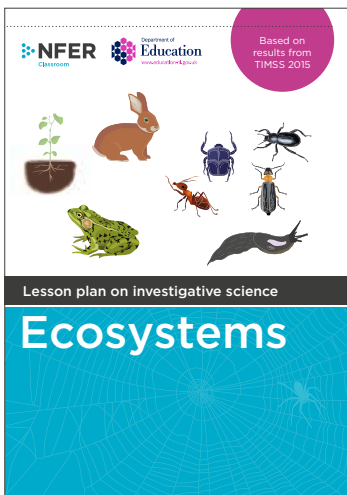
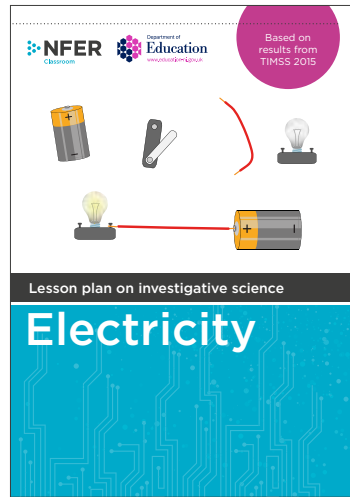





# Lesson plans on investigative science

# TIMSS lesson plans



The design of these science lesson plans has been informed by the performance of Year 6 primary school pupils in Northern Ireland on the TIMSS 2015 science assessments. They cover areas from the science curriculum that pupils in Northern Ireland should be doing well in but the TIMSS data indicates these are areas in which pupils are not performing as well as expected.

 Introduction

 Links with TIMSS data

# Introduction

## What is TIMSS?

TIMSS is Trends in International Mathematics and Science Study. It is an international assessment conducted in a range of countries across the world every four years. TIMSS provides valuable comparative information about the relative strengths and weaknesses of participating countries' education systems and can also be used to track changes in performance over time.

These science lesson plans are based upon the findings from the most recent TIMSS study<sup>1</sup>.

## What does TIMSS assess?

TIMSS is a curriculum based assessment of mathematics and science. It assesses pupils in grade 4 (ages 9-10) and grade 8 (ages 13-14). In 2015, Northern Ireland only participated in the grade 4 assessments.

The grade 4 TIMSS science assessments are divided into three science content areas – life sciences, physical sciences and earth science. As well as assessing content knowledge within these areas, TIMSS also assesses scientific enquiry and investigative skills.

In addition to assessing science and mathematics, TIMSS also collects valuable background information from questionnaires completed by teachers, principals, pupils and parents / guardians about the school, classroom and home environment. These questionnaires provide a rich source of information to help contextualise the attainment data from the TIMSS assessments.

## Who participated in TIMSS 2015?

Over forty countries across Europe, North and South America, Africa and Asia took part in the TIMSS science grade 4 assessments in 2015. In Northern Ireland, 118 primary schools were involved in the study.

## What does TIMSS tell us about science teaching and learning in primary schools in Northern Ireland?

### 1. Overall performance in science

Northern Ireland's performance in science was above the international average for TIMSS in 2015, but it was nevertheless outperformed by 22 countries. Performance in science was comparatively less strong than in mathematics.

The performance of pupils in Northern Ireland on questions assessing Life Science and Earth Science topics was significantly better than their performance on questions assessing Physical Sciences topics.

### 2. Pupils' attitudes to science

Pupils in Northern Ireland reported positive attitudes towards science. For example, a higher proportion of pupils reported that they liked and enjoyed learning science compared to the international average. Pupils also reported high levels of confidence in science. Pupils in Northern Ireland were also categorised as experiencing very engaging teaching in science lessons to a greater extent than most other countries in TIMSS.

### 3. Science lessons – Duration and content

The time devoted to teaching science in Northern Ireland was below the international average for countries participating in TIMSS.

Additionally in Northern Ireland only a very small proportion of Year 6 pupils were taught by science teachers who reported placing an emphasis on science investigation in at least half of their science lessons. This was considerably below the international average and was also a decline from TIMSS in 2011.

### 4. Teachers expertise in science

In Northern Ireland, the vast majority of teachers surveyed in TIMSS 2015 were not specialist primary science teachers, with only 12 per cent having a science specialism.

<sup>1</sup>for further details about Northern Ireland's performance in TIMSS see [www.nfer.ac.uk/media/1539/99957.pdf](http://www.nfer.ac.uk/media/1539/99957.pdf)

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## Why have lesson plans been provided for these particular topics?

We have designed lessons plans on the following topics: ecosystems and plants, electricity, evaporation and dissolving.

These four topics have been selected for a number of reasons:

- Based on analysis of Northern Ireland's performance on TIMSS science, questions assessing these topics were identified as ones where Northern Ireland performed significantly below the international average. Therefore they provide opportunities to reinforce learning in topics where pupils in Northern Ireland are less secure.
- Pupils in Northern Ireland tended to score below the international average on TIMSS items assessing scientific investigation and enquiry. Therefore these particular topics have been chosen as they provide opportunities to incorporate a significant amount of practical and investigative work within the lessons. Each lesson is designed to have a strong practical and investigative element. This is based on the TIMSS finding that pupils in Northern Ireland are less likely than their international counterparts to be taught by teachers who place a strong emphasis on practical investigation within their science lessons. All four lesson plans have been designed so that they do not require specialist resources and all equipment required should be easily accessible for primary schools.
- These topics afford the opportunity to provide lesson plans that make use of real life meaningful contexts for investigation, rather than just doing an experiment for the sake of it. This is consistent with the wider aims of the World Around Us curriculum in Northern Ireland.
- The topics have been selected to cover a range of different areas of science, including biology (plants and ecosystems lesson plan), chemistry (dissolving and evaporation lesson plans) and physics (electricity lesson plan). The reason that no lesson plans have been created for Earth science topics is due to the fact that they provide less opportunity for hands on practical and investigative science.
- The lesson plans have been carefully designed so that they each have a specific focus on a different investigative skill or set of skills. These plans therefore provide rich opportunities for pupils to develop a range of practical and investigative skills in a variety of different contexts.

# Link with TIMSS data

The tables below show which items in TIMSS 2015 pupils from Northern Ireland performed less well than internationally from four key areas of the Northern Ireland science and technology progression guidance all assessed within the context of scientific enquiry. These areas are dissolving, electricity, ecosystems and evaporation. The tables also show how the lesson plans have been designed to focus on these four areas within the context of developing scientific skills.



# Dissolving

## Item in TIMSS 2015 assessing dissolving for which pupils in NI underperformed.

Item ID:	SO41134A: Dissolving sweets
Pupil performance:	TIMSS international average - 28% of pupils achieved full marks on this question Northern Ireland - 18% of pupils achieved full marks on this question

### Cognitive Domain: Reasoning

Items in TIMSS fall into one of the following categories - **knowing, applying** or **reasoning**.

**Reasoning** questions require pupils to engage in reasoning to analyse data and other information, draw conclusions, and extend their understanding to new situations. In contrast to the more direct applications of science facts and concepts, questions in the reasoning domain involve unfamiliar or more complicated contexts. Answering such questions can involve more than one approach or strategy. Scientific reasoning also encompasses developing hypotheses and designing scientific investigations.

### Content Area of TIMSS Question

This item comes from the physical sciences domain and assesses pupils' knowledge and understanding of the factors affecting rates of dissolving using a practical investigative context.

### Number of marks

The item is worth 1 mark and is a reasoning question in which pupils are required to analyse the elements of a scientific problem and provide an explanation.

### Description of item

The item has two parts. In the first part pupils are required to compare two different methods of dissolving and select which method would lead to the solute dissolving faster. The second part of the question requires pupils to explain the reasoning for their answer.

### Why is the item not included in the lesson plan?

This item is a TIMSS secure item that is being used to measure trends in science performance over time. Consequently, the actual item cannot be included in this lesson plan.

Lesson 1 objective	<p>To investigate if the size of solid particles affect how quickly the solid dissolves.</p> <p>To practise skills of observation, design and evaluating.</p>
TIMSS item linked to – Item ID	<p>S041134A</p> <p>Dissolving sweets</p>
Pupil performance on TIMSS item	<p>NI: 18%</p> <p>International average: 28%</p>
TIMSS content domain for item	<p>4. Physical changes observed in everyday life:</p> <p>C. Identify ways of increasing how quickly material dissolves in a given amount of water (temperature, stirring, and surface area); and compare the concentrations of two solutions with different amounts of solute or solvent.</p>
TIMSS cognitive domain for item	<p><b>Reasoning</b></p> <p><b>Analyse</b> - Identify the elements of a scientific problem and use relevant information, concepts, relationships, and data patterns to answer questions and solve problems.</p> <p><b>Explain</b> - provide or identify an explanation for an observation or a natural phenomenon using a science concept or principle.</p>
Lesson link to Science and Technology progression guidance	<p><b>Section 5 – skills progression</b></p> <p><b>Observation</b></p> <ul style="list-style-type: none"> <li>• Use the senses to observe and describe.</li> <li>• Suggest reasons for significant observations by examining evidence and making links between possible cause and effect.</li> </ul> <p><b>Design</b></p> <ul style="list-style-type: none"> <li>• Design and carry out fair tests, identifying what should be changed and what should be kept the same.</li> </ul> <p><b>Evaluating</b></p> <ul style="list-style-type: none"> <li>• Draw conclusions by examining evidence, identifying patterns and making links between cause and effect.</li> </ul> <p><b>Section 6 – progression in understanding</b></p> <p><b>CoT1:</b></p> <ul style="list-style-type: none"> <li>• Materials can interact with each other – some mix and combine whilst others don't.</li> </ul> <p><b>CoT2:</b></p> <ul style="list-style-type: none"> <li>• Changes in materials can be temporary or permanent.</li> </ul>

Lesson 2 objective	To compare the effects of two variables on how quickly jelly dissolves. To practise skills of predicting, doing and evaluating.
TIMSS item linked to - Item ID	S041134A Dissolving sweets
Pupil performance on TIMSS item	NI: 18% International average: 28%
TIMSS content domain for item	4. Physical changes observed in everyday life: C. Identify ways of increasing how quickly material dissolves in a given amount of water (temperature, stirring, and surface area); and compare the concentrations of two solutions with different amounts of solute or solvent.
TIMSS cognitive domain for item	<p><b>Reasoning</b></p> <p><b>Analyse</b> - Identify the elements of a scientific problem and use relevant information, concepts, relationships, and data patterns to answer questions and solve problems.</p> <p><b>Explain</b> - provide or identify an explanation for an observation or a natural phenomenon using a science concept or principle.</p>
Lesson link to Science and Technology progression guidance	<p><b>Section 5 – skills progression</b></p> <p><b>Predicting</b></p> <ul style="list-style-type: none"> <li>• Make and test predictions, examine evidence and make links between possible causes and effects.</li> <li>• Predict likely consequences and evaluate the outcomes.</li> </ul> <p><b>Doing</b></p> <ul style="list-style-type: none"> <li>• Identify and order patterns and relationships through a range of strategies such as grouping, classifying and reclassifying, comparing and contrasting.</li> </ul> <p><b>Evaluating</b></p> <ul style="list-style-type: none"> <li>• Question the accuracy and reliability of evidence and how it could be improved.</li> </ul> <p><b>Section 6 – progression in understanding</b></p> <p><b>CoT1:</b></p> <ul style="list-style-type: none"> <li>• Materials can interact with each other – some mix and combine whilst others don't.</li> </ul> <p><b>CoT2:</b></p> <ul style="list-style-type: none"> <li>• Materials can exist in different states.</li> </ul> <p><b>CoT2:</b></p> <ul style="list-style-type: none"> <li>• States of materials can be changed from one to another.</li> </ul>



# Electricity

## Items in TIMSS 2015 assessing electricity for which pupils in NI underperformed.

Item ID:	SO41195: Bulb lights in which circuit
Pupil performance:	TIMSS international average - 19% of pupils achieved full marks on this question Northern Ireland - 10% of pupils achieved full marks on this question

### Cognitive Domain: Applying

Cognitive Domain: Applying

Items in TIMSS fall into one of the categories - **knowing**, **applying** or **reasoning**.

**Applying** questions require students to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in contexts likely to be familiar in the teaching and learning of science.

### Content Area of TIMSS Question

This item comes from the physical sciences domain (forms of energy and energy transfer) and assesses pupils' knowledge of connecting components in a circuit.

### Number of marks

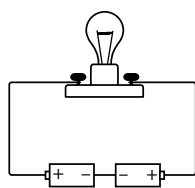
The item is worth 1 mark and is an applying question in which pupils are required to apply their knowledge of how batteries should be connected to create a functioning circuit.

### Description of item

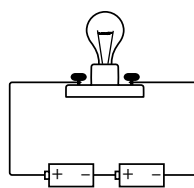
The item has two parts. In the first part, pupils are required to indicate in which of the two circuits the bulb will light. The second part of the question requires pupils to explain the reasoning for their answer.

### The item

Bob has four identical batteries, two light bulbs, and some wire. He sets up two circuits, as shown below.



Circuit 1



Circuit 2

In which circuit(s) will the bulb light?

(Tick one box.)

- Circuit 1 only
- Circuit 2 only
- Circuits 1 and 2

Explain your answer.

**Answer:** Circuit 2 only ticked and an explanation identifying that both batteries face the same way.

Item ID:	S061047: Object X complete circuit
Pupil performance:	TIMSS international average - 76% of pupils achieved full marks on this question Northern Ireland - 70% of pupils achieved full marks on this question

## Cognitive Domain: Applying

Items in TIMSS fall into one of the categories - **knowing, applying** or **reasoning**.

**Applying** questions require students to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in contexts likely to be familiar in the teaching and learning of science.

## Content Area of TIMSS Question

This item comes from the physical sciences domain (forms of energy and energy transfer) and assesses pupils' knowledge of objects and materials that conduct electricity.

## Number of marks

The item is worth 1 mark and is an applying question in which pupils are required to apply their knowledge of electrical conductors to a given context.

## Description of item

The item is multiple choice.

## Why is the item not included in the lesson plan?

This item is a TIMSS secure item that is being used to measure trends in science performance over time. Consequently, the actual item cannot be included in this lesson plan.

<p><b>Lesson 1 objective</b></p>	<p>To use a variety of components (bulbs, batteries, switches) to make electrical circuits that work (understanding these are complete circuits) and to identify why a circuit is not working. To understand that the components in a circuit must be connected correctly and if more than one battery is used they must be aligned correctly.</p> <p>To practise skills of observation and prediction.</p>
<p><b>TIMSS item linked to - Item ID</b></p>	<p>SO41195</p> <p>Bulb lights in which circuit</p>
<p><b>Pupil performance on TIMSS item</b></p>	<p>NI: 10%</p> <p>International average: 19%</p>
<p><b>TIMSS content domain for item</b></p>	<p>4. Electricity and simple electrical systems:</p> <p>C. Explain that simple electrical systems, such as a flashlight, require a complete (unbroken) electrical pathway.</p>
<p><b>TIMSS cognitive domain for item</b></p>	<p><b>Applying</b></p> <p><b>Use models</b> - use a diagram or other model to demonstrate knowledge of science concepts, to illustrate a process cycle relationship, or system, or to find solutions to science problems.</p> <p><b>Explain</b> - provide or identify an explanation for an observation or a natural phenomenon using a science concept or principle.</p>
<p><b>Lesson link to Science and Technology progression guidance</b></p>	<p><b>Section 5 – skills progression</b></p> <p><b>Observation</b></p> <ul style="list-style-type: none"> <li>• Use the senses to observe and describe.</li> <li>• Suggest reasons for significant observations by examining evidence and making links between possible cause and effect.</li> </ul> <p><b>Predicting</b></p> <ul style="list-style-type: none"> <li>• Make and test predictions, examine evidence and make links between possible causes and effects.</li> <li>• Predict likely consequences and evaluate the outcomes.</li> </ul> <p><b>Section 6 – progression in understanding</b></p> <p><b>ME1:</b></p> <ul style="list-style-type: none"> <li>• A completed circuit is needed for the electricity to ‘flow’.</li> </ul>

Lesson 2 objective	To find out about conductors and insulators of electricity and to make links to the dangers of electricity. To practise skills of planning and evaluating.
TIMSS item linked to - Item ID	S061047 Object X complete circuit
Pupil performance on TIMSS item	NI: 70% International average: 76%
TIMSS content domain for item	4. Electricity and simple electrical systems: A. Identify objects and materials that conduct electricity
TIMSS cognitive domain for item	<b>Applying</b> <b>Interpret information</b> - use knowledge of science concepts to interpret relevant textual, tabular, pictorial, and graphical information.
Lesson link to Science and Technology progression guidance	<h2>Section 5 – skills progression</h2> <p><b>Planning</b></p> <ul style="list-style-type: none"> <li>• Be able to plan and set goals.</li> <li>• Select the most appropriate methods for a particular task.</li> </ul> <p><b>Evaluating</b></p> <ul style="list-style-type: none"> <li>• Draw conclusions by examining evidence, identifying patterns and making links between cause and effect.</li> </ul> <h2>Section 6 – progression in understanding</h2> <p><b>ME1:</b></p> <ul style="list-style-type: none"> <li>• Some materials (conductors) carry electricity; some (insulators) do not.</li> <li>• If a circuit is deliberately broken to stop the flow of electricity and then completed again, this constitutes a switch.</li> </ul> <p><b>PDMU:</b></p> <ul style="list-style-type: none"> <li>• There are dangers associated with the use of electricity and electrical appliances.</li> </ul>

# Ecosystems

## Items in TIMSS 2015 assessing ecosystems for which pupils in NI underperformed.

Item ID:	S051194: Test design for plant seedlings
Pupil performance:	TIMSS international average - 24% of pupils achieved full marks on this question Northern Ireland - 19% of pupils achieved full marks on this question

### Cognitive Domain: Reasoning

Items in TIMSS fall into one of the following categories - **knowing**, **applying** or **reasoning**.

**Reasoning** questions require pupils to engage in reasoning to analyse data and other information, draw conclusions, and extend their understanding to new situations. In contrast to the more direct applications of science facts and concepts, questions in the reasoning domain involve unfamiliar or more complicated contexts. Answering such questions can involve more than one approach or strategy. Scientific reasoning also encompasses developing hypotheses and designing scientific investigations.

### Content Area of TIMSS Question

This item comes from the life sciences domain and assesses pupils' understanding of how to carry out a fair test in the context of testing if plant seedlings need light to grow.

### Number of marks

The item is worth 1 mark and consists of two parts. The first part is multiple-choice to select the most appropriate test design, and the second part is an open response explanation.

### Description of item

Pupils are given the context of a girl finding out if plant seedlings need light to grow. They are provided with three possible scenarios and have to select the most appropriate for testing this out, and then provide an explanation for their answer.

### Why is the item not included in the lesson plan?

This item is a TIMSS secure item that is being used to measure trends in science performance over time. Consequently, the actual item cannot be included in this lesson plan.

Item ID:	S051186: Desert food chain
Pupil performance:	TIMSS international average – 72% of pupils achieved full marks on this question Northern Ireland – 63% of pupils achieved full marks on this question

### Cognitive Domain: Applying

Items in TIMSS fall into one of the following categories - **knowing, applying** or **reasoning**.

**Applying** questions require students to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in contexts likely to be familiar in the teaching and learning of science.

### Content Area of TIMSS Question

This item comes from the life sciences domain and assesses pupils' understanding of the interdependence of plants and animals through applying their knowledge of food chains in a desert habitat.

### Number of marks

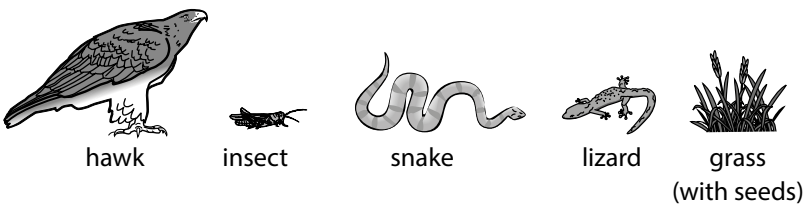
The item is worth 1 mark.

### Description of item

This is a selected response item in which pupils have to select the correct animals to complete a food chain.

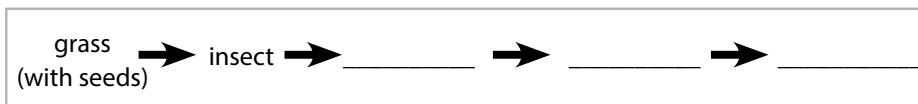
### The item

The living things shown in the picture all live in the desert.



Alfie starts to draw a food chain using the living things shown above. He puts the grass and the insect into the food chain because he knows that insects eat grass seeds.

Complete the food chain by writing in the names of the three missing living things.



**Answer:**



Item ID:

S051007: Importance of spiders

Pupil performance:

TIMSS international average – 54% of pupils achieved full marks on this question

Northern Ireland – 48% of pupils achieved full marks on this question

## Cognitive Domain: Applying

Items in TIMSS fall into one of the following categories – **knowing, applying** or **reasoning**.

**Applying** questions require students to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in contexts likely to be familiar in the teaching and learning of science.

## Content Area of TIMSS Question

This item comes from the life sciences domain and assesses a pupil's ability to apply their understanding of the interdependence of organisms and recognise you cannot get rid of an animal you do not like because all animals are important for the environment.

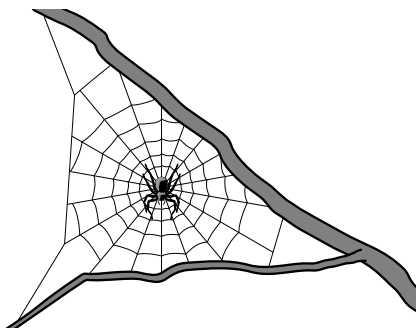
## Number of marks

The item is worth 1 mark.

## Description of item

The item is open response and requires pupils to give a reason for the importance of spiders in the garden.

David wants to get rid of the spiders in his garden. Mohammad tells him this is a bad idea because spiders are important for the environment.



Write down one reason why it is important to have spiders in a garden.

### Answer:

A reason given that recognises spiders eat other organisms or that other organisms eat spiders so they maintain the balance of the food chain / ecosystem. If spiders were removed the numbers of other animals may be affected.

<b>Lesson 1 objective</b>	<p>To find out how sunlight affects the growth of plants and to link the evidence to the understanding that the leaves of a plant need energy from sunlight to be able to produce their own food.</p> <p>To practise the skills of observation and design of a fair test.</p>		
<b>TIMSS item linked to – Item ID</b>	S051194 Test design for plant seedlings	S051186 Desert food chain	S051007 Importance of spiders
<b>Pupil performance on TIMSS item</b>	NI: 19% International average: 24%	NI: 63% International average: 72%	NI: 48% International average: 54%
<b>TIMSS content domain for item</b>	<p>1. How plants and animals obtain energy:</p> <p>B. Explain that plants need sunlight to make their food, while animals eat plants or other animals to get their food.</p> <p>2. Relationships in a simple food chain:</p> <p>A. Complete a model of a simple food chain using common plants and animals from familiar communities, such as a forest or a desert.</p> <p>B. Describe the roles of living things at each link in a simple food chain (plants produce their own food, some animals eat plants, other animals eat the animals that eat plants).</p>		
<b>TIMSS cognitive domain for item</b>	<p><b>Reasoning</b> (S051194)</p> <p><b>Design investigations</b> - Plan investigations or procedures appropriate for answering scientific questions or testing hypotheses; and describe or recognize the characteristics of well-designed investigations in terms of variables to be measured and controlled and cause-and-effect relationships.</p> <p><b>Applying</b> (S051186 and S051007)</p> <p><b>Use Models</b> (S051186) - Use a diagram or other model to demonstrate knowledge of science concepts, to illustrate a process cycle relationship, or system, or to find solutions to science problems.</p> <p><b>Explain</b> (S051007) - Provide or identify an explanation for an observation or a natural phenomenon using a science concept or principle.</p>		



## Section 5 – skills progression

### Observation

- Use the senses to observe and describe.
- Suggest reasons for significant observations by examining evidence and making links between possible cause and effect.

### Doing

- Identify and order patterns and relationships through a range of strategies such as grouping, classifying and reclassifying, comparing and contrasting.

### Evaluating

- Draw conclusions by examining evidence, identifying patterns and making links between cause and effect.
- Explain and justify methods, opinions and conclusions.
- Question the accuracy and reliability of evidence and how it could be improved.

## Section 6 – progression in understanding

### PL1, PL2:

- Animals and plants together form ecosystems and interdependence within systems is essential.

<b>Lesson 2 objective</b>	<p>To draw a conclusion linking to scientific understanding.</p> <p>To understand that all food chains begin with a green plant because green plants make their own food using energy from sunlight.</p> <p>To begin to recognise the importance of organisms within an ecosystem.</p> <p>To practise the skills of drawing conclusions and evaluation information.</p>		
<b>TIMSS item linked to - Item ID</b>	S051194 Test design for plant seedlings	S051186 Desert food chain	S051007 Importance of spiders
<b>Pupil performance on TIMSS item</b>	NI: 19% International average: 24%	NI: 63% International average: 72%	NI: 48% International average: 54%
<b>TIMSS content domain for item</b>	<p>1. How plants and animals obtain energy:</p> <p>B. Explain that plants need sunlight to make their food, while animals eat plants or other animals to get their food.</p> <p>2. Relationships in a simple food chain:</p> <p>A. Complete a model of a simple food chain using common plants and animals from familiar communities, such as a forest or a desert.</p> <p>B. Describe the roles of living things at each link in a simple food chain (plants produce their own food, some animals eat plants, other animals eat the animals that eat plants).</p>		
<b>TIMSS cognitive domain for item</b>	<p><b>Reasoning</b> (S051194)</p> <p><b>Design investigations</b> - Plan investigations or procedures appropriate for answering scientific questions or testing hypotheses; and describe or recognize the characteristics of well-designed investigations in terms of variables to be measured and controlled and cause-and-effect relationships.</p> <p><b>Applying</b> (S051186 and S051007)</p> <p><b>Use Models</b> (S051186) - Use a diagram or other model to demonstrate knowledge of science concepts, to illustrate a process cycle relationship, or system, or to find solutions to science problems.</p> <p><b>Explain</b> (S051007) - Provide or identify an explanation for an observation or a natural phenomenon using a science concept or principle.</p>		

## Section 5 – skills progression

### Observation

- Use the senses to observe and describe.
- Suggest reasons for significant observations by examining evidence and making links between possible cause and effect.

### Design

- Choose appropriate equipment and techniques to measure accurately.
- Design and carry out fair tests, identifying what should be changed and what should be kept the same.

### Recording and communicating

- Develop methods for collating and recording and monitoring progress on a task.

## Section 6 – progression in understanding

### PL1, PL2:

- Animals and plants can be influenced over time by seasonal or environmental change.
- Animals and plants together form ecosystems and interdependence within systems is essential.

# Evaporation

## Item in TIMSS 2015 assessing evaporation for which pupils in NI underperformed.

Item ID:	S061080: Puddle of water
Pupil performance:	TIMSS international average - 59% of pupils achieved full marks on this question Northern Ireland - 48% of pupils achieved full marks on this question

### Cognitive Domain: Reasoning

Items in TIMSS fall into one of the following categories - **knowing, applying** or **reasoning**.

**Knowing** questions assess pupils' knowledge of facts, relationships, processes, concepts, and equipment. Accurate and broad-based factual knowledge enables pupils to successfully engage in the more complex cognitive activities essential to the scientific enterprise.

### Content Area of TIMSS Question

This item comes from the physical sciences domain and assesses pupils' knowledge and understanding of a context in which evaporation is occurring.

### Number of marks

The item is worth 1 mark and is a knowledge question in which pupils are required to identify a description of the process occurring in a given context.

### Description of item

Pupils are given a context in which a puddle of water decreases in size. They are asked to review a number of descriptions to select the correct one that best describes why this has occurred.

### Why is the item not included in the lesson plan?

This item is a TIMSS secure item that is being used to measure trends in science performance over time. Consequently, the actual item cannot be included in this lesson plan.

Item ID:	S061041: Boiling water
Pupil performance:	TIMSS international average – 49% of pupils achieved full marks on this question Northern Ireland – 25% of pupils achieved full marks on this question

## Cognitive Domain: Reasoning

Items in TIMSS fall into one of the following categories - **knowing, applying** or **reasoning**.

**Applying** questions require pupils to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in contexts likely to be familiar in the teaching and learning of science.

## Content Area of TIMSS Question

This item comes from the physical sciences domain and assesses pupils' understanding of evaporation in a given context.

## Number of marks

The item is the first in a question with two items and is worth 1 mark. It is a reasoning question in which pupils are required to apply their knowledge of the process of evaporation to a given context in order to give an explanation.

## Description of item

For this item, pupils are given a picture of a context in which evaporation is occurring and asked to provide an explanation of what is happening.

## Why is the item not included in the lesson plan?

This item is a TIMSS secure item that is being used to measure trends in science performance over time. Consequently, the actual item cannot be included in this lesson plan.

Item ID:	S061034: Wet clay
Pupil performance:	TIMSS international average - 24% of pupils achieved full marks on this question Northern Ireland - 10% of pupils achieved full marks on this question

## Cognitive Domain: Applying

Items in TIMSS fall into one of the following categories - **knowing, applying** or **reasoning**.

**Applying** questions require pupils to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in contexts likely to be familiar in the teaching and learning of science.

## Content Area of TIMSS Question

This item comes from the physical sciences domain and assesses pupils' understanding of evaporation in a given context.

## Number of marks

The item is worth 1 mark and requires pupils to apply their knowledge of evaporation to give an explanation.

## Description of item

The item requires pupils to give an explanation for what happens to the water when wet clay dries.

## Why is the item not included in the lesson plan?

This item is a TIMSS secure item that is being used to measure trends in science performance over time. Consequently, the actual item cannot be included in this lesson plan.

Lesson 1 objective	<p>To understand the process of evaporation and to plan an investigation to decide on the most suitable container for a bird water bowl.</p> <p>To design a fair test and consider a range of factors.</p>		
TIMSS item linked to - Item ID	S061080 Puddle of water	S061041 Boiling water	S061034 Wet clay
Pupil performance on TIMSS item	NI: 48% International average: 59%	NI: 25% International average: 49%	NI: 10% International average: 24%
TIMSS content domain for item	<p>4. Physical changes observed in everyday life:</p> <p>B. Describe changes in the state of water (melting, freezing, boiling, evaporation, and condensation) and relate these state changes to changes in temperature.</p>		
TIMSS cognitive domain for item	<p><b>Knowing</b> (S061080, S061041 and S061034)</p> <p><b>Recall/Recognize</b> - Identify or state facts, relationships, and concepts; identify the characteristics or properties of specific organisms, materials and processes.</p> <p><b>Applying</b> (S061080, S061041 and S061034)</p> <p><b>Explain</b> - provide or identify an explanation for an observation or a natural phenomenon using a science concept or principle.</p>		
Lesson link to Science and Technology progression guidance	<p><b>Section 5 – skills progression</b></p> <p><b>Planning</b></p> <ul style="list-style-type: none"> <li>• Be able to plan and set goals. Select the most appropriate methods for a particular task.</li> </ul> <p><b>Doing</b></p> <ul style="list-style-type: none"> <li>• Experiment and investigate real life issues.</li> <li>• Engage with a range of problem-solving methods. Seek out problems to solve.</li> <li>• Design and carry out fair tests, identifying what should be changed and what should be kept the same.</li> </ul> <p><b>Section 6 – progression in understanding</b></p> <p><b>CoT2:</b></p> <ul style="list-style-type: none"> <li>• Materials can exist in different states.</li> <li>• States of materials can be changed from one to another.</li> </ul>		

<b>Lesson 2 objective</b>	<p>To make the link between surface area and how much water evaporates in a given time.</p> <p>To recognise that evaporation is a temporary change and that water vapour can change back to liquid water by the process of condensation.</p> <p>To practise the skills of recording results, and concluding by drawing together information from different sources.</p>		
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<b>TIMSS cognitive domain for item</b>	<p><b>Knowing</b> (S061080, S061041 and S061034)</p> <p><b>Recall/Recognize</b> - Identify or state facts, relationships, and concepts; identify the characteristics or properties of specific organisms, materials and processes.</p> <p><b>Applying</b> (S061080, S061041 and S061034)</p> <p><b>Explain</b> - provide or identify an explanation for an observation or a natural phenomenon using a science concept or principle.</p>		
<b>Lesson link to Science and Technology progression guidance</b>	<p><b>Section 5 – skills progression</b></p> <p><b>Doing</b></p> <ul style="list-style-type: none"> <li>• Question the reliability of evidence.</li> <li>• Explain and justify methods, opinions and conclusions.</li> </ul> <p><b>Evaluating</b></p> <ul style="list-style-type: none"> <li>• Draw conclusions by examining evidence, identifying patterns and making links between cause and effect.</li> <li>• Explain and justify methods, opinions and conclusions.</li> <li>• Question the accuracy and reliability of evidence and how it could be improved.</li> </ul> <p><b>Recording and communicating</b></p> <ul style="list-style-type: none"> <li>• Have a sense of audience and purpose when communicating.</li> </ul> <p><b>Section 6 – progression in understanding</b></p> <p><b>CoT2:</b></p> <ul style="list-style-type: none"> <li>• Materials can exist in different states.</li> <li>• States of materials can be changed from one to another.</li> </ul>		



