins | Students dig up the tea bags as per the instructions. They are then dried and weighed and the results are recorded in the table from the University of Sydney. | Trowels, etc from the Tea-Composition kit. |
| **DEVELOPMENT** | | | |
| 'Tea bag' results should relate to the characteristics of the soil.<br><br>Students make conclusions about the soil sampled.<br><br>Students predict the growing ability of other soils from the Tea-Composition project. | Some time later<br><br>20 mins | Soil samples are taken from the 'planted' areas and sent to the University of Sydney for analysis<br><br>Analysis is compared to the things known about the soil – temperature, whether it is disturbed or undisturbed, microbial activity, pH, etc. | The University of Sydney |
| **CLOSURE** | | | |
| Soils that have a similar index should have similar land use. | 10 mins | Students map soils of a similar Tea Bag Index onto a regional map and compare their land use. | |

## Suggested assessment task

Students can be asked to present their findings from the Tea-Composition project as a video/photo blog that may take the form of a news report, documentary, a song and film clip, or any other creative video presentation that would appeal to the audience. The assessment task proposed below will allow your school to address this for Stage 4.

- **Stage 4 syllabus link:** ES3 Scientific knowledge influences the choices people make in regard to the use and management of the Earth's resources

Task title: How can we ensure soil security?
Students could present their videos/photo blogs (in their chosen format) in a symposium format with a judging panel, or to the class during a lesson. The presentations will be both teacher- and peer-reviewed. To ensure each task is unique, perhaps each group could focus on a different agricultural practice that impacts soil health, e.g. till versus no till, crop rotation, use of legumes as alternative crops, or comparing managed and unmanaged soils (so the task is directly related to the Tea-Composition project).

Introduction – overview of human impact on the environment (e.g. climate change), humans' impact on soil as a specific example. If soil is not managed and used in a sustainable way, its future security is uncertain and this will have wide-reaching negative effects. How does this contrast with Indigenous land management practices?

Body – discussion about why it is important to measure and monitor soil quality, and how the students were able to do this throughout the Tea Bag Index project. Students present their methodology and their data about soil properties and health in this section, including a comparison between the managed and unmanaged soils. They must also make explicit reference to their specific agricultural practice that impacts upon soil health.

Conclusion – what did the students learn about the soil in their local environment? What combination of practices leads to the healthiest soil? (ideally looking for aspects such as no till, crop rotation and use of legumes to return nutrients to the soil)

Implications – does the soil in the students' local environment need to be better managed? How can Australia's soil security be ensured in the future? Can we utilise Indigenous land management practices to improve the management of Australia's soil? Students can also consider some explicit links with what they learned about climate change and the managed versus unmanaged burial site decomposition rates from the tea bag practical.

## Evaluation

## Suggested self and peer evaluation form

In rating yourself and your peers, use a one-to-five point scale where:
5 = best work possible, on task and self-motivated, a group player
4 = pretty good work, some reminders needed
3 = ok work, would be better with more effort or focus
2 = not great, off task a lot and not really helping with the group. Needs more effort
1 = Major distraction to the group, others had to do your part

| Names (begin with your own) | Participated in group discussions or meetings | Helped keep the group focussed on the task | Contributed useful ideas | Quantity of work done | Quality of work done | | Total scores |
|---|---|---|---|---|---|---|---|
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## Suggested self and peer evaluation form (continued)

Strength(s) of the group:

Weakness(es) of the group:

Ways you resolved conflicts:

What could you have done better during this group project?

Additional comments: