GEOSCIENCE FOR LEAVING CERTIFICATE GEOGRAPHY

Continuing Professional Development Course 2021

COMPLETE RESOURCE BOOKLET

Created by the 2021 Teacher cohort and geoscience experts from iCRAG and Geological Survey Ireland

iCRAG
SFI RESEARCH CENTRE IN APPLIED GEOSCIENCES

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

An Roinn Comhshaoil, Aeráide agus Cumarsáide
Department of the Environment, Climate and Communications

Contents

About the programme

The aim of this resource is to encourage the teaching and inclusion of geology in Leaving Certificate Geography classrooms. To achieve this, iCRAG and Geological Survey Ireland developed this CPD course which partnered up 6 Leaving Certificate teachers with 12 geoscience practitioners across Ireland. The course involved a series of talks by the geoscience practitioners which informed the teachers of current and ongoing geoscience research happening in Ireland. They then worked together to create either a classroom-based or field-based lesson or module plan for a particular subject area, complete with presentation and teacher and student notes. The teachers brought in their expertise and experience with teaching Leaving Certificate Geography and how the various aspects of geoscience can be linked to the curriculum, and the geoscience practitioners contributed their knowledge and relevant applications of geoscience at a classroom level.

The subjects covered by these 6 resources include a Glendalough field study, geothermal energy, an introduction to geology, Irish geohazards, seismic activity, and volcanoes.

The CPD course was led by Elspeth Sinclair and Fergus McAuliffe, from iCRAG, and Siobhán Power and Amrine Dubois Gafar, from Geological Survey Ireland. We would like to thank Peter Lydon for his help in recruiting our wonderful teachers.

About us

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, the Science Foundation Ireland (SFI) Research Centre in Applied Geosciences, are a team of researchers creating solutions for a sustainable society. They develop innovative science and technologies to better understand Earth's past, present, and future and how people are connected to it. iCRAG drives research into areas that are critical to society, including:

- The minerals and metals we need for decarbonisation and sustainable energy.
- Securing and protecting groundwater and marine resources.
- Protecting society from Earth's hazards, such as floods and landslides.

Further information is available at: www.icrag-centre.org

About the Resources

1. Geothermal Energy Module

This resource has been developed by Elaine Egan, a geography teacher at Synge Street CBS, alongside geoscience professionals Rory Dunphy and Koen Verbruggen, both from Geological Survey Ireland. The resource is a deep dive into geothermal energy, covering at least four lessons. It is suitable for TY students as well as Leaving Certificate Students.

2. Glendalough Field Study

This resource has been developed by Susan Breen, a geography teacher at Presentation College Carlow, alongside geoscience professionals Dr Danny Hnatyshin from iCRAG at UCD and Dr Siobhán Power from Geological Survey Ireland. This resource is a field guide and accompanying teacher guide for a field investigation of Glendalough, Wicklow. The field investigation covers the geology of the area, alongside considering the historical and human importance of the site. It has been designed for Leaving Certificate students but may be suitable for younger students with some additional preparation.

3. Volcanic Activity in the Irish Context

This resource has been developed by Geraldine O'Brien, a teacher from Carrigallen Vocational School and Drs Hilde Koch and Maurice Brodbeck from iCRAG at UCD and TCD respectively. This resource is a lesson plan for at least a double lesson that investigates volcanic activity from the Irish context. It has been designed for Leaving Certificate Students.

4. What Lies Beneath? (An Introduction to Geoscience)

This resource has been created by Jennifer O'Sullivan from Killorglin Community College alongside geoscience professionals Dr Tiernan Henry from iCRAG at NUIG and Dr Eamon Doyle from the Burren and Cliffs of Moher UNESCO Global Geopark. This is an introductory resource for classes just starting their geoscience learning journey. It is aimed for a double class and is suitable for Leaving Certificate level students, though younger students may also benefit from this resource.

5. Irish Geohazards: How we monitor and mitigate them

This resource has been created by Eileen Kelley from Castleknock Community College, alongside geoscientists Drs Eve Daly and Haleh Karbala Ali both from iCRAG at NUIG and DIAS respectively. This resource examines the geohazards that affect Ireland, such as groundwater and flooding, and investigates the methods we use to monitor the hazards and mitigate for their potential effects. This resource has been designed to cover at least a double class and is suitable for Leaving Certificate level students.

6. Seismic Activity Module

This resource has been created by Claire Healy, a geography teacher from Douglas Community School in County Cork, and Drs Srikumar Roy and Pablo Rodriguez-Salgado, both from iCRAG at UCD. This resource is a full module that examines seismic activity in depth. The resource covers everything from the basics of seismicity to the tsunamis that have threatened Ireland in the past. It has been designed as a Transition Year module, but aspects are suitable for Leaving Certificate classes.

Disclaimer:

Every effort has been made to ensure that the information in this book is accurate. Data, links, and maps are accurate as of January 2022. The publishers cannot accept responsibility for any consequences arising from the use of this book. The publishers are in no way liable or responsible for any injury or loss to any person using this book.

GEOSCIENCE FOR LEAVING CERTIFICATE GEOGRAPHY

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GEOTHERMAL ENERGY MODULE

Elaine Egan (Synge Street CBS), Rory Dunphy and Koen Verbruggen (Geological Survey Ireland)

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Geothermal Energy: Module plan

Links to curriculum

Core unit 1: Patterns and Processes in the Physical Environment

1.2	**The rock cycle** **Statement:** **Rocks are continually formed, modified, destroyed and reconstituted as part of the rock cycle. They are formed and modified by endogenic forces; they are destroyed by exogenic forces of erosion on exposure to weather and climate; they are reconstituted by the deposition of sediments.** Students should study		
	The human interaction with the rock cycle, paying particular attention to **one** of the following: mining, extraction of building materials, oil gas exploitation, geothermal energy production.	Appropriate national examples.	Appropriate international examples.

Elective unit 4: Patterns and Processes in Economic Activities

4.5	**Environmental impact** **Statement: Economic activities have an environmental impact.** Students should study • the use of renewable and non-renewable resources in the economy • the impact of the burning of fossil fuels and the use of alternative energy sources	National energy resources. Smoke free zones. Patterns of production and consumption.	Production and consumption of energy - appropriate European examples. Acid rain - a European issue.

Learning Outcomes

Students should be able to:

- Understand the concept of geothermal energy and its link to rocks
- Gain a deeper understanding into the geological processes involved in geothermal energy
- Learn about the ways in which geothermal energy is captured and its uses
- Learn about a number of case studies; Iceland, Ireland & Paris
- Work together to investigate if geothermal energy is/can be a source of sustainable renewable energy for areas in Ireland and identify advantages and/or current limitations.

Keywords and definitions

Geothermal	The heat/energy generated by the earth naturally
Percolates	The movement of liquid through a semi solid material (water soaking into the ground/landscape)
Boreholes	Ground source heat pumps (GSHPs) use pipes which are installed in boreholes to extract heat from the ground.
Energy Intensive	Heavy use of energy (e.g. energy intensive industries)
Decarbonise	Reducing the amount of carbon emissions in the energy sector
OPEX	Daily operating expense (the cost to run a day-to-day project/business)
CAPEX	An expense a business/project incurs to create a benefit in the future
Ground Source Heat Energy	A renewable source of energy that can be used to heat buildings
Open loop (domestic/small commercial)	Type of Geothermal Capture for domestic and small commercial energy demand
Open loop (larger commercial/industrial processes)	Type of Geothermal Capture for larger commercial and industrial energy demand

Linkage and Integration

Linkage

- English: Oral discussion, debating, various styles of writing techniques to learn core facts
- SPHE/Team building: Working as part of a group to investigate a plan and provide an outcome
- Maths: Problem solving, logistics & critical thinking
- STEM: Engineering
- Geography/Science/Green schools: Investigating the wider environmental aspects

Differentiation

- Teaching Style: Identifying what students already know in a verbal (discussion)/nonverbal (wall sticky notes) manner. Various methods of learning (visual/verbal; higher order, lower order discussions and recall/reading/writing)
- Group work: Each group assigned a role but roles within the group assigned between them so as those comfortable to lead/talk/research can do so as they feel comfortable to do.

Geothermal Energy: Teacher Notes

Lesson one: Introduction to Geothermal Energy (Case study: Iceland)

Learning Activities

-Discuss the links that volcanic activity and the rock cycle has with geothermal activity (brainstorm map of all suggestions on the board) 5mins

-Wall stickers: Given sticky notes to write advantages/limitations to stick on the wall before video (5mins)

-How Geothermal Energy Revolutionised Iceland's Greenhouses | Earth Lab - YouTube (9mins students asked to think of further advantages/ limitations)

-Wall stickers (sticky notes): add advantages/limitations (5 mins)

Homework (Explanation 5 mins)

-Textbook case study on p79/80 of Iceland- given placemat to break down into bullet points for 4 headings:

1. Iceland and Geothermal Energy
2. How is geothermal energy captured?
3. Uses of Geothermal energy
4. Benefits of Geothermal Energy

Assessment:

-Teacher questioning of their understanding of the links between and roles that are played with rocks/volcanic activity & geothermal energy, discussion.

-Teacher observation and comparison of wall stickers advantages/limitations before the video and then further assessment of additions to that after the video

-Homework task to extract important facts from case study to assist note making and summarising skills.

Resources Given:

Planet & People Textbook Case Study on Geothermal Energy in Iceland (p 79/80 Print for each student)

(Video Youtube- 9 mins) How Geothermal Energy Revolutionised Iceland's Greenhouses | Earth Lab - YouTube

(Video Youtube- 3 mins) Energy 101: Geothermal Energy – YouTube

Placemat (Print for each student)

Exit card (Print for each student)

Materials Needed:
Printed resources above

Sticky notes (2/3 per student) & blue tack to stick to wall

Lesson two: Geothermal Energy Capture Types and Case Study: Ireland

Part 1: Geothermal Energy Capture & Ireland

Learning Activities
-Document "Geothermal Energy Explained (Dr. Sarah Blake GSI) handed out to each student and read in sections, with discussion/clarification after each section. (10 mins)

-Geothermal Energy in Ireland FAQ (10 mins) Students spend time reading this, noting important facts- highlight to them that this is very useful information that they may wish to use when given the main module task)

-Use of the Geothermal Suitability maps for Ireland **Geoenergy (gsi.ie)** Student Questions (10 mins)

-Using the Geothermal Suitability map to explore data available (10 mins)

-Homework Activity: Identifying areas of suitability for each of the 3 types (vertical closed loop, open loop domestic and open loop commercial)

Assessment
-Teacher and students discuss what main points of Geothermal Energy Explained are

-Students highlight/note what they feel are interesting facts from Geothermal Energy FAQ

-Students answer questions on Geothermal Energy Suitability Map & can navigate the map using different layers

-Homework Task: Use the map on a device to identify 3 areas for each of the 3 layers (vertical closed loop, open loop domestic and open loop commercial)

Resources Given:

-Handout on Geothermal Energy Explained (Dr. Sarah Blake GSI) Can be found in the Resources Appendix section- teacher may wish to print as handout/ put online document on student accessed platform for further access during class

-Geothermal_energy_FAQ.pdf (gsi.ie) can be accessed by students in class on a device

-**Geoenergy (gsi.ie)** Map page on Geothermal Suitability Map for Questions in Activity 3

-Link **Geoenergy (gsi.ie)** used for Activity 4 and Homework Activity also

Materials Needed:

-Copies of documents above if teacher wished to print for each student/copies per group

-Internet Access (for students)

-Devices for each student/in groups to read documents and access the Geothermal Suitability Map

Part 2: Geothermal Energy Capture Types & Ireland

Learning Activities:
-5 min video on use of the Irish District Heat Atlas Map

-Students use devices in groups to experience the data available on Irish District Heat Atlas Map (15 mins)

-Investigation of the Tallaght District Heating Scheme and Questions to answer (15 mins)

-Homework Activity to investigate further information available through links provided

Assessment:
-Teachers observe students using the Irish Heat Maps as shown in the video previous to work together on finding data available to them

-Teacher assess questions outlined on PowerPoint in relation to Tallaght District Heating Scheme

Resources Given:
Irish Heat Atlas: Version 1 – YouTube (Instruction video)

Irish Heat Atlas Version 2.1 (arcgis.com) (Interactive Map)

Tallaght District Heating Scheme | Energy Efficiency Agency Dublin | Codema (Case Study)

(Further Information)

district_heating_brochure.pdf (codema.ie) (Further Information)

Geothermal Energy (gsi.ie)

Energy 101: Geothermal Heat Pumps – YouTube

Geothermal Energy | A Student's Guide to Global Climate Change | US EPA

Shallow Geothermal Energy (gsi.ie)

Materials Needed:
-Internet access (Students)

-Use of devices for students to access links and investigate further information

Lesson 3: Student Investigation into Geothermal Energy viability in Dublin City

Learning Activities

-Arrange students into groups of approx. 4 students each

-Direct students to school platform (or online classroom) where they can access links/resources used in the module and/or additional resources to assist their research.

-Outline research question and break down the body of the research

-Outline methods of producing/submitting findings (video, PowerPoint presentation, report)

-Students may be given an extra class to work on this if needed.

Assessment

-Teacher assess that the students understand each section of the instructions

-Teacher observes if the students are organising the roles in the group and are able to access and find the links for further research

-Teacher checks if each person in each group understands their role

-Teacher assess if students, at the end of the class understand the research question, how to gather the information and what is expected as a final result.

Resources Given

-Breakdown of the criteria expected (can also show students assessment rubric in Lesson 4 Assessment so students can set result target)

-Full PowerPoint presentation, documents, and links available to students on an online platform in order to do their own group research

Materials Needed

-Internet Access (students)

-Devices for groups to access online platform and investigate material available to them

Lesson 4: Group Presentation of Findings

Learning Activities

-Groups will be given 5-10mins to present their findings in the format they have chosen (video/PowerPoint/report)

-Other students will be given an opportunity to ask questions once the group has finished presenting

-Students will then be able to add their findings to the Geothermal Wall where suitable

Assessment:

-Teacher can use own assessment method or that which is provided in the PowerPoint presentation "Lesson 4"

Resources Given

-Assessment rubric in slide 22

Materials Needed:

-Internet Access (students)

-Devices for groups to access online platform and investigate material available to them

Resources for Geothermal Energy Module

Lesson 1: Geothermal Energy in Iceland

-Link to YouTube video (9 mins)

How Geothermal Energy Revolutionised Iceland's Greenhouses | Earth Lab - YouTube

-Link to YouTube video (3 mins)

Energy 101: Geothermal Energy – YouTube

-Placemat (**Appendix**: full A4 to be printed and used landscape):

-Geothermal Energy in Iceland Case Study **(Appendix)**

-Exit card : 3 things you found out, 2 interesting things, 1 question **(Appendix)**

Lesson 2: Geothermal Energy in Ireland

PART 1

-3 A4 pages Document Geothermal Energy Explained (Adapted Dr. Sarah Blake GSI) (**APPENDIX)**

-Geothermal_energy_FAQ.pdf (gsi.ie) (reading document)

-Geoenergy (gsi.ie) (Geothermal Suitability Map)

PART 2

Irish Heat Atlas: Version 1 – YouTube (Instruction video)

Irish Heat Atlas Version 2.1 (arcgis.com) (Interactive Map)

Tallaght District Heating Scheme | Energy Efficiency Agency Dublin | Codema (Case Study)

(Further Information)

district_heating_brochure.pdf (codema.ie) (Further Information)

Geothermal Energy (gsi.ie)

Energy 101: Geothermal Heat Pumps – YouTube

Geothermal Energy | A Student's Guide to Global Climate Change | US EPA

Shallow Geothermal Energy (gsi.ie)

Lesson 3/ Lesson 4

Students own work and use of the materials found above through the links and in the following appendix.

Appendix:

Lesson 1:

- Placemat for Iceland case Study Summary
- Iceland Case Study (Planet & People Leaving Certificate Geography Textbook p 79/80)
- Exit Card: 3 things you found out, 2 interesting things, 1 question you still have

Lesson 2:

- 3 A4 page Document on Geothermal Energy Explained (adapted from Dr. Sarah Blake GSI)

Geothermal Energy In Iceland:

Capture, Uses & Benefits

Option 2: Geothermal energy in Iceland

CHAPTER 5
Case Study 2

Geothermal energy is heat energy captured from hot rocks in the earth's crust. Iceland is a major producer of geothermal energy.

1. Iceland is located on the Mid-Atlantic ridge. This is the constructive plate boundary between the North American and Eurasian tectonic plates. The two plates are moving apart at a rate of about 2 cm per year. This allows magma to reach the surface of the earth forming hot igneous rock that is used to make geothermal energy.
2. In Iceland the active volcanic zone stretches through the country from the south-west to the north-east and contains more than 200 volcanoes. This volcanic zone is used to generate geothermal energy.

Fig. 23 Map of Iceland showing geothermal zones

How is geothermal energy captured?

3. Magma rising from the mantle heats the ground to over 200°C just 1 km below the surface.
4. Precipitation (rain and snow) falling on the highland seeps (**percolates**) three kilometres into the bedrock where it is heated by the hot rocks beneath the surface. In some areas the water is heated to more than 380°C. The hot water then rises towards the surface often forming hot springs and steam vents.
5. The rocks are drilled (**boreholes**) to capture the hot water. As the hot water reaches the surface, the pressure drops causing it to turn into steam. The steam is used to turn a turbine to make electricity. After this the steam cools and condenses into cold water which is returned to the ground through a different borehole where it is reheated and the cycle starts again.

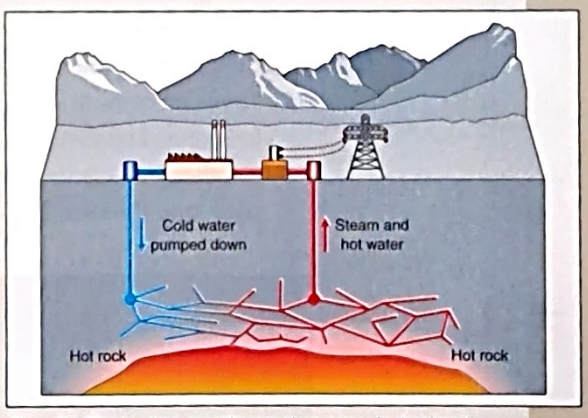


Fig. 24 Capturing geothermal energy in Iceland

Uses of geothermal energy

6. Iceland has used geothermal energy since the 1930s. Today five major and many other smaller geothermal power plants exist in Iceland. These produce over 30% of the nation's energy.
7. Geothermal energy plants provide heating and hot water for approximately 87% of all buildings in Iceland. Water usage is metered and people pay for the water they use.

8. In Iceland's two largest cities, the capital Reykjavík and Akureyri, pavements and car parks are kept ice-free during winter by underground heating systems.
9. One of Iceland's most important uses of geothermal energy is for heating greenhouses. For years, the naturally warm soil has been used for growing potatoes and other vegetables. Horticulture has benefited considerably from geothermal resources, as the heating of greenhouses has increased production, lengthened the growing season and reduced the cost of importing heating oil for growers.

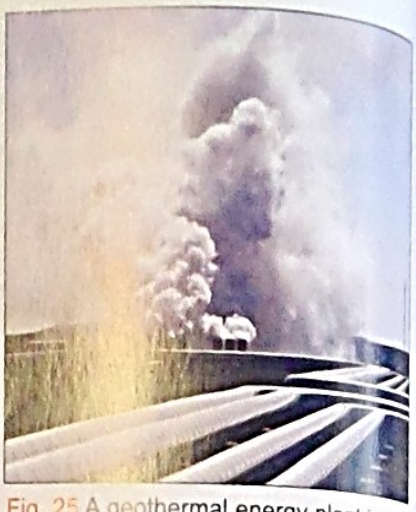


Fig. 25 A geothermal energy plant in Iceland

Benefits of geothermal energy

10. There is potential to generate 40% of Icelandic energy requirements from geothermal sources. This reduces the need to import expensive fossil fuels. The use of geothermal energy has also benefited the environment due to lower CO_2 emissions compared to fossil fuel power plants.
11. The availability of cheap electricity has made Iceland an attractive location for the **energy-intensive** [energy hungry] metal-smelting industries. Aluminium smelting is worth one-seventh of Iceland's GDP. For example, one American smelting company, Century Aluminium, produces 300,000 tonnes of aluminium per year in Iceland.
12. There are plans to lay 1,300 kilometres of submarine electricity cables from Iceland to Scotland so that geothermal energy can be exported to Europe.
13. Geothermal activity is important to the Icelandic tourist industry, e.g. geysers, hot pools and the Blue Lagoon (geothermal swimming pool).

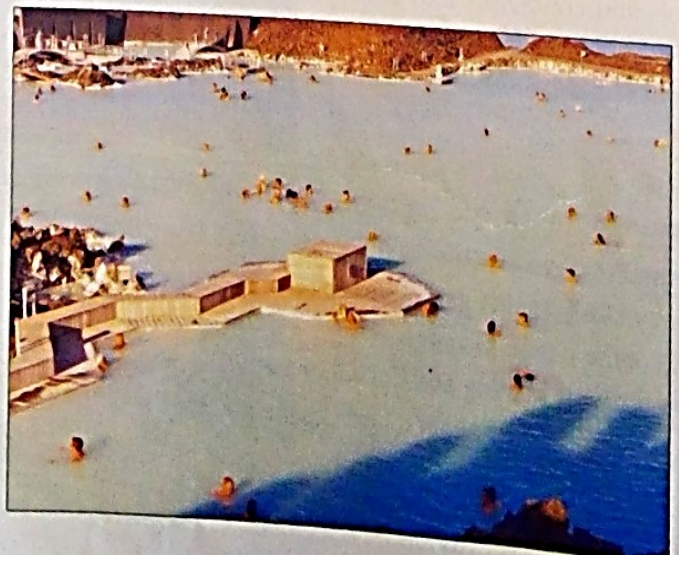


Fig. 26 The Blue Lagoon tourist attraction

weblinks

Cable between Iceland and Britain

Powering Scotland from Icelandic volcanoes

THINGS YOU FOUND OUT:

3

INTERESTING THINGS

2

QUESTION YOU STILL HAVE

1

Geothermal Energy Explained (adapted from Dr Sarah Blake Geological Survey of Ireland)

The Geology of Geothermal Energy

What is Geothermal Energy?

Geothermal energy is heat energy stored below the surface of the Earth which can be used as heat or to generate electricity. Heat flows outwards from the centre of the Earth, and the temperature (and the amount of available energy) increases with depth at an average rate of 25 to 30 °C per kilometre for most places in the world. Heat flow is highest in volcanic regions, such as at tectonic plate boundaries and traditional exploitation of geothermal resources has occurred in these areas where the heat is easily accessible (e.g., Iceland, Italy, New Zealand).

Advances in technology over the past century have led to the development of geothermal resources for heating and/or electricity production away from these plate margins in places where the heat flow is not particularly high (e.g., France, Netherlands, Belgium, UK, Germany). Such geothermal energy types could be a viable, important source of energy for Ireland.

Of all of the thermal energy in the Earths crust, beneath a specific area, a geothermal resource is the portion of that energy that is shallow enough to be tapped by drilling and recovered as useful heat both economically and legally.

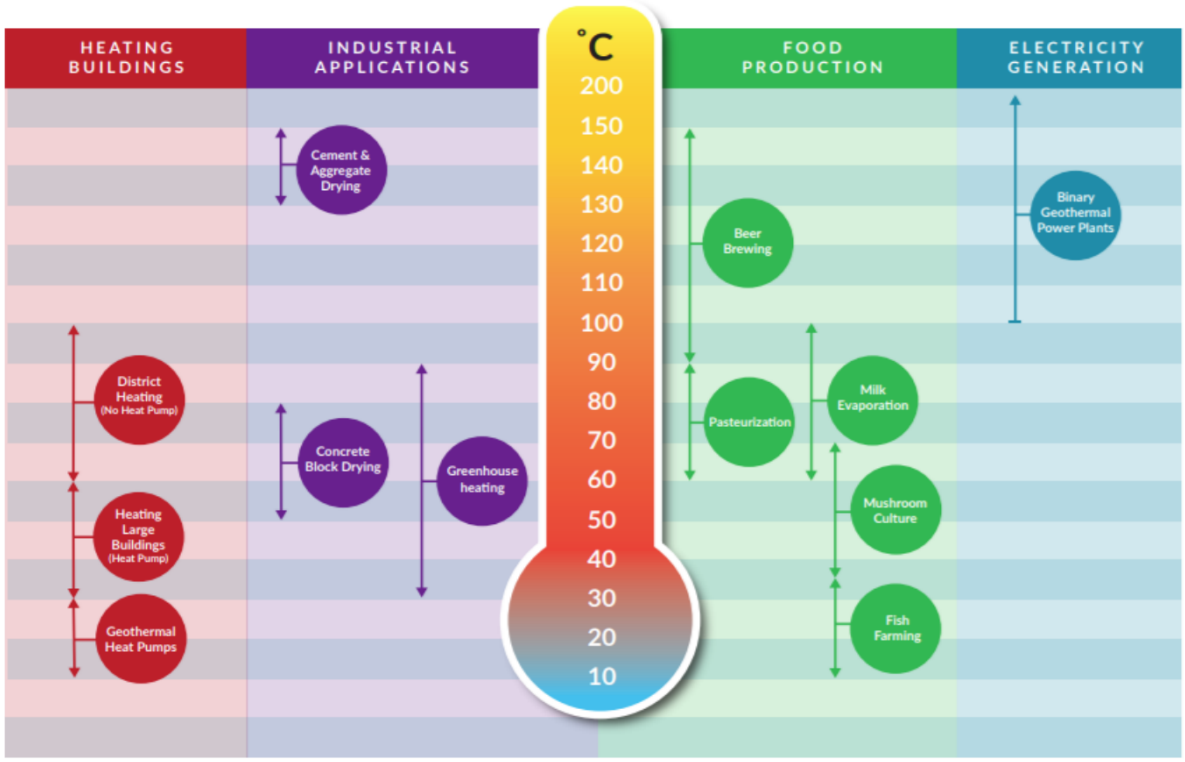
The size of the potential geothermal resource in Ireland has yet to defined and is a focus of the National Geothermal Database project which is being undertaken by the Geological Survey of Ireland as part of the Climate Action Plan.

For geothermal resources a shallow Ground Source Heat Pump (GSHP) will exploit the heat directly underneath the house it is heating and a geothermal powerplant will be located nearby to the wells that produce the water or steam that supply it.

Categories of Geothermal Resources:

Category	Temp	Description	Uses
Very Low Enthalpy	10-30 C	Shallow soil temp & sun influence	Heating single small building
Low Enthalpy	30-80 C	Located by deeper drilling	Bigger demand of energy
Mid- Enthalpy	80-120 C	Power plants are necessary for electricity production	Heating/electricity production of combined
High Enthalpy	120-300 C	Lower end of temp can be used for potential electricity in Ireland	Electricity production

How Geothermal Energy Can Be Used



Heat Generation/Distribution

District Heating: (also known as heat networks) is a system for distributing heat generated in a centralized location through a system of insulated pipes for residential and commercial heating requirements such as space heating and water heating.

More than 250 geothermal district heating systems were in operation in Europe in 2015. Progressive efficiency improvements in district heating technology has meant that lower temperature inputs are acceptable. Studies in South County Dublin have shown that geothermal fluid temperatures in excess of 60 ^{o}C are likely to be achieved at depths of 2.5 km, and such temperatures would enable geoDH to proceed without the use of a heat pump.

Agriculture, food production and food and beverage processing

At very low temperatures, geothermal heat can be used for aquaculture (e.g., Huka Prawn Park, Taupo, New Zealand) and soil warming. Geothermal heating can be effectively used for traditionally energy-intensive horticultural operations such as heating greenhouses to grow fruit, vegetables, flowers (e.g., Slovenia; the Netherlands) and mushrooms (e.g., Oregon, USA). Geothermal heat is used to brew beer in Reykjavik, Iceland and Colorado, USA. Geothermal heat can also be used to dry agricultural products, e.g., tomatoes, chillies, rice, cotton, timber, etc. Dairy processing requires large amounts of energy for heating and cooling, and geothermal energy can be successfully used for processes such as milk pasteurization (e.g., Oregon, USA), and cheese maturation and storage (near Lardarello, Italy).

Metal Extraction /Brine Mining

Hot fluids processed through geothermal electricity production plants could contain economic quantities of dissolved minerals and metals, which could be extracted at a profit under appropriate

market conditions. Extraction like this will generate much less environmental impact than traditional surface or underground mining operations, examples include USA where zinc is extracted in economic amounts and the United Downs project in Cornwall UK where lithium concentrations in the produced fluid are up to 250 mg/L.

Shallow Geothermal

Heat and Hot water – Domestic Buildings Low temperature, shallow geothermal resources are available everywhere in Ireland. They can be exploited in conjunction with a heat pump (GSHP), and the stability of the subsurface temperatures results in highly efficient, low-carbon and economical heating schemes. The use of heat pumps for individual dwellings is recognised as the best way to decarbonise the heat sector in rural areas where there is low density housing and low heat demand, and GSHPs represent the lowest-carbon option for a heat pump.

Recreation

In Ireland, the only example of a thermal spring being used for geothermal energy purposes is Lady's Well in Mallow, Co. Cork. There, waters of approximately 21 ^{o}C are used to heat a public swimming pool.

Types of Geothermal Technologies

-Shallow Geothermal Open & Close Loop

-Mine Water Extraction

-Deep Geothermal Open Loop Systems

-Deep Closed Loop Systems

-Engineered Geothermal Systems

The type of technology/ system used depends on several factors:

-Geology/topography of the site (suitability)

-Presence of groundwater aquifers

-Energy product and supply demand

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GLENDALOUGH FIELD COURSE FIELD INVESTIGATION

Susan Breen (Presentation College Carlow), Dr Danny Hnatyshin (UCD, iCRAG) and Dr Siobhán Power (Geological Survey Ireland)

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Glendalough Field Investigation: Module plan

Links to curriculum

- Carrying out a Geographical Investigation is an integral part of Leaving Certificate Geography. Teachers are provided with a prescribed list of investigation topics each year which are common to Higher and Ordinary Level. Some topics that have appeared over the years include, a river study, urban study, changing land use, a local environmental issue, study of geology to name but a few. Students are required to complete a written element, along with graphs, sketch-maps and diagrams based on one Geographical Investigation chosen by the teacher.
- This field study to be carried out in Glendalough covers a range of elements for students to explore to carry out a geographical Investigation/field study based on Glendalough's landscape, geology, and its human aspect. This field study gives students the opportunity to prepare for their Leaving Certificate Geographical Investigation worth 20% of their overall Geography grade.

Learning Outcomes

- To explore and appreciate the landscape, geology, and human interaction in Glendalough.
- To support the Geography curriculum by promoting geographical knowledge and understanding
- To provide a real-world opportunity for students to develop and extend their geographical thinking
- To reinforce student's understanding of geographical terminology and processes
- To develop a variety of geographical skills which can be applied to the world of work
- To determine different rock types and their characteristics
- To observe and identify river features in the Glendalough area
- To draw a detailed field sketch
- To engage in teamwork and discussions

Learning activities

Students will have the opportunity to develop a wide range of different skills and learning activities, such as,

- Information gathering skills
- Enquiry skills (observational skills, data collection, data analysis, map work)
- Investigative skills – carry out a Geographical Investigation/Field Study
- Social skills – working effectively alone or in groups
- Engage in talks and discussions on the landscape in Glendalough, the geology and human interaction
- Evaluate their work using a booklet provided
- Present work/findings to the class, individually, in pairs or in groups.
- Engage in discussions throughout the day and upon returning to the classroom.

Detailed instructions

- Before undertaking this field study in Glendalough, teachers will revise the necessary chapters from the Geography curriculum linked to the field study in question. Chapters include, Rocks, Rivers, Glaciation, Tourism, Human Interaction with the landscape and the skills and materials required to carry out a field-sketch. Teachers can opt to do PowerPoint presentations, videos, bookwork etc to revise chapters mentioned.
- Familiarise students with Geological Survey's Ireland Map viewer and Geological Survey Ireland website to allow students to explore the area and gain knowledge before the fieldtrip. These websites offer a wide range of information for students to access before visiting the field study site in question, Glendalough.
- Students must be made aware of materials required and safety information as outlined at the start of their booklet before departure day
- Day of departure. Students must arrive on time, wearing their full school/PE uniform with all the necessary materials and a packed lunch. Students will be provided with the booklet on the bus. It is very important to advise students to complete each section carefully and in detail. The more information recorded, the better.
- Upon arriving in Glendalough, students will be divided into three groups. Each group will be accompanied by a teacher.
- This field study is divided up into three parts, (a) Geology (b) Field-Sketch and (c) Discussions. Allow 90 minutes to complete each section. This gives students enough time to complete the questions in the booklet, ask questions, engage in discussion, and admire and appreciate the landscape around them.
- Each group will work on a different section of the booklet at any one time. This allows for smaller groups, more interaction and social distancing.
- Once students have completed two sections of the booklet, allow for lunch in the Upper Lake. Students can have some free time, avail of facilities (toilets, stalls) and admire the landscape around them. Depending on travel time, teachers can suggest the maximum time provided for lunch
- After lunch, students will return to their groups with their accompanying teacher and complete the final section of their booklet
- Once each group has completed the three sections, students will meet at a designated point to return to the bus for departure
- Depending on travel time, teachers can opt to visit the Visitor Centre in Glendalough. This centre has a wonderful exhibition and audio-visual shows. There is also an option for a guided tour.
- As outlined under learning activities, students will have the opportunity to develop a wide range of different skills and learning activities throughout the day. Most of the knowledge and information gained will be recorded in their booklet. Regarding presenting their work to the class, students can work individually, in pairs or in small groups and give a five-minute presentation to the class (PowerPoint or oral) on their results, analysis and findings from the day spent at Glendalough. Students will have one week to prepare for this presentation
- Finally, students will engage in discussions after each group has presented their presentation. Questions to discuss include, what did I enjoy most about completing

this field study, what worked well, what were the main challenges I faced, how could I overcome these challenges in the future, what new geographical skills did I develop while completing this field study

Resources provided

- Glendalough field guide workbook

Glendalough Field Investigation: Teacher Notes

Introduction to teacher notes

- Preparation and revision are vital before carrying out this field trip
- Use the necessary websites mentioned above to aid student's understanding
- Go through the field study booklet in detail to ensure students are aware of what is expected.
- Explain to students that they will give a PowerPoint or oral presentation to the class based on their analysis of the day. Students can work individually, in pairs or in small groups (max 4 people).

Methodologies

- PowerPoints to aid revision prior to field study
- Talks and discussions
- Collaborative Learning
- Active Learning
- Investigative Approach

Assessment

- Self-assessment using field study booklet
- Teacher observation throughout the day
- Questioning at different points of the day
- Individual, pair or group presentations back in the classroom
- Talks and discussions

Linkage and Integration

Linkage

- History – through its archaeologically and architecturally rich landscape.

Differentiation

- Support/Guidance
- Booklet with higher and lower order questions
- Teacher questioning - Talks and discussions

GEOSCIENCE FOR LEAVING CERTIFICATE GEOGRAPHY

Continuing Professional Development Course 2021

VOLCANIC ACTIVITY IN THE IRISH CONTEXT LESSON PLAN

Geraldine O'Brien (Carrigallen Vocational School), Dr Hilde Koch (UCD, iCRAG) and Dr Maurice Brodbeck (TCD, iCRAG)

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Department of the Environment, Climate and Communications

Lesson plan: Getting to know volcanoes and looking at volcanic activity in the Irish Context

Links to curriculum

Core unit 1: Patterns and Processes in the Physical Environment

- Statement 1.3 examines landforms influenced by the operation of the tectonic cycle. Students will study volcanic activity, sedimentary processes and the impact of folding, faulting and doming.

Learning Outcomes

Students should know:

- The positive and negative effects of volcanoes on society and planet.
- The different volcanic cone structures.
- The two types of lava emitted from a volcano.
- All materials emitted from a volcano.
- The different parts of a volcano
- How to identify rocks (basalt) by appearance?
- Ireland's tectonic journey

Keywords and definitions

Cinder volcano	A volcano made of cinders with steep sides formed by violent eruptions.
Composite volcano	A volcano made of layers of ash and acidic lava formed by explosive eruptions; sides are not as steep as a cinder cone. Also known as a stratovolcano, strato means layers.
Dome volcano	A volcano made of acid lava with steep sides formed by violent eruptions, looks like an upside-down bowl.
Shield volcano	A volcano made of basic lava with gentle slopes and a wide/broad base.
Cinders	Small volcanic bombs - the size of peas.
Bombs	Huge rocks from a volcano.
Pumice	Lava mixed with air causing it to fill up with air bubbles.
Basic lava	Low in silica and very runny.
Acidic lava	High in silica and is pasty.
Pyroclastic flows	A mixture of hot lava, ash and volcanic gases that travel down a volcano at great speeds
Lahar	A volcanic mudflow.

Learning activities

Students will:

- Complete the retrieval exercise on previous knowledge.
- Learn about volcanoes and volcanic activity in Ireland through a PowerPoint presentation.
- Participate in a group activity to construct models of the volcanic cones.
- Engage in talk and discussion on the different types of volcanic cones.
- Present their models to the class.
- Participate in a group activity to identify rocks.
- Engage in talk and discussion on the appearance of rocks.
- Evaluate their work by completing 3-2-1 Exit ticket.

Extra info and files

	Web Address	Brief Description
1.	https://www.nationalgeographic.com/science/article/mass-extinction	5 mass extinctions
2.	https://scied.ucar.edu/learning-zone/how-climate-works/mount-tambora-and-year-without-summer	Mount Tambora
3.	https://www.bbc.co.uk/bitesize/guides/z8p9j6f/revision/1	Volcanoes
4.	https://blogs.unimelb.edu.au/sciencecommunication/2020/09/21/fire-and-bikes-how-a-volcano-sparked-the-invention-of-the-bicycle/	Volcanoes & the bike
5.	www.gsi.ie	Maps Spatial Resources
6.	www.gsi.ie	Your County

Resources provided

- Teacher Lesson Plan
- PowerPoint to guide lesson
- Photocopiable Activity 1 Worksheet
- Photocopiable Activity 2 Worksheet
- 3-2-1 Exit ticket

Materials needed

- Play dough – 2 colours per student
- Rock samples
- GSI Map - Bedrock Geology of Ireland
- Wipes and hand sanitiser

Volcanic Activity in the Irish Context: Teacher Notes

Activity one: Guess what type of volcano

Learning Intentions	At the end of the activity students will: • Know the four types of volcanic cones • Understand the formation and structure of various volcanoes • Provide examples
Materials required	Play dough – 2 colours Photocopiable Worksheet
Activity explanation	Students get into groups of 4. Students are provided with 2 different colours of play dough – one representing lava, the other cinders. Using this worksheet, student selects one of the volcanic cones and makes their own. Students discuss the differences and similarities between the types of volcanic cones. The class tries to guess what volcanic cone the student has made.
Composite/stratovolcano	Use 2 different colours of play dough Made of layers of cinders and lava Steep sides Tallest volcanic cone
Shield	Gentle sides Broad base Largest and flattest volcanic cone
Cinder	Use 2 different colours of play dough Loosely arranged cinders Not very high Smallest and steepest
Dome	Steep sides Looks like an upturned bowl

Methodologies

- Talk and Discussion Q&A
- Active learning
- Investigative approach
- Group Work
- Keywords accompanied by a set of Notes
- Visual examples

Assessment

- Teacher observation and discussion on the construction of volcanic cones and completing worksheet on rocks.
- Teacher questioning – talk and discussion
- Worksheet
- Review keywords at the end by writing out what they have learned on a new page.
- Self-assessment – Exit ticket

Linkage and Integration

Linkage

Art- model construction

Maths – statistics

S.P.H.E. – working together co-operatively

English- oral language through talk, discussion, and presenting their work

Differentiation

- Teaching style
- Support
- Task

Photocopiable

Activity 1: Constructing a volcanic cone

Materials required	Play dough – 2 colours Worksheet
Activity explanation	1. Get into groups of 4. 2. You are provided with 2 different colours of play dough – one representing lava, the other cinders. 3. Discuss in the group and select one of the volcanic cones to make. Make sure that each volcanic cone is selected in the group. 4. Using the play dough, make a model of your chosen volcanic cone. 5. After completion, discuss the differences and similarities between the types of volcanic cones in your group. 6. Then present your model to the class for them to guess what volcanic cone you have made. 7. Continue to make each of the other volcanic cones in your group.
Composite/stratovolcano	Use 2 different colours of play dough Made of layers of cinders and lava Steep sides Tallest volcanic cone **Example:**
Shield	Gentle sides Broad base Largest and flattest volcanic cone **Example:**
Cinder	Use 2 different colours of play dough Loosely arranged cinders Not very high Smallest and steepest **Example:**
Dome	Steep sides Looks like an upturned bowl **Example:**

Photocopiable

Activity 2: Identifying rocks

Rocks	Basalt	Cinders	Pumice	Ash
Place the rock sample into the correct space				
Type of Rock				
Colour				
Density				
Bubbles present				
Hard or soft				
Uses & why				

GEOSCIENCE FOR LEAVING CERTIFICATE GEOGRAPHY

Continuing Professional Development Course 2021

WHAT LIES BENEATH?

LESSON PLAN

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Lesson plan: Introduction to online rock identification using the Geological Survey Ireland map viewer

Links to curriculum

Core unit 1 Tectonic cycle

- Seismic activity and measurements of seismic activity

Learning Outcomes

Students should be able to:

- Navigate the Geological Survey Ireland map viewer website i.e. the layer list
- Be able to find their local area (geographical location) on the Ordnance survey map (accessed through the GSI map viewer)
- To become familiar with the different layers e.g. relief, bedrock etc
- Identify the different rock types in their area & across Ireland

Resources required

- Whiteboard
- Laptop/Device/Access to computer room
- Posters (optional)

Links required

- Geological Survey Ireland Map Viewer: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228
- You may also want to watch the Geological Survey Ireland Map Viewer video tutorial before the lesson: https://www.youtube.com/watch?v=gTKxX0cEL2U

Literacy and Numeracy

- To assist with Literacy, you could put key terms up on the board. Flash cards would also be an option to use (Dependant on student's level) For example: bedrock, relief etc.
- To build on the student's computer literacy
- To assist with numeracy, the student can give a grid reference for their home or school location.

Differentiation

- I will divide the class into pairs or groups depending on the number of devices available to the class. The groupings will be done strategically so everyone will be able to participate in class.
- Depending on the class ability specific tasks can be reduced down or increased.
- ***This class could just be a starter class before beginning rocks

Introduction to online rock identification: Teacher Notes

Introduction to teacher notes

This lesson provides a simple and accessible guide to learning about the different rocks in your local area. Students will learn about the geology of their area using maps, images and data from the Geological Survey Ireland website.

What's down there? An accessible guide to the ground beneath our feet

Lesson goal:

- To make geology accessible and recognise links to local information, features etc.

Content	**Methodology**
<u>Introduction</u> [10 mins] What is GSI? Hands up anybody who has heard of GSI? What does it stand for?	Introduce the **objectives** of the lesson (See Powerpoint Slide 2)
<u>Development</u> **[10 mins]**	Introduce the students to the GSI website www.gsi.ie Watch a short demo carried out by the teacher on the whiteboard- how to navigate the website **<u>(Optional)</u>** Opportunity to go over Ordnance Survey features/grid reference of local area, school, etc.

Student Activity **[15 mins]**	Students familiarise themselves with the website Click on **Data and Maps** Click on **Layer list** • Click on Bedrock Geology 100k • Shaded Relief In pairs/groups find your local area/home/school/place you like to visit during the summer holidays etc
2nd Activity **(35 mins)**	Identify the rock type in these areas. Make a list that can be shared with the class. Do a screen grab of the image These can be sent to the teacher to be shown to the class or student's could present themselves (3 places they picked or 3 different rock types.)
Summary, Recap/Homework **[5 mins]**	I will summarise the key points of the lesson (Slide 3) and will finish with a slide listing the **Learning Outcomes** "At the end of this lesson you should be able to/ have learnt Homework: Print off their own map

GEOSCIENCE FOR LEAVING CERTIFICATE GEOGRAPHY

Continuing Professional Development Course 2021

IRISH GEOHAZARDS:
HOW WE MONITOR AND MITIGATE THEM

LESSON PLAN

Eileen Kelley (Castleknock Community College) , Dr Eve Daly (NUIG,iCRAG) and Dr Haleh Karbala Ali (DIAS, iCRAG)

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Irish geohazards: how we monitor and mitigate them: Lesson Plan

Links to curriculum

Leaving Certificate Geography

Core unit 1:

- 1.1 the tectonic cycle, earthquakes
- 1.2 the rock cycle
- 1.6 landform development – rivers
- 1.7 human interaction – flooding

Core unit 2:

- 2.1 the concept of a region – physical regions
- 2.2 the dynamics of a region – climate, relief, soils, and drainage.

Elective 4:

- 4.5 environmental impact, sustainable development, and conflicts of interest in economic development and environmental impact.

Junior Cycle Science

Senior Cycle Physics

Learning Outcomes

Students will:

- Learn what Geo hazards are and identify Irish geo hazards
- Find out geo hazards are monitored and mitigated in and environmentally and sustainable manner.
- Learn how a seismograph works and identify how they are used outside of earthquake and volcano monitoring
- Make their own seismograph
- Identify flood areas using websites and maps and assess suitability for land use.

Keywords and definitions

Seismometer	Instrument used to measure the intensity of seismic waves
Geo hazards	Geological and environmental conditions that can lead to widespread damage or risk
P and S waves	Primary and surface waves in earthquake/ seismic activity
Flooding	An overflow of water that submerges land that is usually dry
Earthquakes	A sudden shaking of the surface of the earth caused by a release of energy in the earths lithosphere that creates seismic waves
Richter Scale	Scale used to measure the strength of an earthquake
Ground water vulnerability	The natural ground characteristics that determine the ease with which groundwater can be contaminated by human activities
Turlough	A seasonal lake in a limestone region
Bedrock geology	The solid rock beneath the surface looser material
INSN	Irish National Seismic Network
IRIS	Incorporator research institutions for seismology
GSI	Geological Survey of Ireland
Converging boundaries	Colliding boundaries
Diverging boundaries	Separating boundaries
Transform boundaries	Passive or sliding boundaries
Permeable	Water can pass through
HEP	Hydroelectric power

Learning activities

Students will:

- Engage in discussion and group work based on website information
- Make their own seismogram
- Research earthquake activity in Ireland and the world using the websites
- Research vulnerable flood areas
- Complete homework questions based on information given in class on seismometers and their use
- Complete a written task on geohazards in Ireland
- Create reports on topics learned - a flood event and assessing a location for building
- Download the seismometer app on their phones. *"Vibrometer".*

Extra info and files

- www.floodinfo.ie
- www.gsi.ie
- www.insn.ie
- www.iris.edu

Resources provided

- PowerPoint

Materials needed

- iPad or computers/computer room

Methodologies

- Inquiry based and student-based learning.
- Group work and communicative and collaborative learning.
- Teacher led and guided but student engagement and control of learning.
- Investigating topic and reflective learning

Assessment

- Questions and discussions in class
- Formative feedback on written work and tasks
- Teacher observation
- Graphic organiser on topics learned i.e., fish bone diagram
- Written assessment

Differentiation

- By the teacher- lower order questions
- Support by teacher
- Differentiated worksheets if needed

Irish Geohazards: Teacher Notes

Introduction to teacher notes

This lesson plan is aimed at TYs and or 5th years. It is planned for a double class or over two single classes.

Lesson one: Introduction to geohazards

Use the power point to guide through the lesson.

1. Introduction to geohazards.
   1.1. Give examples and prompt discussion.
2. Power point slides on earthquakes and plate boundaries and types of earthquakes.
3. Look at the IRIS website and world seismic events.
   3.1. Specifically, look at the Pacific Ring of Fire and investigate recent events. What are their size?
   3.2. Look at what a seismogram is in the instrument section. View the component seismogram-P and S waves video.
   3.3. Find the 'Build your own seismograph' video in lessons demonstration. Build the seismogram as homework task. Take down notes on how to do it from the website.
4. Power point slides on seismometers and their use in earthquakes. Introduction to the Richter Scale slide.
5. Focus on Irish geohazards specifically earthquakes and groundwater and flooding. Look at INSN website and identify recent and older seismic events in Ireland. Note the strength and date of the events
6. Power point slides on the history of the Seismogram and its relationship with Killiney beach
7. Slides on using seismometers to monitor groundwater and flooding

Lesson two: Geohazard investigation

For this class it would be ideal to have access to the computer room/ school laptops, so students can access the websites also.

1. Go to the GSI website and find the GSI map viewer.
   1.1. Look at the tab for Groundwater and tick the groundwater vulnerability and bedrock geology layers.
   1.2. Study this map. Seismology can monitor groundwater before it gets to the surface.
   1.3. Look at the predicted groundwater flooding map - groundwater programme satellite imagery- monitoring on the surface. How can this information be used?
2. Power point slides on areas likely to flood e.g., rivers and Karst. Human interaction with rivers. HEP on the River Shannon.
3. Look at potential flood areas e.g., Karst and rivers.
4. Look at floodinfo.ie. Choose an area and assess its suitability for building a house. Look at flooding- causes, monitoring and preventing.
5. Power point slides on seismic instruments and Avoca River project
6. Download the phone app. Seismometer- Vibrometer and test it

7. Worksheet, questions and report based on the lesson. This includes questions, downloading the seismometer app on their phones, making a homemade seismometer, and writing two reports. One on an Irish flooding event and the other on assessing a location on its suitability for building a house.

Sources:

- "Earth" Leaving Cert Geography core book. Michael Organ
- "Landscapes" Leaving Cert Geography core book. Declan Fitzgerald and JP White. Gill and Macmillan
- www.Educate.ie
- www.insn.ie
- www.iris.edu
- www.gsi.ie
- https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228
- www.floodinfo.ie

GEOSCIENCE FOR LEAVING CERTIFICATE GEOGRAPHY

Continuing Professional Development Course 2021

SEISMIC ACTIVITY MODULE

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Module plan: Seismic activity

Links to curriculum

Core unit 1 Tectonic cycle

- Seismic activity and measurements of seismic activity
- Tsunami activity national and international level
- Causes and effects of seismic activity

Core unit 1 Landform development

- Mass movement in the form of submarine landscapes-
- How the 18th century tsunami impacted Ireland.

Core unit 1 Human Interaction

Learning Outcomes

Students should be able to:

- Understand the causes of seismic activity.
- Understand how seismic activity can be measured.
- Understand how we measure seismic activity in Ireland.
- Understand earthquake damage and the effects of earthquakes.
- Understand what is meant by a tsunami and the causes of.
- Develop an understanding of international examples of tsunamis and the effects.
- Understand how seismic activity is measured off the coast of Ireland.
- Understand the historical impact of seismic activity off the Irish coast- examples of earthquakes that have affected coastal landforms.
- Understand the ways a tsunami could possibly happen off the coast of Ireland in the future.
- Understand the impacts of a tsunami in the cork harbour and coastal area.

Keywords and definitions

Seismology	The study of earthquakes.
Seismologist	A person who studies earthquakes.
Seismic belt	An area of earthquake activity, mainly found at plate boundaries.
Convergent boundary	Where plates collide, also known as destructive boundaries.
Divergent boundary	Where plates separate, also known as constructive boundaries.
Transform boundary	Where plates slide past each other, also known as conservative boundaries.
Focus	Point beneath the surface at which an earthquake starts.
Epicentre	The point directly above the focus on the earth's surface, where most damage occurs.
Fault lines	A large fracture between two blocks of rocks.
Escarpment	An area separating two level land surfaces that occur as a result of faulting.
Fracking	The process of drilling down into the earth before a high-pressure water mixture is directed at the rock to release the gas inside.
Quarrying	The process of extracting rock from the earth's surface.
Fissures	A small-scale fracture in rock.
Seismometer	An instrument used to measure earthquakes.
Magnitude	The strength of an earthquake.
Population density	The number of people per square kilometre.
Geology	The study of the earth, it's composition and processes relating to and acting upon it.
Liquefaction	The process of turning something liquid.
Tsunami	A large tidal wave.
Contamination	The action or state of making or being made impure by polluting or poisoning
Submarine landslide	Mass movement of sediment across the continental shelf into deeper water

Continental shelf	Area of seabed around a land mass where the water is relatively shallow.
Pyroclastic flow	A fast-moving flow of volcanic material ejected during an eruption, can contain lava, ash, rock etc.
Caldera	Volcanic crater caused by the collapse of the mouth of a volcano.
Mega tsunami	Very large wave caused by displacement of water in the ocean- waves of 50m + at source.

Learning activities

- Video clips – questionnaires
- Project development
- GIS – maps
- Field trip

Extra info and files

All info and files are attached in the PowerPoint presentation.

- https://www.researchgate.net/publication/323199042_The_1755_Lisbon_Earthquake-Tsunami_and_the_West_Cork_Coast
- https://www.dias.ie/2010/10/19/geophyicsrobertmallet/?option=com_content&view=article&id=3961:geophysicsmalletbook&catid=148
- https://www.insn.ie
- https://www.usgs.gov/faqs/can-nuclear-explosions-cause-earthquakes?qt-news_science_products=0#qt-news_science_products
- https://shakenet.raspberryshake.org/#?net=AM&sta=RF7A3
- https://sea-seis.ie/2018/08/08/project-sea-seis/
- http://geoserver.iris.edu/stations/view/SIE#zoom=3&lat=44.18516&lon=-25.26855&layers=TFFBFFFFFFFFFF
- https://www.ga.gov.au/scientific-topics/community-safety/tsunami
- https://www.gsi.ie/en-ie/geoscience-topics/natural-hazards/Pages/Tsunami.aspx
- https://www.gsi.ie/en-ie/geoscience-topics/natural-hazards/Pages/Tsunami.aspx
- https://imarl.ie/about/
- https://www.gsi.ie/en-ie/programmes-and-projects/geohazards/activities/Pages/Irish-National-Seismic-Network.aspx
- https://www.mdpi.com/2076-3263/10/6/226/htm
- https://www.valleyrovers.com/news_detail/368057/
- http://www.deepmapscork.ie/past-to-present/climate/1755-lisbon-earthquake-tsunami-west-cork-coast/
- https://www.gsi.ie/en-ie/programmes-and-projects/geohazards/activities/Pages/Tsunami-Hazard-and-Response.aspx

Videoclips

- https://youtu.be/JypTLDLABzM
- https://youtu.be/13TEKNP7lBY
- https://youtu.be/ILlyfwDwJVs
- https://youtu.be/AXHN14IHtLY
- https://youtu.be/feXCIfatJYo
- https://www.rte.ie/archives/2019/0617/1055768-east-coast-earthquake/
- https://youtu.be/Ht0W2E9g8cA
- https://youtu.be/zqcdeMmJy1E
- https://youtu.be/N0lN_f4JijE
- https://youtu.be/Nomlo8X58PY

Resources provided

- PowerPoint

Materials needed

- iPad or computers
- Google classroom – access to links
- A2 paper
- Printers
- Shoe box
- Markers
- Strips of paper
- Elastic bands
- Foam

Methodologies

- Talk and discussion
- Use of open questioning- higher order
- Guided and discovery learning- investigation
- Collaborative learning- peer assessment

Assessment

- Self-assessment – evaluation worksheet
- Teacher observation – project development
- Teacher questioning – higher and lower order questions.

Linkage and Integration

Linkage

- Numeracy – problem solving
- STEM – I.T. Research. Use of PowerPoints for presentation.
- Art – labelled diagrams.
- S.P.H.E. – working together co-operatively
- Literacy – writing of project.
- English- presentation
- History- local history

Differentiation

- Through question
- Worksheets
- Support
- Tasks

Seismic Activity: Teacher Notes

Introduction to teacher notes

At this stage, students would have already studied the tectonic cycle. They should be aware of the global distribution of the different types of plates- divergent (both oceanic crust (o)/oceanic crust – focus on the North American and Eurasian- and continental crust (c)/continental crust- focus on the African Rift Valley), convergent (o/o, c/c and o/c), and transform. This may form part of the project that the students will develop as the module progresses.

Lesson one: causes of seismic activity

Learning outcome:

- Understand the causes of seismic activity.

This will take part the format of recapping what is meant by the term earthquake and revising the different plate boundaries.

The use of visual images and animations can be used here.

Possible questions: use both higher and lower order question as a form of differentiation based on student ability.

An experiment from https://www.mtu.edu/geo/community/seismology/learn/earthquake-cause/

Can be used also.

Students will then look at the further causes of earthquake activity such as human interaction. This will take the form of discussion and use of visual imagery (all sources credited in the PowerPoint attached).

Students will then look at natural processes as a cause. Volcanic eruptions and mass movement.

If students want to develop a better understand of volcanic eruption earthquakes- http://www.mshslc.org/activity/volcano-seismicity/ .

In class students will watch the following video clip:

https://youtu.be/JypTLDLABzM discussion or work sheet will follow.

Students will look at human activity as a cause- a brief discussion on this should occur- this can be done using the visual image in the PowerPoint as a starting point- asking students what they might already know about these activities and how they might cause seismic activity. Student or groups will then be assigned one to research.

Activity:

Students will start the project: this can be done as a group project or as an individual assignment. The aim at the end of the module would be to present the work to the class.

Task one is too research and develop a PowerPoint or info graph on the causes of seismic activity. This will be added after each lesson. Research can be done during class time and as part of a homework assignment.

Students should first state what is meant by seismic activity.

List the different causes of seismic activity.

Briefly explain the causes. Focus on plate tectonics and how either convergent or transform boundaries create earthquakes. Focus on one of the natural process causes in a bit more detail. One of the human causes.

Lesson two: measurement of seismic activity

Learning outcomes:

- Understand how seismic activity can be measured.
- Understand how we measure seismic activity in Ireland.
- This lesson will start off with a recap of the previous lesson. Key terms will be checked through higher and lower order questioning. This can be differentiated based on student ability. Students will have a opportunity to ask questions about terms they still feel unsure on and hear oee4 responses and explanation of the key terms. Later in the lesson as the activities are taking place the students project work can be checked up on too.
- Next student will look at the concept of what is a seismometer. This will be done looking a visual Imagery and a short video clip.
- A map will then be used to show where seismometers are located both internationally and at a more local level.
- The different scales will then be looked at. The three scales that are focused on make up part of the leaving cert geography course. Richter scale, Mercalli scale, moment magnitude scale.
- How earthquakes are predicted will form then next part of the lesson. Students will be asked do they know how earthquakes are predicted before going through how scientists can help determine when an earthquake can occur.

Activities:

There are three activities linked to this lesson.

Take a trip to the local primary school where a seismometer might be present.

Make a seismometer.

As part of the project- talk about what is a seismometer.

Look and where they are located both in Ireland and abroad.

Why do you think they are located here?

Pick one of the scales mentioned and write up how they work.

Activity one would work well in areas that are located close to primary schools with seismometers. A list can be found here:

Activity two: involves using a shoe box, strips of paper and elastic bands. The ideas is to show the basic idea behind how a seismometer can pick up vibrations of movement.

Activity three: again, the research project is the main way in which students will be assessed in this module. Building on the project after every lesson allows the students to focus on key elements of each lesson and help to further the understanding and knowledge of the topic.

Lesson three: earthquake damage and the impact of earthquakes

Learning outcome:

- Understand earthquake damage and the effects of earthquakes.

The class will start with a recap of the previous lesson, looking at key terms.

Students will then be asked a question- what factors might lead to earthquakes being more or less destructive in different areas.

After putting together a discussion board the different factors will be discussed in more detail through the use of visual imagery and different case studies. i.e. Haiti and Japan.

Students will then look at the concept of both short- and long-term impacts in relation to earthquakes. These will be looked at in relation to the social, economic, and environmental.

These will form the structure of the next part of the student project. See the activity below.

Class work activity:

You are a county councillor or emergency services worker.

think of the impacts from the perspective of the character/role they are playing?

Write down your answers.

Discuss with the person next to you.

Discuss with the class group.

Activity: project work

When did this earthquake occur?

Where did this earthquake occur?

Why did this earthquake occur?

What was the measurement of this earthquake?

Look at the impacts this specific earthquake had- look at this under the headings short term and long-term impacts in relation to social, economic and environmental impacts.

Lesson four: tsunamis and the causes of

Learning outcomes:

- Understand what is meant by a tsunami and the causes of
- Develop an understanding of international examples of tsunamis and the effects.

The class will begin with a discussion board- if opened in explain everything the board can be written on using a interactive pen and saved as a pdf form of the presentation.

Students will be asked to name all the points they know about tsunamis and what causes them.

Students will look at the different causes of tsunamis. This will be done through video links and discussion after each one.

The lesson will then move on to how a tsunami occurs looking at the 5 stages-

What activated the tsunami? Cause

How did it build up?

The formation.

How it changed as it approached the shore.

The impact once it hit the shoreline. Destruction.

Finally, students will be Introduced to the idea of a tsunami effecting an Irish coastline. In preparation for the next lesson.

Activity: project work

When did this tsunami occur?

Where did this tsunami occur?

What caused this tsunami to occur?

What were the short-term and long-term impacts of this tsunami on the area? Look at this under the headings social, economic, and environmental impacts

Lesson five: the impact of seismic activity in Ireland

Learning outcomes:

- Understand how seismic activity is measured in Ireland.
- Understand the historical impact of seismic activity off the Irish coast- examples of earthquakes that have affected coastal landforms.
- Understand the ways a tsunami could possibly happen off the coast of Ireland in the future.
- Understand the impacts of a tsunami in the cork harbour and coastal area.

The lesson will start with a discussion board where the students are asked to think about is Ireland effected by seismic activity.

Once students have discussed what they know they will be introduced to the iMarl deep ocean listening project through the about page, found in the link attached to the PowerPoint.

The first activity of the lesson involves the students researching the project on the website.

Students will next be introduced to the concept of seismic activity in Ireland and the historical impact of this on the Irish coastline.

Students will look at the Irish plan for tsunami impacts.

Activity:

This is the final aspect of the project.

Students are asked to look at tsunamis that have affected the Irish coast.

Look at:

- When they occurred.
- What was the cause.
- What was the impact on the Irish coastline?

Students are then asked to research the Irish tsunami action plan.

Students are asked to look at other factors that may cause a tsunami on the Irish coast and what might be the impact on their local area.

Students will then be allocated class time to present their individual or group project.