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Ring Binder
Background

**NEED – Northern Environmental Education Development**

The Northern Environmental Education Development (NEED) project is a transnational cooperation project between Ireland, Finland, Norway and Iceland and is a part of the Northern Periphery Programme 2007-2013. The project is designed to develop an innovative, operational model to improve the educational use of geo-scientific knowledge in sites of Natural value.

The focus of the project is:

- environmental education and educational tourism
- environmental awareness amongst local inhabitants
- conserving natural environments and cultural heritage
- networking between the urban and rural educational and tourism resources

**Project Funding**

The project is funded under the Northern Periphery Programme, which is part of the EU’s Interreg IVB funding program. The Northern Periphery Programme aims to encourage and support transnational co-operation between the regions of Europe. It provides the opportunity for organisations from the programme area to work together on joint projects concerning common issues and problems.

**Project Management**

The National Partner of the NEED Project in Ireland is the Burren Connect Project (Clare County Council). Regional partners include the Geological Survey of Ireland, the Cliffs of Moher Visitor Experience, Shannon Development, National University of Ireland, Galway, The Burren Centre Kilfenora, Burrenbeo Trust Ltd, The Burren Outdoor Education Centre, Clare Farm Heritage Tours Co-op and Burren National Park/ National Parks and Wildlife Service.

**Project & Partner Websites**

NEED Project: [www.geoneed.org](http://www.geoneed.org)

Burren Connect Project: [www.burrenconnect.ie](http://www.burrenconnect.ie)

Burren & Cliffs of Moher Geopark Project: [www.burrengeopark.ie](http://www.burrengeopark.ie)

Geological Survey of Ireland: [www.gsi.ie](http://www.gsi.ie)

Shannon Development: [www.shannondevelopment.ie](http://www.shannondevelopment.ie)

Cliffs of Moher: [www.cliffsomohere.ie](http://www.cliffsomohere.ie)

The Burren Centre: [www.burrencentre.ie](http://www.burrencentre.ie)

Burren Outdoor Education Centre: [www.burrenec.ie](http://www.burrenec.ie)

Burrenbeo Trust Ltd: [www.burrenbeo.ie](http://www.burrenbeo.ie)

Burren National Park: [www.burrennationalpark.ie](http://www.burrennationalpark.ie)

County Clare Farm Heritage Tours Co-op: [www.farmheritagetours.com](http://www.farmheritagetours.com)
Introduction

This education resource pack has been designed to promote geology as a theme in the teaching of the geography and science subject areas of the Social, Environmental and Scientific Education (SESE) curriculum at primary level and Geography at the Junior and Senior Certificate at secondary level.

The pedagogical philosophy of this education resource pack is based on the gaining of an insight into the geology, geography and environment of the Burren. By building up a knowledge foundation of the rocks and past environments of the region, students can begin to appreciate the vast history of this local region.

The Burren landscape provides excellent learning opportunities and the study modules within this education pack include outdoor aspects, whereby learners can be immersed in that unique natural learning environment. The activities are linked to learning centres at the Burren Centre Kilfenora, the Cliffs of Moher Experience Visitor Centre, the Burren Outdoor Education Centre, the Burrenbeo Trust Centre and to outdoor environments such as the Burren National Park and the Clare Farm Heritage Tours.

The pack is divided into four main themes devised by the Northern Environmental Education Development (NEED) project – Elements of Geology, Landscape, Natural Hazards and Climate Change. Under each theme are a number of modules amounting to eight in total. Teachers' instructions are included in this booklet, while information sheets and student worksheets for each module are contained within the ring binder.

Each module can stand alone as an individual lesson plan or can be linked with others in the pack. Teachers can adapt each of the modules to the particular age group that they are teaching using the information sheets provided.

School curriculum linkages

This education resource pack has been designed to link into the learning curriculum at both primary and secondary level.

At Primary Level the links are to the Social, Environmental and Scientific Education (SESE) curriculum as follows:

**SESE Geography:**
- **STRAND: NATURAL ENVIRONMENTS**
  - Unit: The local natural environment
  - Unit: Rocks and Soil
  - Unit: Land, rivers and seas of Ireland
  - Unit: Weather, climate and atmosphere

**STRAND: ENVIRONMENTAL AWARENESS AND CARE**
- Unit: Environmental Awareness
- Unit: Caring for the Environment

**SESE Science:**
- **STRAND: MATERIALS**
  - Unit: Forces
  - Unit: Properties and characteristics of materials
  - Unit: Materials and Change

**STRAND: ENVIRONMENTAL AWARENESS**
- Unit: Environmental Awareness
- Unit: Science and the Environment
- Unit: Caring for the Environment

At second level the education resource pack links to both the Junior and Leaving Certificate Geography Syllabus as follows:

**Junior Certificate Geography:**
- **SECTION A: THE HUMAN HABITAT**
  - Processes and Change

The Burren is specifically identified as a suitable study area in the Junior Certificate Geography syllabus.

**Senior Certificate Geography (Ordinary and Higher Level):**
- **CORE UNIT 1: PATTERNS AND PROCESSES IN THE PHYSICAL ENVIRONMENT**
  - 1.1. The tectonic cycle
  - 1.2. The rock cycle
  - 1.3. Landform development

- **CORE UNIT 2: REGIONAL GEOGRAPHY**
  - 1.4. The concept of a region
    - Karst landscapes (the Burren is specifically identified as a study area for this section of the Leaving Certificate syllabus)

- **CORE UNIT 3: THE GEOGRAPHICAL INVESTIGATION AND SKILLS UNIT**
Section A: Elements Of Geology

Module A1: Understanding important stages of geological time

**Learning objectives**
- Students learn about various important stages in the 4.5 billion year history of Earth.
- They gain an appreciation of the immense age of the Earth and how humans have only recently arrived on Earth.
- They begin to understand where events associated with the development of the Burren fit into the history of the Earth.

**Materials Required**
- One “washing line” set, each containing sixteen “time period” pictures. Available for download at www.geoneed.org:
  - 5 metre length of cord/fishing line
  - Clothes pegs to attach “time period” sheets to the washing line
  - Drawing pins to fix the line to the wall
- Information sheets (1, 2, 3 and 4)
  1. Formation of the Earth
  2. Geological Time
  3. Earths geological time periods
  4. Ireland during the Carboniferous Period
- Map 1
  Palaeography – Ancient Environments
- Student Work sheet (1 and 2)
  1. ‘Washing Line of Time’
  2. Geological Time

**Class Preparation**
The students need to have a basic understanding with regard to the formation of the earth, the concept of geological time and how time is divided into geological periods. The information sheets included with this module provide the background information which the teacher can adapt to the level of understanding of his/her students. In the case of the older student the information sheets can be circulated and read by the student. Class discussion should be encouraged with regard to these topics and to ensure that all pupils understand the concepts involved, before undertaking the activities.

**Instructions**
Students are informed that the washing line represents the 4,560 million years since the formation of the Earth. The end of the washing line which represents today is indicated. Students place the “time period” sheets in the position of time that they think the events happened. Helpful hints are contained in the text beneath the pictures. Students answer worksheet questions as part of a guided discussion using the information sheets provided.

**Suggested Locations for Activity**
- Classroom
- Burrenbeo Centre, Kinvara
- Burren Outdoor Education Centre
- Burren Centre, Kilfenora

Module A2: Interpreting geological maps and map reading

**Learning objectives**
Students become familiar with the geology of Ireland and begin to identify the geology of specific locations. They learn to observe how landscape topography is often related to geology. The students learn to read and interpret geology maps.

**Materials Required**
- Map 2
  Bedrock geology map of Ireland
- Student Work sheet (3)
  3. Rocking around Ireland

**Class Preparation**
The students should have a basic understanding with regard to the mapped geography of Ireland and the names and locations of the counties. The bedrock geology map of Ireland, which is provided, should be studied in terms of the colour coding and how it relates to the rock type of the area which is shaded. Class discussion should be encouraged with regard to these topics and to ensure that all pupils understand the concepts involved, before undertaking the activities.

**Instructions**
Each pair of students is given a bedrock geology map of Ireland.
The students are asked to examine the map, taking note of the different colours that are used for different rocks.
The different ages of the different rocks are discussed – noting that some similar rock types (e.g. sandstone) were formed at different time periods.
Students answer the questions on the work sheets ‘Rocking around Ireland’

**Suggested Locations for Activity**
- Burren Outdoor Education Centre
- Burren Centre, Kilfenora
- Cliffs of Moher Visitor Centre
- Burrenbeo Centre, Kinvara
Section B: Landscape

Module B3: The rocks of the Burren

Learning objectives
This module enables the student to focus on the rocks of north County Clare and the Burren region. Students are taught to identify and differentiate between the three main bedrock types that are found in the region and how they differ in their origins and composition. The characteristic features of rocks often provide clues about how the rocks were formed.

This module will enable the student:
• To learn how to read and interpret geology maps
• To identify the characteristic features of, and the differences between the three main rock types of the Burren region
• To learn of the origin of each of the three main rock types found in the Burren region

Materials required
• Information Sheets (5, 6 and 7)
  5. How Rocks are formed
  6. How the limestones of North Clare were formed
  7. How the shales, siltstones and sandstones of North Clare were formed
• Map 3
  Bedrock geology map of North Clare
• Student Work sheets (4, 5, 6, 7, 8 and 9)
  4. The Rocks of the Burren and North County Clare
  5. Rocks of the Burren Word Puzzle
  6. Reading the rocks
  7. Limestone
  8. Shale
  9. Sandstone and siltstone
• For experiments:
  Rock samples (limestone/ shale/sandstone or siltstone)
  Dilute HCl acid (10%)
  Sandpaper

Class Preparation
The teacher should work through the information sheets for this module with the students adapting the information supplied to the level of understanding of the class. Class discussion should refer to the various topics of geological time, the three ways in which rocks are formed, the Carboniferous period of Earth history, the idea of a tropical sea covering the Burren, and the concept of what a delta is.

The class should be instructed on how acid can dissolve alkaline such as the calcium carbonate found in limestone; how rain water is naturally slightly acidic and how the action of rainfall on the Burren dissolves the limestone creating a karst landscape. (See Information sheets for Module D8).

Instructions
• Each student/pair of students is given a copy of the bedrock geology map of north County Clare
• The students are asked to examine the map and to identify the different rocks shown on the map
• The ages of the rocks found in north County Clare are discussed, referring back to the bedrock geology map of Ireland for ages and names of rock types (Module A2; Map 2)
• Students compare the rocks in Co. Clare with rocks found elsewhere in Ireland.
• Students answer the questions on worksheets 4–9.
• Each pair of students is then given two samples of a rock and the accompanying worksheets

Using the worksheets (7-9)
Students describe the characteristics of each rock type to the best of their ability.

Students drop a little dilute hydrochloric acid (HCl) acid on each rock to determine if the acid reacts and indicates the presence of calcium carbonate (e.g. limestone).

Suggested Locations for Activity
Classroom
Burrenbeo Centre, Kinvara
Burren Centre, Kilfenora
Burren Outdoor Education Centre
Cliffs of Moher Visitor Centre
Flaggy Shore
Doolin Pier
Fanore Beach
Poulnabrone
Burren National Park
Michael Cusack Centre
Module B4: Fossils in the rocks

Learning objectives
This module will enable the students:
• to understand the connection between fossils and rock types.
• to learn how fossils can help identify the environment in which the rocks formed.

Materials Required
• Sheets of paper (A4 preferably)
• Pencil
• Crayons or dark coloured chalk
• Ruler
• Information sheets (8, 9, 10 and 11)
  8. The Burren fossils
  9. Identifying coral fossils
  10. Identifying brachiopod fossils
  11. Identifying crinoid fossils
• Student Work sheet (10)
  10. The Burren fossils

Class Preparation
The teacher should work through the information sheets with the students prior to working in the field using the photo guides and worksheets supplied. The students should understand how the fossils came to be part of the rock and why there are different types of fossils in different types of rock e.g. shale and limestone.

Instructions
Students are asked to look for and discover fossils in the rocks of the paths, steps, fence slabs and walls near their school, the Cliffs of Moher Visitor Centre, Burren National Park, Fanore Beach - or any other Burren location, using the photo guide provided.

Students use the paper and crayon/chalk to trace or draw/sketch the fossils they discover.

A discussion is held about the type of fossils discovered. The discussion then leads on to what type of environment was present when the fossil was preserved (e.g. worm trails on silty sea floor; broken coral in shallow wave affected marine environment), using the information sheets provided. Students complete work sheet 10.

Suggested Locations for Activity
Classroom/School Yard
Caherconnell Stone Fort
Fanore Beach
Flaggy Shore
Doolin Pier
Cliffs of Moher Visitor Centre
Section C: Natural Hazards

Module C5: Earthquakes

Learning objectives
- To investigate where earthquakes occur and why they occur in these places and not in others
- To consider Ireland's location with regard to earthquake zones
- To realise that natural geological processes can lead to human catastrophes
- To understand how tsunamis are created by earthquakes
- To realise that Ireland was once hit by a tsunami in 1755
- To appreciate how quickly a tsunami can travel and how this can impact on emergency response
- To consider how the coast of Clare could be affected by a tsunami and to consider factors that may be involved in an emergency response to a tsunami alert.

Materials Required
- Information Sheet (12)
- Map 4: The Earth's tectonic plates
- Student Work sheets (11, 12 and 13)
  11. 'Where does the Earth quake?'
  12. Lisbon earthquake - tsunami travel times
  13. Lisbon Earthquake 1755

Class Preparation
The students should be familiarised with the concept that the earth's surface is made up of different plates that float on the plastic (neither solid nor liquid) upper mantle. These plates are in constant motion. When they crash against each other, the edge of one plate may be crumpled up to form mountains, whilst the other plate may sink down below the crumpled-up plate edge. Pressure builds up where plates collide – and when this pressure is suddenly released – we get earthquakes. When earthquakes occur at sea, the result can be a tsunami.

Instructions
- Students study and discuss the map of the Earth's tectonic plates (on their worksheet or in the Cliffs of Moher Centre Atlantic Edge exhibition - Panel 4-5).
- Students discuss tsunamis and great waves that occur in the sea (e.g. the large wave off the Cliffs of Moher).
- Students study the maps and diagrams on the worksheets and answer the accompanying questions

Suggested Locations for Activity
- Classroom
- Cliffs of Moher Visitor Centre
- Burrenbeo Centre, Kinvara
- Burren Outdoor Education Centre
- Burren Centre, Kilfenora

Module C6: Rocks under stress

Learning objectives
- To consider where on Earth (e.g. plate boundaries, mountain ranges) rocks may become subjected to stress (folding and faulting)
- To understand how rocks can be broken and deformed (strained) by the actions of stress (physical force)
- To discover how heat and pressure can affect the properties of a solid object such as a rock
- To learn how such processes shaped the rocks around Mullaghmore in the Burren

Materials Required
- 2 Mars Bars (1 cold; 1 warm)
- Information Sheet (13)
- 13. Tilted limestones
- Student Work sheet (14)
- 14. Stressed Out

Class Preparation
The teacher works through the information sheet supplied to familiarise the students with the concept of how rocks are placed under stress by earth movements, heat and pressure and how such stresses result in folding and tilting of the rocks and sometimes breaks in the rock (faults).

Instructions
- Using a cold Mars bar (from fridge or outdoors) and a warm Mars bar (from a warm pocket or even sat on for some time), demonstrate how the same object can behave differently when undergoing stress (bending) in a warm or cold state.
- Students answer questions on worksheets and observe the folded strata of Mullaghmore in the Burren.

Suggested Locations for Activity
- Classroom
- Burren National Park, Gortalecka Nature Trail
- Burren Outdoor Education Centre
- Burren Centre, Kilfenora
- Clare Farm Heritage Tours


Section D: Climate Change

Module D7: The action of ice

Learning objectives
This module will help the students understand that there has been at least six ice ages throughout the Earth's history. Working through this module the students will begin to understand that the last Ice Age in Ireland shaped the landscape we see today. They will observe how the moving ice sheets left clues in the landscape of the direction in which the ice sheets moved.

They will gain an understanding of why Ireland has relatively mild weathers compared to other countries/places at the same latitude.

The students will begin to appreciate that climate change is a natural process, but that humans can accelerate this process and that the retreat of the polar ice sheets can have detrimental environmental effects.

Materials Required

- Information Sheets (14, 15, 16 and 17)
  14. Glaciers
  15. The Burren during the last ice age
  16. Glacial deposits in the Burren
  17. Melting ice and sea level change

- Student Work sheets (15, 16 and 17)
  15. Clues to the ice age
  16. Melting ice and sea level
  17. Why no sea ice in winter?

Class Preparation

Class discussion, prior to completing the worksheets, should include the following topics:

- the type of winter weather conditions experienced in Ireland and compare them with those that occur in Newfoundland and Siberia (both at a similar latitude to Ireland).
- how the Atlantic weather systems affect our winter weather and how winter weather in Ireland might be affected by weather systems coming from the north (e.g. winter in early and late 2010).

Instructions

The teacher works through the supplied information sheets with the students adapting the information to the particular age group being taught. Students then complete the supplied worksheets.

Suggested Locations for Activity

Classroom
Burren Centre, Kilfenora
Burren Outdoor Education Centre
Burrenbeo Centre, Kinvara
Cliffs of Moher Visitor Centre
Doolin Pier
Burren National Park

Module D8: Water and the Burren

Learning objectives
This module explores how water has shaped and formed the landscape of the Burren, creating a unique ‘glaciokarst’ landscape. It helps the student understand that this process has been going on for a very long time and is still happening today. The student will be enabled to identify the unique features of the Burren that are the result of this process and how the hydrology of the Burren works.

Materials Required

- Information Sheets (18, 19, 20, 21 and 22)
  18. Karst landscapes
  19. Features of a karst landscape
  20. The formation of terraces in the Burren
  21. Caves and springs in the limestone
  22. Freeze-thaw action on limestone

- Student Work sheets (18)
  18. Karst features

Class Preparation

The students should work through Module B3 to familiarise themselves about the acidic nature of rainwater and how this acidity can dissolve the calcite in limestone.

They should also be aware of the action of the last ice age on the rocks of the Burren and how the shales, sandstones and siltstones were eroded from the surface of the north Burren, exposing the bare limestone underneath which was then exposed to dissolution by the rainwater.

Instructions

The teacher works through the supplied information sheets with the students adapting the information to the particular age group being taught. Students then complete work sheet 18.

Suggested Locations for Activity

Classroom
Burren National Park, Gortalecka Nature Trail
Doolin Cave
Clare Farm Heritage Tours
Burren Outdoor Education Centre
Burrenbeo Centre, Kinvara
Cliffs of Moher Visitor Centre
Poulnabrone
Carron
Fanore Beach
Flaggy Shore
Also in this series are:

Stone, Water and Ice – A geology trip through the Burren. This handy A5 size book gives an introduction to the fascinating story of the Burren landscape. The origin and unique geology of the Burren is presented using a variety of maps, illustrations and photographs. This book introduces nine locations (geosites) in the Burren, where characteristic features of the landscape may be observed – allowing the reader to appreciate how the Burren is a landscape moulded and shaped by stone, water and ice.

The Stone, Water and Ice Z-Card is the ideal pocket sized guide to the many visitor centres and educational environments in the Burren, where visitors can experience and learn about the unique character of this Atlantic-edge landscape.

Stone, Water and Ice – The Geology of the Burren Region is an A4 sized scientific review of the widely researched and fascinating geology of the Burren region. This review provides detailed information on topics such as palaeogeography, lithology, palaeontology, geomorphology, and the occurrence of mineral resources in the region.

Look for the Stone, Water and Ice information panels located at visitor centres and learning environments throughout the Burren.