GEOSCIENCE FOR LEAVING CERTIFICATE GEOGRAPHY

Continuing Professional Development Course 2023

DYNAMIC COASTS MODULE PLAN

Charlene O'Hagan (St Vincent's Secondary School, Dundalk), Gregor Rink (UoG, iCRAG) Phoebe Walsh (UCD, iCRAG) David Hardy (Geological Survey Ireland)

iCRAG
SFI RESEARCH CENTRE IN APPLIED GEOSCIENCES

Geological Survey
Suirbhéireacht Gheolaíochta
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An Roinn Comhshaoil, Aeráide agus Cumarsáide
Department of the Environment, Climate and Communications

Geoscience for Leaving Certificate Geography Teachers CPD programme

About the Geoscience for Leaving Certificate Geography Teachers CPD programme

Geoscience is vital for our sustainable future, and geography is the key gateway to geoscience for most students. The Geoscience for Leaving Certificate Geography Teachers CPD programme has been developed by iCRAG (the Science Foundation Ireland Centre for Research in Applied Geosciences) and Geological Survey Ireland to create an opportunity for teachers and geoscience professionals to come together to increase the awareness of geoscience within the Leaving Certificate geography curriculum.

During the CPD course, teachers and geoscience professionals from both research and industry are paired together to co-create curriculum facing resources that are freely available for use. Over the course of six evening sessions, teachers learn more about the cutting-edge geoscience being undertaken by their partnered geoscientists, before working together to develop a curriculum-facing resource using their interests, teaching expertise and the knowledge of the geoscientist. In 2023, the resources produced have included lesson plans and module plans, and the accompanying teacher notes and slides/field booklets for each resource.

The resources link the most recent advances in geoscience to the geography curriculum in a way that is both understandable and relevant. The resources are freely available to be used for classes anywhere in the world. We hope that you and your students enjoy using them.

This resource

This resource has been developed by Charlene O'Hagan, a geography teacher at St. Vincents Secondary School, Dundalk, Co Louth and iCRAG researchers Gregor Rink and Phoebe Walsh, as well as David Hardy from Geological Survey Ireland. The resource provides an in-depth introduction to coastal dynamics, using a case study of Templetown Beach, Co Louth. Included in this resource pack is a full module plan and associated teacher notes, and a PowerPoint of slides. It is suitable for Transition Year and can also be used as a base resource for Leaving Certificate students.

Sincerely,

Elspeth Sinclair, Fergus McAuliffe, Siobhán Power
Programme Managers – Geoscience for Leaving Certificate Geography Teachers

Geological Survey Ireland, a division of the Department of Environment, Climate and Communications, has been mapping Ireland since 1845. They continue to map the Irish land and marine territories, as well as mineral and groundwater resources. They have responsibility for actions in the current Climate Action Plan including monitoring coastal change, the Just Transition in the midland counties, and providing data for de-risking offshore renewable energy. Irish geoscience research, particularly as it contributes to the development of government policy, is an important part of their work and they fund and co-fund many research projects, including some of the iCRAG research work. Their data and maps are freely available to all at www.gsi.ie.

iCRAG is the Research Ireland Centre for Applied Geosciences hosted by University College Dublin.
We are a team of researchers creating solutions for a sustainable society.
We develop innovative science and technologies to better understand the Earth's past, present, and future and how people are connected to it.
We drive research in areas that are critical to society and the economy, including:
• Sustainable discovery of energy resources and raw materials required for decarbonisation.
• Securing and protecting groundwater and marine resources.
• Protecting society from Earth's hazards such as flooding and landslides.
The iCRAG Research Ireland Centre for Applied Geosciences hosted by UCD, comprises 150 researchers across ten universities and institutions. iCRAG is funded by Research Ireland, Geological Survey Ireland and industry partners.
Further information is available at: www.icrag-centre.org

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Module plan: Dynamic Coasts – A TY Study of Templetown Beach, Co Louth

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Module plan:

Links to curriculum

Core Unit 1: Patterns and Processes in the Physical Environment

1.2 The Rock Cycle
Rocks are continually formed, modified, destroyed, and reconstituted as part of the rock cycle. They are formed and modified by Endogenetic forces. They are destroyed by exogenetic forces of erosion on exposure to weather and climate. They are reconstituted by deposition of sediment.

1.5 Landform development
The development of landforms is influenced by surface (exogenetic) process, which may vary (both spatially and temporally) in their intensity and frequency of operation.

1.6 Landform Development
All landforms represent a balance between endogenetic and exogenetic forces; This balance may change through time.
Students should study the way in which landforms result from a combination of crustal uplift (in response to isostatic readjustment) and denudation by surface processes, and that sometimes landscapes illustrate that these opposing forces are temporarily out of balance.

Specific Teaching objectives

- To give students an understanding of the geotectonic setting of the formation of igneous, metamorphic and sedimentary rocks.
- To give students an understanding of the coastal processes, patterns and associated landforms which occur during beach formation.
- To give students an understanding of the glacial processes, patterns, and sociated landforms which occur during raised beach formation.
- To give student an understanding of the concept of isostacy.
- To give students an understanding of the interconnections between surface process, rock type and landform development through the study of Templetown Beach, Co Louth, using practical demonstrations and investigations.

Learning Outcomes

Students should be able to:

- Describe the process of deposition and transportation involved in beach formation.
- Explain how beaches are formed and identify the features found on a beach.
- Measure beach slope and comment on the processes that are active (storm beach vs long sloping beach).
- Measure wind using an anemometer and classify wind speed according to Beauford Wind Speed Scale.
- Read a synoptic weather chart to determine wind conditions (speed and direction), wave height, and weather conditions.
- Identify different coastal landforms on OS maps and aerial photographs and use the correct terminology to describe their positioning.

- Investigate and classify bedrock geology of Co Louth using GIS as a tool.
- To identify and classify rock samples according to classification, colour, size, shape, and texture.
- Discuss the reasons behind varying rock samples collected at locations with a specific bedrock classification (encouraging discussion of fluvial, coastal, and glacial transportation).
- Describe the causes and impacts of the last Ice Age on Ireland's landscape with particular focus on raised beaches and isostacy.
- Carry out a field study of Templetown Beach to investigate the impacts of coastal transportation, deposition, and glaciation on the landscape.

Keywords and definitions

Fetch	The distance a wave has travelled before it reaches land.
Swash	Term given to when waves break, and water rushes up the beach.
Destructive Waves	High frequency waves with a stronger backwash than swash.
Hydraulic Action	The crushing force of tonnes of water in each wave wearing away the land.
Longshore Drift	The movement of material along the coast.
Wave Refraction	The bending of wave crests as they approach headlands and islands.
Storm Beach	Steep beaches composed of rounded cobbles, shingle and occasionally sand.
Beach	A narrow strip of land separating a body of water from inland areas.
Constructive Waves	Low frequency waves where the swash is stronger than the backwash.
Beaufort Wind Scale	An empirical measure that relates wind speed to observed conditions at sea or on land.
Foreshore	Part of the beach closest to the shore.
Midshore	The middle shore is the part of the beach where ripple marks are found. These are gentle lines in the sand created by the swash.
Backshore	The area where the storm beach, sand dunes and cliff face are found.
Berm	Berms are long, narrow ridges of stones and shingles which tend to mark the dividing point of the middle shore and backshore.
Quaternary	A subdivision of geological time that covers the last 2.6 million years up to the present day.
Glaciation	The process of formation, movement, and erosion of glaciers and glacial landforms by snow and ice.
Isostacy	When large ice sheets cover the land, it weighs down the land resulting in the land sinking. When the ice melts, the land begins to rise as the weight is removed – this is called isostatic readjustment.
Eustatic Change	The change in the amount of water in the sea. During an Ice Age, there is less water in the ocean as more precipitation falls as snow and joins the ice on the land. Therefore, sea level falls.
Raised Beach	A raised beach is an emergent coastal landform. Raised beaches and marine terraces are beaches or wave-cut platforms raised above the shoreline by a relative fall in the sea level.

Linkage and Integration

Linkages

- English: Expression of finding and interpretation of data collected needs to be coherently conveyed in students written work and in class discussions.
- Maths: A range of measuring and calculation skills are required within this module. The measurement of beach slope encourages students to accurately measure and calculate the slope of an area.
- Science: Use of hydrochloric acid to test for the presence of limestone during rock identification, this links back to Junior Certificate Geography and should assist students in remembering the process of carbonation and its impact on limestone areas which can be found in areas of the Cooley Peninsula.

Differentiation

- Think-pair-share on impact of mining, sustainable mining, application to Ireland etc.
- Use of higher and lower order questions in class.
- Power point will aid visual learners.
- Group work, note taker, presenter: Students assign roles.

Approaches to teaching and learning

Resources

- Print out of student work booklet
- PowerPoint
- Rock samples
- Callipers
- Laptops/Tablets to access all links and websites used in the PowerPoint
- Clinometer
- Range poles
- Measuring tape
- Anemometer
- Pens, pencils, colouring pencils, calculator and rulers

Literacy

- Use of keywords
- Use of typed notes and power point slides
- Map interpretation
- Photograph analysis
- Rock analysis
- Map sketching and field sketching

Numeracy

- Data relating to the inputs in construction of wind turbine and solar panels
- Figure interpretation
- Data collection and interpretation in class and in the field (optional)
- Information technology applications
- Analysis and presentation of results and conclusions

Further Development of Resource

- The resource can be adapted to work as a pre-teaching tool for the geographical investigation. Tasks can be adapted, modified or excluded depending on the lesson requirements.
- The module is designed as a Transition Year module of work, however, it can also be used as a base resource for a Leaving Certificate class on rock types, coastal processes and landforms, glacial processes and landforms. Some of the information contained in this PowerPoint may need to be added to meet all the requirements of a Leaving Certificate study of the topics mentioned above.

Teacher Notes

Dynamic Coasts – A TY Study of Templetown Beach, Co Louth

Learning Activities and Detailed Instructions

Class 1
Title: Back to the Coast
Materials Needed: Pen, pencil, ruler, colouring pencils

https://maps.scoilnet.ie/OSiMaps/EsriVer17/index.html

Keywords

Fetch	The distance a wave has travelled before it reaches land.
Swash	Term given to when waves break, and water rushes up the beach.
Destructive Waves	High frequency waves with a stronger backwash than Swash.
Hydraulic Action	The crushing force of tonnes of water in each wave wearing away the land.
Longshore Drift	The movement of material along the coast.
Wave Refraction	The bending of wave crests as they approach headlands and islands.
Storm Beach	Steep beaches composed of rounded cobbles, shingle and occasionally sand.
Beach	A narrow strip of land separating a body of water from inland areas.

Student Workbook Page(s): 2-7
Lesson One is designed to refresh and build student's confidence by drawing on prior Junior Certificate knowledge and skills. It is a highly active lesson with specifically designed short and manageable class tasks to guide students through the content that will be developed through the course of the module.

Slide 6 of the PowerPoint is designed to ignite discussion and can be used as a prompt for student recovery learning discussion in pairs or in groups.

Slide 7 of the PowerPoint contains the *scoilnet.ie* link above and should be used in conjunction with workbook pages 5-7.

Students will try to identify coastal landforms and classify them as either landforms of deposition or erosion. Map skills of 6-figure grid referencing are used in this activity also ***can be adapted to use 4-figure for differentiation purposes.***

Students will then practice sketching an OS map of Skerries, Co Dublin to half scale. The teacher may need to provide more or less guidance on this activity depending on the needs of the class group.

Matching Activity Answers

A	2
B	6
C	3
D	7
E	1
F	4
G	5
H	8

Class 2

Title: The Making of a Beach – Processes Involved 1/ 2 lessons
Materials Needed: Pen, pencil, ruler, colouring pencils
Student Workbook Page(s): 8

Keywords

Constructive Waves	Low frequency waves where the swash is stronger than the backwash.
Beaufort Wind Scale	An empirical measure that relates wind speed to observed conditions at sea or on land.

Lesson Two is designed to inform students about the various processes involved in beach formation including: fetch, wave activity, types of waves, wind speed, longshore drift, wave refraction. Students will understand how a combination of forces interact to form beaches and other coastal landforms. Using the https://windy.app/map/ link on slide 19 students will have an opportunity to compare and contrast weather conditions in Templetown Beach, Co Louth and Lahinch Beach, Co Clare under several headings – see workbook page 8 for specific information required.

This can be amended to suit any location required by the teacher.

Using the information, gather lead students in a discussion on how weather can impact the processes previously discussed and how it can contribute to either the process of deposition or erosion.

Class 3

Title: How Beaches Form 2/2
Materials Needed: Pen, pencil, colouring pencils, ruler
Student Workbook Page(s): 9

Keywords

Foreshore	Part of the beach closest to the shore.
Midshore	The middle shore is the part of the beach where ripple marks are found. These are gentle lines in the sand created by the swash.
Backshore	The area where the storm beach, sand dunes and cliff face are found.
Berm	Berms are long, narrow ridges of stones and shingles which tend to mark the dividing point of the middle shore and backshore.

This lesson content is quite theory-heavy, and the teacher will lead students in a discussion and overview of how a typical beach is formed. Teachers may wish to draw from local examples and encourage students to name examples.

Questions

- Do all beaches look the same? Why?
- Do all beaches have the same sediment deposits? Why?
- How might weather impact beach formation? Explain.
- How might the shape of the coastline impact beach formation? Explain.
- Can human activity impact beach formation? How? Why? Explain?

Teachers may opt to have students draw out the beach diagram sketch at this point, an optional task page can be found in the workbook on page 10.

A check your learning activity on page 9 of the workbook requires students to match images of beach features to the correct term.

Class 4

Title: Templetown Beach Geology
Materials Needed: Pen, pencil, colouring pencils, ruler
Student Workbook Page(s): 11 – 13

In this lesson students will aim to identify the rock type(s) present along the Cooley Peninsula and examine examples of rock types found along the Cooley Peninsula. Students will begin by using the GIS Bedrock Geology Map of Ireland Handout to identify the rock types present at Templetown Beach and surrounding areas. They will note the rock type on workbook page 11.

Students will then use the interactive link to https://maps.scoilnet.ie/OSiMaps/EsriVer17/index.html to obtain a more detailed classification of rock types present on the peninsula. Details are also recorded on Page 11 of Workbook.

On workbook page 12 students will create their own colour coded map and legend to clearly identify the rock types present on the Cooley Peninsula.

Ideally, the teacher will have samples of all the rock types present in the GIS map of the area for demonstration purposes. Using each sample in turn, the teacher will guide students through the description of each sample.

Quick check-in on student learning with the Rock Identification Task on PowerPoint slide 41, workbook page 13.

Lesson concludes with a prompt for next class. The teacher shows image on slide 42 and ask students to think about and explain the presence of rock types other than those identified and studied today.

Class 5 and 6

Title: Journey to the Beach – Transportation and Deposition
Materials Needed: Pen, pencil, colouring pencils, ruler
Student Workbook Page(s): 14-18

Keywords

Quaternary	A subdivision of geological time that covers the last 2.6 million years up to the present day.
Glaciation	The process of formation, movement, and erosion of glaciers and glacial landforms by snow and ice.
Isostacy	When large ice sheets cover the land, it weighs down the land resulting in the land sinking. When the ice melts, the land begins to rise as the weight is removed – this is called isostatic readjustment.
Eustatic Change	The change in the amount of water in the sea. During an Ice Age, there is less water in the ocean as more precipitation falls as snow and joins the ice on the land. Therefore, sea level falls.
Raised Beach	A raised beach is an emergent coastal landform. Raised beaches and marine terraces are beaches or wave-cut platforms raised above the shoreline by a relative fall in the sea level.

The lesson begins with the prompt from Class 4, students should be allowed to discuss their ideas and explanation for the presence differing rock types on Templetown Beach.

Students access Scoilnetmap.ie via the link on Slide 45. Encourage or guide students through the map. This can be done in two ways:

1. Students study the map independently and can identify the river and sea as explanations for varying rock types.
2. The teacher highlights the area of the river and the sea and asks students find the link between them and the varying rock types on the beach at Templetown.

The teacher should then guide students towards a third possibility – glacial transportation and deposition of sediment. Show Image of raised beach and discuss.

Slide 47 – Time-lapse video of ice cover over the island of Ireland.

Lead into the video link on Slide 48 – students answer multiple-choice questions on Pages 14, 15, and 16 of their workbooks. (9 mins long)

Answers to video multiple choice questions

1. Ice	1. Alpine glaciers	2. Calving	3. U-shaped valley	4. Till
5. Striations	6. Erratics	7. Drumlin	8. Glacial Movement	9. Outwash
10. Upstate New York	11. Rising sea levels due to increased freshwater in oceans	12. Moraines	13. Warming atmosphere and oceans due to climate change	14. Terminal Moraine

Teacher led learning on glacial periods and the Quaternary Period - explain geological time.

Slide 52 – Image of Templetown cliff face - students can come up to the white board to identify different layers visible in the cliff face.

Teacher led learning of eustatic and isotactic processes and their meanings – focus on landform of raised beaches and Irish examples.

Slide 57 – Virtual Field Trip to Templetown Beach.

Using tablets or at a PC students click on the https://sketchfab.com/3d-models/glacial-sediments-templetown-beach-cooley-71994bced6334251ace518ff8b09ecb3 link to begin their virtual examination of the cliff face. Using workbook page 17 students research each layer of the cliff face.

Possible Extension Activity- page 18 of the workbook: Students study the two images of the cliff face at Templetown beach. Comment on any similarities or differences they can identify. Encourage use of the vocabulary gained from Task 2 on page 17 to help discuss the landforms and the partial collapse of the cliff.

Class 7 & 8 (optional)

Title: Beach Slope and Sediment
Materials Needed: Pen, pencil, colouring pencils, ruler, student workbook, range poles, cinometers, cones, measuring tapes, trundle wheels
Student Workbook Page(s): 19

These lessons aim to introduce students to the skill of beach slope measuring, in doing so, students should be able to comment on the ever-changing nature of beach landscapes due to seasonality, weather events, and wave action.

Lesson begins with an introduction to the role of the Berm line on a beach – place short 4min video on slide 60 for context.

The teacher can allude to beach slope as a potential task that is carried out during LC Geography field study work (optional).

Based on images on slide 62 teacher should try to extract an explanation or understanding from students as to why there are such differences in slope.

Suggested Approach to Practice Slope Measurement

- In class read the description on slides 65 – 67 use this time to pass around equipment and demonstrate use.
- For the practice element move to an outside location, suitable for this activity. Organise class into working groups and ensure all students have an opportunity to practice using the different pieces of equipment.
- Follow through the process, teacher guiding and instructing through the process.
- Have students record the clinometer measurements to determine the slope back in class.

Back in class use the Sample Slope Recording Sheet on slide 68 to demonstrate how to determine the angle of your chosen slope. Students complete workbook page 19.

Class 9

Title: Preparing for Geography in Action
Materials Needed: Student workbook, range poles, clinometers, cones, measuring tapes, trundle wheels, quadrats, callipers, view finders, compass, stopwatch, manual counter, anemometer, oranges
Student Workbook Page(s): 20 – 29

During this lesson teacher should organise the data collection groups, go through each task and the equipment needed to investigate, check the weather forecast and tide times, run through health and safety procedures on the day.

Class 10 – Requested Half Day trip to Templetown Beach
Title: On the Beach
Materials Needed: Student workbook, range poles, clinometers, cones, measuring tapes, trundle wheels, quadrats, callipers, view finders, compass, stopwatch, manual counter, anemometer, oranges
Student Workbook Page(s): 20-29

Students travel to the beach.

Organise students into groups.

Run through task list – see student workbook page 21.

Begin data collection – the teacher should demonstrate the equipment again on site before the students carry out the task themselves. This helps to foster confidence in their work and encourages collaborative learning.

Remind students to record their data and take pictures of their work.

Before Final Class
Students should calculate and collate all their data and draw up suitable graphs to exemplify their findings. A short conclusion or statement of understanding should accompany each graph or chart. This work can be used as material for Transition Year credits.

Class 11
Final Class – Presentation and Submission of Student Work

Sources

- Leaving Certificate Geography Syllabus 2003 The Stationary Office.
- 'Earth' Leaving Certificate Geography textbook by Michael Organ (Educate.ie).
- 'Plant and People' Geography textbook 3rd Edition by Sue Honan and Sue Mullholand. (Mentorbooks).
- 'Understanding Earth Processes, Rocks and the Geological History of Ireland' (2004) Andrew Sleeman, Brian McConnell and Sarah Gatley (C) Geological Survey of Ireland 2004.
- Geological Survey Ireland website www.gsi.ie
- https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/Resources/Rock%20sets/Rock%20set%20general%20cards.pdf?la=en
- https://www.gsi.ie/documents/Amsc%C3%A1la_geola%C3%ADoch2.pdf
- https://geology.com/rocks/
- https://gsi.geodata.gov.ie/downloads/Geoheritage/Reports/LH031_Templetown_Raised_Beach.pdf
- https://www.gsi.ie/en-ie/publications/Pages/The-Geological-Heritage-of-Louth.aspx