**Stage 1 Chemistry**

**Polymers/Plastics; Are plastics labelled as biodegradable better for the environment?**

Practical Investigation Task: Deconstruct a problem and  
design a method for which the outcome is unknown.

**Introduction and Purpose of this task:**

After making plastic from potato starch in a previous lesson and considering other biodegradable options from which plastics may be produced, it is now important to consider how these materials and other polymers are disposed.

Plastics, one type of polymer, are a problem for the environment, some may be degradable, but others persist for hundreds of years and even release toxins that could be detrimental to living system organisms and their ecosystems.

In this task, you need to deconstruct the problem “Are plastics labelled as biodegradable really better for the environment?” You might consider the claims of manufacturers of biodegradable coffee pods, green waste bin liners or shopping bags.

As you deconstruct the problem and do some research consider the following: What is the process that occurs for plastic/polymer to be broken down? How long does it take for the plastic/polymer to breakdown? What are the conditions needed for plastic/polymer to be broken down? How do you know that the plastic/polymer has degraded and what has it degraded into? Are the degradation products safe?

After you have deconstructed the problem, design a detailed method to the test a hypothesis you have constructed based on one of the problems/questions listed above. Consider all variables (Independent, dependent, constant variables) and factors that cannot be controlled. Predict the results that would be obtained to support the hypothesis, and consider the possible limitations of the investigation. Include some justification for the choices made to ensure a fair test was designed. Include a possible results table.

Then conduct an investigation, with your own method or one provided by the teacher.

**Part A: Deconstruct and Design**

Individually, you research the question “How can the rate of decomposition of plastics labelled as biodegradable be increased?” and deconstruct the problem and design an investigation which includes the following steps:

* Deconstruct the problem by breaking it down into parts from which you will select one to investigate
* Construct an aim and hypothesis
* Identify variables, factors that must be controlled, cannot be controlled
* Address safety and other risks, and ethical considerations if applicable
* Prepare a detailed method
* Justify decisions made about the method (could be annotations)
* Suggest possible results if the hypothesis was supported, and link the relevant chemistry, including equations if applicable.
* Describe any limitations of the experiment or the conclusions that could be drawn, provide justification for these conclusions
* Include references

**Part B: Conduct and investigation.**

Carry out the investigation in designated groups. Each individual to collect their own observations and data. You may in negotiation with your teacher perform your own method, however, if not appropriate, a method will be provided to you by the teacher.

**Part C: Analysis of Data and Evaluation of Procedures.**

Individually, you will prepare a report with all of the following:

* Introduction
* Hypothesis
* variables
* materials and method used
* safety and/or ethical considerations
* results
* discussion (analysis and evaluation)
* conclusion (justified and any limitations)
* consider the environmental implication of their results.

**Assessment conditions for this task:**

**Part A:** Students work individually. Total of 4 A4 single sided pages (minimum font size 10) to show evidence of deconstruct and design.

**Part B:** In class, working in groups. Appropriate time will be allocated to enable students to collect data.

**Part C:** Students present their own individual report. Word count for Part C is 1000 words. *Only* the following sections of the report are included in the word count:

* introduction
* hypothesis
* variables
* analysis of results
* evaluation of method/procedure
* conclusion, with justification and limitations.

**Assessment Design Criteria**

Investigation, Analysis and Evaluation: 1, 2, 3, 4 Knowledge and Application: 1, 4

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| **Performance** **Standards** | | **A** | **B** | **C** | **D** | **E** |
| **Investigation, Analysis and Evaluation** |  | Critically deconstructs a problem and designs a logical, coherent, and detailed chemistry investigation.  Obtains records, and represents data, using appropriate conventions and formats accurately and highly effectively.  Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.  Critically and logically evaluates procedures and their effects on data. | Logically deconstructs a problem and designs a well-considered and clear chemistry investigation.  Obtains, records, and represents data, using appropriate conventions and formats mostly accurately and effectively.  Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.  Logically evaluates procedures and their effects on data. | Deconstructs a problem and designs a considered and generally clear chemistry investigation.  Obtains, records, and represents data, using generally appropriate conventions and formats with some errors but generally accurately and effectively.  Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.  Evaluates procedures and some of their effects on data. | Prepares a basic deconstruction of a problem and an outline of a chemistry deconstruction and investigation.  Obtains, records, and represents data, using conventions and formats inconsistently, with occasional accuracy and effectiveness.  Describes data and undertakes some basic interpretation to formulate a basic conclusion.  Attempts to evaluate procedures or suggest an effect on data. | Attempts a simple deconstruction of a problem and a simple procedure for a chemistry deconstruction and investigation.  Attempts to record and represent some data with limited accuracy or effectiveness.  Attempts to describe results and/or interpret data to formulate a basic conclusion.  Acknowledges that procedures affect data. |
| **Knowledge and Application** |  | Demonstrates deep and broad knowledge and understanding of a range of chemical concepts.  Applies chemical concepts highly effectively in new and familiar contexts.  Critically explores and understands in depth the interaction between science and society.  Communicates knowledge and understanding of chemistry coherently with highly effective use of appropriate terms, conventions and representations. | Demonstrates some depth and breadth of knowledge and understanding of a range of chemical concepts.  Applies chemical concepts mostly effectively in new and familiar contexts.  Logically explores and understands in some depth the interaction between science and society.  Communicates knowledge and understanding of chemistry mostly coherently with effective use of appropriate terms, conventions, and representations. | Demonstrates knowledge and understanding of a general range of chemical concepts.  Applies chemical concepts generally effectively in new or familiar contexts.  Explores and understands aspects of the interaction between science and society.  Communicates knowledge and understanding of chemistry generally effectively using some appropriate terms, conventions, and representations. | Demonstrates some basic knowledge and partial understanding of chemical concepts.  Applies some chemical concepts in familiar contexts.  Partially explores and recognises aspects of the interaction between science and society.  Communicates basic chemical information, using some appropriate terms, conventions, and/or representations. | Demonstrates some limited recognition and awareness of chemical concepts.  Attempts to apply chemical concepts in familiar contexts.  Attempts to explore and identify an aspect of the interaction between science and society.  Attempts to communicate information about chemistry. |

Performance Standards for Stage 1 Biology

| - | Investigation, Analysis, and Evaluation | Knowledge and Application |
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| A | Critically deconstructs a problem and designs a logical and coherent biological investigation with detailed justification.  Obtains, records, and represents data, using appropriate conventions and formats accurately and highly effectively.  Systematically analyses and interprets data and evidence to formulate logical conclusions with detailed justification.  Critically and logically evaluates procedures and their effect on data. | Demonstrates deep and broad knowledge and understanding of a range of biological concepts.  Applies biological concepts highly effectively in new and familiar contexts.  Critically explores and understands in depth the interaction between science and society.  Communicates knowledge and understanding of biology coherently, with highly effective use of appropriate terms, conventions, and representations. |
| B | Logically deconstructs a problem and designs a well-considered and clear biological investigation with reasonable justification.  Obtains, records, and represents data, using appropriate conventions and formats mostly accurately and effectively.  Logically analyses and interprets data and evidence to formulate suitable conclusions with reasonable justification.  Logically evaluates procedures and their effect on data. | Demonstrates some depth and breadth of knowledge and understanding of a range of biological concepts.  Applies biological concepts mostly effectively in new and familiar contexts.  Logically explores and understands in some depth the interaction between science and society.  Communicates knowledge and understanding of biology mostly coherently, with effective use of appropriate terms, conventions, and representations. |
| C | Deconstructs a problem and designs a considered and generally clear biological investigation with some justification.  Obtains, records, and represents data, using generally appropriate conventions and formats, with some errors but generally accurately and effectively.  Undertakes some analysis and interpretation of data and evidence to formulate generally appropriate conclusions with some justification.  Evaluates procedures and some of their effect on data. | Demonstrates knowledge and understanding of a general range of biological concepts.  Applies biological concepts generally effectively in new or familiar contexts.  Explores and understands aspects of the interaction between science and society.  Communicates knowledge and understanding of biology generally effectively, using some appropriate terms, conventions, and representations. |
| D | Prepares a basic deconstruction of a problem and an outline of a biological investigation.  Obtains, records, and represents data, using conventions and formats inconsistently, with occasional accuracy and effectiveness.  Describes data and undertakes some basic interpretation to formulate a basic conclusion.  Attempts to evaluate procedures or suggest an effect on data. | Demonstrates some basic knowledge and partial understanding of biological concepts.  Applies some biological concepts in familiar contexts.  Partially explores and recognises aspects of the interaction between science and society.  Communicates basic biological information, using some appropriate terms, conventions, and/or representations. |
| E | Attempts a simple deconstruction of a problem and a procedure for a biological investigation.  Attempts to record and represent some data, with limited accuracy or effectiveness.  Attempts to describe results and/or interpret data to formulate a basic conclusion.  Acknowledges that procedures affect data. | Demonstrates limited recognition and awareness of biological concepts.  Attempts to apply biological concepts in familiar contexts.  Attempts to explore and identify an aspect of the interaction between science and society.  Attempts to communicate information about biology. |

**Teacher Notes:**

This article, Recycling Science: Test Biodegradable Products in an Indoor Composter provides some ideas on what methods might be possible to use to test the biodegradability of different materials. URL: <https://www.scientificamerican.com/article/bring-science-home-biodegradable-products/> accessed 30/08/2018.