# GEOSCIENCE FOR LEAVING CERTIFICATE TEACHERS

Continuing Professional Development Course 2024

# OFFSHORE WIND ENERGY AND COASTAL EROSION MODULE PLAN

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iCRAG
RESEARCH IRELAND CENTRE FOR APPLIED GEOSCIENCES

Geological Survey
Suirbhéireacht Gheolaíochta
Ireland | Éireann

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

# Geoscience for Leaving Certificate Teachers CPD programme

## About the Geoscience for Leaving Certificate Teachers CPD programme

Geoscience is vital for our sustainable future, and geography is the key gateway to geoscience for most students. Additionally, the new Climate Action and Sustainable Development (CASD) subject provides a brilliant opportunity to engage students with the geosciences through a new lens. The Geoscience for Teachers CPD programme has been developed by iCRAG and Geological Survey Ireland to create an opportunity for teachers of geography and CASD, and geoscience professionals to come together to increase the awareness of geoscience within the Leaving Certificate 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 2024, the resources produced have included lesson plans and module plans and the accompanying teacher notes and slides/activities for each resource.

The resources link the most recent advances in geoscience to the 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 teacher John Hegarty and geoscientist Shauna Creane from iCRAG at UCD. The resource is a full module plan, covering coastal erosion and offshore wind generation. The module provides information and resources for at least five lessons, with suggestions for expansion. This resource pack includes the full module plan and associated teacher notes and lesson plans. It also includes further information sheets and quizzes. It is suitable for TY students as well as Leaving Certificate Students.

Sincerely,

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

*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 2025. The publishers cannot accept responsibility for any consequences arising from the use of this resource. The publishers are in no way liable or responsible for any injury or loss to any person using this resource.*

# Module plan: Offshore Wind and Coastal Erosion

## Contents

# Module plan:

# 1. Coastal Erosion

## Links to Curriculum

***Core Unit 1.3 of the Leaving Certificate Syllabus***

Landform Development

Patterns and Processes in the physical environment

- Rock Cycle
- Process of weathering
- Mass washing and erosion by sea

Optional Unit 9

- The Atmosphere-ocean environment

The aim of the lessons is to show students that the effects of climate change can be seen in the accelerated erosion of our coastlines. The extra water level along with the more frequent storms gives a higher and more aggressive wave surge which does severe damage.

## Learning Outcomes

***Students should be able to:***

- Summarise the processes that cause erosion.
- Link the climate change to erosion
- Identify the various forms of erosion
- Identify the reasons for rapid and slow erosion/ composition of coast

## Resources Required

- Access to computers
- Worksheets
- Sand/gravel mixture
- Container

## Field Trip to Coastline

- Draw a section of the coast
- Identify the rock type
- Recommend methods to curtail Erosion on this part of the coast e.g. Rock Armour or Marram grass etc

## Keywords and Definitions

| | |
|---|---|
| Abrasion | Rocks thrown against the coastline by waves |
| Attrition | Wearing of rocks by hitting against each other |
| Compression | Squeezing of rocks, causing fold or fracture |
| Deposition | The laying down of sediment by wind or water |
| Erosion | The wearing away of earthen materials |
| Hydraulic Action | The force of water crashing against a coastline |
| Rock Cycle | The processes that form the 3 rock types |
| Rock Armour | Stone used to form a Barrier at the coast |

## Linkage and Integration

### *Linkage*

- English- Literacy skills, composition and presentation of material. Communication skills both within the group and in the role play.
- SPHE - Working together.
- CSPE- Climate change and sustainability in the community.

### *Differentiation*

- Groups can be predetermined so that weaker or students with additional needs are accommodated.
- Groups can be given additional help by the teacher if needed.
- If needs be, work sheets or quizzes could also be differentiated, however it would be preferable if the work sheets were kept the same, but roles assigned to weaker students, like filling in the forms.

# Teacher Notes

## Teacher Notes: Coastal Erosion

### *Learning Activities*

Using your local coastline (in this case Ballybunion) the students work out what has caused the landscape to look like this. There is a newspaper article on research done by a student on the Ballybunion coastline, this gives some clues to the landscape formation. The curriculum for Junior Cert will also help them explain the formation in the area. There is also a quick quiz on the newspaper article.

### *Detailed instructions*

Students to work in groups of four. They are to reinforce the information they have received regarding coastal erosion. Each group is assigned a character for the interactive session via role play.

Groups are then given time to research the topic and the aspect they will be dealing with in the interactive session.

Each group is assigned a computer, and they will be able to look at material regarding their own aspect of coastal erosion, e.g. Myrtleville.

Each group to be assigned a set time in the role play to put across their points.
The teacher will assess the information given and give any feedback necessary.

***Homework task:***

Students asked to go to their local beach and bring in photographic evidence if possible, or drawings to reinforce their various roles.

Extra info: This information is given at the end of the section on each role play.

### *Methodologies:*

Teacher Based: Teacher Talk through the various aspects of Costal Erosion.

Student based: Researching the different aspects of erosion and putting together the information for their role play.

Collaborative: Working together and observing each other in a group dynamic as well as observing other groups and how they interact and put their role play together.

# 2. Offshore Energy

## Links to Curriculum

### *Sustainability*

- Students consider the balance between economic, environmental and social systems necessary for meeting the needs of the today while also thinking about the future.
- Students need to critically reflect on current concepts and practices in relation to sustainability.

The aim of the lessons is to show students that the effects of climate change can be seen in global warming, and this is due to the excess use of fossil fuels. Ireland strategically is ideally positioned to utilise natural resources, like wind and ocean currents, to provide us with a clean source of energy for our industrial and domestic use.

## Learning Outcomes

***Students should be able to:***

- Identify fossil fuels as the main source of climate change.
- Understand that fossil fuels are the problem.
- Identify the various forms of natural energy sources.
- Identify how Ireland could harness this source of energy.
- Understand the size of Irelands maritime area.

## Resources Required

- Access to computers
- Worksheets

## Field Trip to Coastline

- Acquire models of seashore wind turbines.
- Determine through experimentation the ideal model.

## Keywords and Definitions

| | |
|---|---|
| Offshore wind energy | Harness the power of the wind on the high seas |
| Piling and Monopiling | Anchor points that are driven into the seabed |
| Jacket | Alternative foundation to anchor and support turbines on the sea bed |
| Marine substation | Offshore substation used to boost the voltage of the electricity |
| Sub Marine Cables | Used to transport electricity generated over long distances to the coast |
| Fixed foundations | Used for wind farms that place their wind turbines on the seabed |

| | |
|---|---|
| Offshore wind energy | Harness the power of the wind on the high seas |
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# Linkage and Integration

## *Linkage*

- English- Literacy skills, composition and presentation of material. Communication skills both within the group and in the role play.
- SPHE- Working together.
- CSPE- Climate change and sustainability in the community.

## *Differentiation*

- Groups can be predetermined so that weaker or students with additional needs are accommodated.
- Groups can be given additional help by the teacher if needed.
- If needs be, work sheets or quizzes could also be differentiated, however it would be preferable if the work sheets were kept the same, but roles assigned to weaker students, like filling in the forms.

# Teacher Notes

## Teacher Notes: Offshore Energy

### *Learning Activities*

Use could be made of classroom wind turbines to demonstrate how off shore wind Turbines work. Students by experimentation understand that the natural energy of the wind can be utilised to generate electricity. Students will learn how the building of a farm will help the local economy and provide employment as well as help the environment.

### *Detailed instructions*

Students to work in groups of four. They are to reinforce the information they have received regarding Offshore Wind farms. Each group is assigned a character for the interactive session via role play.

Groups are then given time to research the topic and the aspect they will be dealing with in the interactive session.

Each group is assigned a computer, and they will be able to look at material regarding their own aspect of Offshore Wind

Each group to be assigned a set time in the role play to put across their points.
The teacher will assess the information given and give any feedback necessary.

***Homework task:***

Students asked to show their experimentation from the models and state, with experimental evidence, their choice of turbine for Offshore use.

Extra info: This information is given at the end of the section on each role play.

### *Methodologies:*

Teacher Based: Teacher Talk through the various aspects of Offshore Energy.

Student based: Researching the different aspects of Offshore energy and putting together the information for their role play.

Collaborative & Peer: Working together and observing each other in a group dynamic as well as observing other groups and how they interact and put their role play together.

# Full Lesson Plans and Detailed Instructions

## Lesson set 1: Coastal erosion, offshore wind and our communities

Two sessions are proposed:

1. Interview expert in climate-related work (1 class)
2. Role plays on climate-change related issues (2/3 classes)
   - Second year / Transition year
   - CSPE / Geography

## Session 1: Interview an expert in Climate-related work

- Teachers notes:
  - List of resources to find local scientists
    - Agricultural and sustainability MTU, Teagasc (Listowel), iCRAG
  - Questionnaire to give to incoming experts
    - Very simple questions to allow students to generate their own list of questions

- Student activities:
  - Give students a worksheet with several leading questions
  - Provide students with the completed questionnaire and they design 10 extra questions they want to ask specific incoming expert
  - They record interview, present findings in a method of their choosing
  - Homework. Quiz relating to the interview.

### *Leading Questions for an interview with a climate scientist*

- What exactly is “climate change”? ...
- What is causing this to happen? ...
- Are you sure this isn't part of a natural cycle? ...
- Why is climate change a problem? ...
- Do scientists really agree on climate change? ...
- How is climate change affecting the planet right now?
- Why has my town received record breaking cold snaps and snow if the climate is heating up?

- Students to compile further questions for the scientist

## Session 2: Role Play on Climate Change-related issues

Two role play scenarios are designed. These scenarios will enable students to form discussions about climate-related issues from different perspectives of people in the community. In order to tackle these issues a multidisciplinary approach must be used including the social sciences.

## *Role Play 1: Coastal erosion along the east coast of Ireland*

### ***Background to the problem: Coastal Erosion***

The power of the sea has shaped Ireland's coast into what we can see today. Two main processes are responsible for this: erosion and deposition. Coastal erosion is the breaking down and carrying away of materials by the sea. Deposition is when material carried by the sea is deposited or left behind on the coast.

**Destructive Waves**

Coastal erosion takes place with destructive waves. These destructive waves are very high in energy and are most powerful in stormy conditions. The swash is when a wave washes up onto the shoreline and the backwash is when the water from a wave retreats into the sea. Destructive waves have stronger backwashes than swashes. This strong backwash pulls material away from the shoreline and into the sea resulting in erosion.

**Constructive Waves**

Constructive waves, on the other hand, are low energy waves that result in the build-up of material on the shoreline. Constructive waves are low energy and have stronger swashes than backwashes. This means that any material being carried by the sea is washed up and begins to build up along the coastline. The material that is deposited by constructive waves can most often be seen by the creation of beaches.

**How Waves Erode**

Destructive waves erode through four main processes; Hydraulic Action, Compression, Abrasion and Attrition.


Image credit: Jeff Hansen, U.S. Geological Survey.

*Hydraulic Action*

Hydraulic Action is the sheer force of water crashing against the coastline causing material to be dislodged and carried away by the sea.

*Compression*

Compression occurs in rocky areas when air enters into crack in rock. This air is trapped in cracks by the rising tide, as waves crash against the rock the air inside the crack is rapidly compressed and decompressed causing cracks to spread and pieces of rock to break off. Compression is one of the main processes that result in the creation of caves.

*Abrasion*

Abrasion is when rocks and other materials carried by the sea are picked up by strong waves and

thrown against the coastline causing more material to be broken off and carried away by the sea.

*Attrition*
Attrition is when material such as rocks and stones carried by waves hit and knock against each other wearing them down. As these materials are worn down sand and rounded beach pebbles are formed.

## *Instructions for Role Play I*

**Scenario is outlined below:**

- Name of local town is Myrtleville
- Exposed soft coastline therefore very vulnerable to climate change effects such as rising sea level, increased in frequency of storms, changing wave and current regimes
- No existing coastal protection works
- Public road being eroded and at further risk of being damaged
- Irish Railway at risk of being damaged
- Farmland being eroded
- Houses at risk of being eroded away
- Coastline is a known habitat for local birds
- County Council is suggesting building a sea wall with a large rock armour to prevent erosion **https://www.youtube.com/watch?v=htoTw2FZhvU**

**Each student is designated a 'character'.** Discuss this scenario from the point of view of that designated character:

a) County Council Engineer
b) Coastal Geoscientist/Engineer Consultant
c) Local politician
d) Irish Rail representative
e) Ecologist
f) Bird watcher
g) Holiday home owner
h) Sea Kayaker

**Questions to evoke discussion:**

1. How does existing trends of coastal erosion impact you?
2. From your perspective, what are the positive and negatives of the proposed coastal defence works?
3. What are the synergies between characters? What are the main conflicts?
4. Considering point 3, are there any alternative ways to address this issue? For example,
    a. Should the coast be left alone?
    b. Should we still intervene with mitigation strategies but consider a nature-based solution?
    c. Or is a combination of nature-based solution and hard structures a reasonable approach?

**Homework**

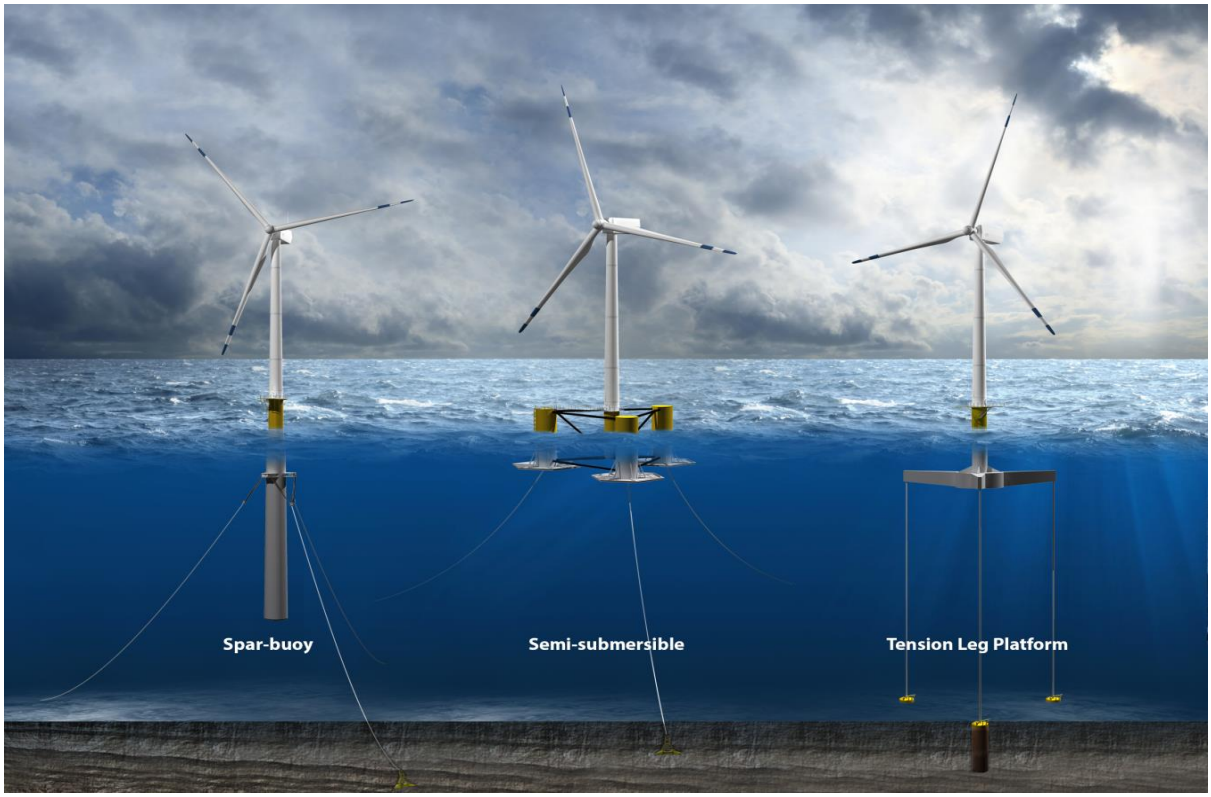
Research Costal erosion in North Kerry. Write an essay on coastal erosion in Ballybunion and what methods have been used to try and combat the erosion. Do the students agree with the methods used or could they suggest better ways to combat this erosion? Include natural barriers in the answer.
An experiment could be conducted using a mixture of sand and gravel assailed by water.
https://www.climateireland.ie/impact-on-ireland/climate-hazards/coastal-erosion/

## *Role Play 2: Proposed Offshore Wind Farm Development being located off the south coast of Ireland*

***Background to the problem:***
In 2023, the EU adopted a set of Commission proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. This will enable the EU to become the first climate-neutral continent by 2050.

Ireland's 2030 target under the EU's Effort Sharing Regulations (ESR) is to reduce its greenhouse gas emissions by at least 42% by 2030.

Ireland has very few natural resources and is therefore totally dependent on other countries to supply our energy needs. The two problems with this are 1) we are dependent on others for our energy which puts us in a very poor position. 2) The energy sources we are getting are fossil fuel based which does not help with our agreed terms of greenhouse gas reduction. A natural solution would be to utilise our natural resources of wind and ocean to generate the energy we require.



*Instructions for Roleplay II*

**Scenario is outlined below:**

- Offshore Wind Farm Development is proposed to be built 20 km off the coast of X
- EIA complete and open for consultation
- Wind farm will be comprised of 60 turbines, 2 offshore substations and cables running along or just below seafloor from the wind farm to the coast
- Landfall of cables will be the coast near a beach connected to onshore substation.
- Local port and harbour are being developed to support operation and maintenance during 35-year operational phase
- Construction over 3 years
- Operational for 35 years
- Decommission over 2 years

**Each student is designated a 'character'.** Discuss this scenario from the point of view of that designated character:

a) Wind Farm Developer
b) Local politician
c) Coastal Homeowner
d) Local Business Owner
e) Sea Swimmer
f) Fisherman/Fisherwoman/Fisher
g) Climate activist who has a podcast.

**Questions to evoke discussion:**

1. Do we want a beautiful Horizon now or a future horizon for future generations?
2. Are wind farms kilometres out to sea really going to affect our appreciation of the coastline.
3. What benefits will a wind farm bring to the country, the local community and to the environment via climate change.

**Potential future sessions:**

- Get into Geoscience Career Talk programme https://www.getintogeoscience.com/career-talks
- https://igi.ie/assets/uploads/2024/06/IGI-Offshore-Renewable.pdf
- https://www.offshorewind4kids.com/
- For Experimentation https://www.seai.ie/sites/default/files/publications/ORE-Technology-Roadmap.pdf
- https://www.onesteppower.com/post/offshore-power-generation
- Wind Energy Ireland Videos: https://windenergyireland.com/about-wind/the-basics/offshore-wind
- https://www.bbc.com/storyworks/unlocking-science/what-do-irelands-shipwrecks-have-to-do-with-renewable-energy
- https://youtu.be/Vo2DVVdZKFI
- https://www.marei.ie/project/idea-irl-integrated-design-floating-wind/

# Lesson set 2: All Aspects of Offshore Power Generation

Three 50-minute lesson plan on all aspects of offshore power generation for 2nd Year TY students.

## *Lesson Objectives*

By the end of these lessons, students will be able to:
1. Define offshore power generation and its main types
2. Explain the advantages and challenges of offshore power generation
3. Describe the environmental impacts and mitigation strategies
4. Discuss the economic aspects of offshore power generation

## *Lesson One (50 minutes)*

***I. Introduction (20 minutes)***

- Begin with a brief discussion: "What do you know about power generation at sea?"
- Introduce the concept of offshore power generation

***II. Types of Offshore Power Generation (30 minutes)***

A. Offshore Wind Power
  - Explain fixed-bottom and floating wind turbines
  - Discuss wind farm layouts and sizes

B. Wave Energy
  - Describe different wave energy converter technologies
  - Examples: point absorbers, oscillating water columns, overtopping devices

C. Tidal Energy
  - Explain tidal barrages and tidal stream generators
  - Discuss the predictability of tidal energy

D. Ocean Thermal Energy Conversion (OTEC)
  - Describe the principle of using temperature differences in ocean layers
  - Explain closed-cycle and open-cycle OTEC systems

## *Lesson Two (50 mins)*

***III. Advantages and Challenges (20 minutes)***

A. Advantages
  - Higher wind speeds and wave energy in offshore environments
  - Large-scale power generation potential
  - Reduced visual and noise impact compared to onshore installations

B. Challenges
  - Higher construction and maintenance costs
  - Harsh marine environment (corrosion, storms)
  - Grid connection and power transmission issues

***IV. Environmental Impacts and Mitigation (15 minutes)***

A. Potential impacts
  - Effects on marine ecosystems and bird populations
  - Underwater noise during construction and operation
  - Changes in sediment transport and coastal processes

B. Mitigation strategies
  - Environmental impact assessments
  - Careful site selection and timing of construction activities
  - Use of noise reduction technologies and wildlife monitoring

***V. Economic Aspects (15 minutes)***
- Discuss the costs of offshore power generation compared to onshore alternatives
- Explain government incentives and support for offshore renewable energy
- Brief overview of job creation in the offshore energy sector

## *Lesson Three*

***VI. Conclusion and Discussion (50 minutes)***
- Recap the main points of the lesson (10 minutes)
- Open the floor for questions and discussion (15 minutes)
- Prompt students to consider the future of offshore power generation (15 minutes)
- Discuss the most recent technology for harnessing wind or wave/tidal energy (10 minutes)

***Homework Assignment***
Ask students to research and write a one-page report on a specific offshore power generation project, discussing its technology, environmental considerations, and economic impact. Minimum of 500 words and should include drawings and pictures relating to offshore power generation.

# Resources for Offshore Power Generation Lesson Plans

## *Lesson One: Introduction to Offshore Power Generation*

1. Definition of Offshore Power Generation
Offshore power generation refers to the production of electricity from renewable energy sources located in ocean waters. This includes technologies like wind, wave, tidal, and ocean thermal energy conversion (OTEC).

2. Types of Offshore Power Generation
***A. Offshore Wind Power***
- **Fixed-Bottom Turbines**: These are anchored to the seabed and are used in shallow waters.
- **Floating Wind Turbines**: These are anchored to the seabed with cables and can be placed in deeper waters.

**Example**: The Hornsea One wind farm off the coast of the UK is one of the largest offshore wind farms in the world.

***B. Wave Energy***
- **Point Absorbers**: Devices that float on the water surface and move with the waves.
- **Oscillating Water Columns**: Structures that use the motion of waves to push air through a turbine.
- **Overtopping Devices**: Capture water from waves and release it to drive turbines.

**Example**: The Pelamis wave energy converter was a notable project that harnessed wave energy.

***C. Tidal Energy***
- **Tidal Barrages**: Dams built across the entrance of an estuary that capture water during high tide.
- **Tidal Stream Generators**: Underwater turbines that generate electricity from the flow of tidal currents.

**Example**: The La Rance Tidal Power Station in France is one of the first and largest tidal barrage systems.

***D. Ocean Thermal Energy Conversion (OTEC)***
Uses the temperature difference between warm surface water and cold deep water to generate electricity.
- **Closed-Cycle OTEC**: Uses a working fluid with a low boiling point to drive a turbine.
- **Open-Cycle OTEC**: Uses warm seawater to create steam that drives a turbine.

**Example**: The NELHA OTEC facility in Hawaii demonstrates the closed-cycle OTEC system.

## *Lesson Two: Advantages and Challenges of Offshore Power Generation*

1. Advantages
- **Higher Energy Potential**: Offshore locations typically have stronger winds and more consistent wave action.
- **Reduced Visual Impact**: Offshore installations are less visible from land, minimizing aesthetic concerns.
- **Large-Scale Generation**: Offshore sites can accommodate larger installations than onshore.

2. Challenges
- **Cost**: Offshore projects are generally more expensive to build and maintain due to harsh marine conditions.
- **Environmental Factors**: Marine environments pose unique challenges, such as corrosion and extreme weather.
- **Grid Connection**: Connecting offshore power to the onshore grid can be complex and costly.

3. Environmental Impacts and Mitigation
- **Potential Impacts**: Disruption to marine ecosystems, underwater noise, and changes to sediment transport.
- **Mitigation Strategies**: Conducting environmental impact assessments, careful site selection, and using noise-reduction technologies.

## *Lesson Three: Conclusion and Future of Offshore Power Generation*

1. Recap of Main Points
- Offshore power generation encompasses various technologies, including wind, wave, tidal, and OTEC.
- It offers significant advantages but also faces challenges, especially regarding costs and environmental impacts.

2. Future Considerations
- Students should think about advancements in technology, such as improved turbine designs and energy storage solutions.
- Discuss recent innovations, such as floating wind farms and advanced wave energy converters.

3. Homework Assignment
Students are encouraged to research a specific offshore power generation project and prepare a report that includes:
- Technology used
- Environmental considerations
- Economic impact
- Drawings or pictures related to the project

https://www.youtube.com/watch?v=Vo2DVVdZKFI

# Further Resources: Quizzes

*Quiz: Geology and Mapping of Ballybunion's Coast. (Coastal Erosion)*

**Instructions:** Choose the best answer for each question.

1. **What geological period does Hugh O'Keeffe's research focus on?**
A) 450 million years ago
B) 250 million years ago
C) 150 million years ago
D) 50 million years ago

2. **Which award did Hugh O'Keeffe receive for his field mapping project?**
A) The Geological Survey Award
B) The Cunningham Prize
C) The National Science Medal
D) The Best Student Project Award

3. **What type of rock formations did Hugh primarily study along the Ballybunion coast?**
A) Igneous and metamorphic
B) Limestone, sandstone, and shale
C) Granite and basalt
D) Clay and siltstone

4. **What environmental conditions did Hugh's research indicate about the region 450 million years ago?**
A) It was a desert.
B) It was covered by glaciers.
C) It was located at the Equator and in the tropics.
D) It was underwater with no land exposure.

5. **Which fossils did Hugh find during his mapping project?**
A) Dinosaur bones
B) Spores, ammonites, and bivalves
C) Coral and sea urchins
D) Mammoth remains

6. **How did Dr. Brian McConnell describe Hugh's final year work?**
A) Incomplete and rushed
B) A model of its kind
C) Average and unremarkable
D) Too ambitious for a student project

7. **What was the primary focus of Hugh's research on the Ballybunion coast?**
A) The geography of the area
B) The sedimentology of the coast
C) The climate changes over time
D) The human impact on the coastline

8. **What does the term "sedimentology" refer to in the context of Hugh's work?**
A) The study of ancient civilizations

B) The study of sedimentary rocks and their formation
C) The study of volcanic activity
D) The study of ocean currents

9. **How long did Hugh O'Keeffe spend mapping the coastline?**
A) One month
B) Two months
C) Three months
D) Four months

10. **Why is it significant that Hugh found fossilized remains of tropical inland plants?**
A) It indicates that the area was once a desert.
B) It helps confirm the age of the rock and its historical environment.
C) It shows that the area was always submerged underwater.
D) It suggests that the climate has always been cold.

**End of Quiz**

**Answers:** (For teachers to check after students complete the quiz)
1. A
2. B
3. B
4. C
5. B
6. B
7. B
8. B
9. B
10. B

Link for the information that the quiz is based on

https://www.independent.ie/regionals/kerry/lifestyle/hugh-maps-his-way-to-top-prize/30961701.html

*Quiz: Marine Geoscience*

**Instructions:** Choose the best answer for each question.

**1. Which of the following best describes oceanography?**
A) The study of sedimentary rocks and their formation
B) The study of marine life, ecosystems, currents, and seafloor geology
C) The examination of landforms and the processes that shape them
D) The analysis of sediment layers below the seabed

**2. What is the primary focus of sedimentology?**
A) The movement of ocean currents
B) The arrangement of sediment layers
C) The study of sedimentary rocks and their formation processes
D) The impact of human activity on marine ecosystems

**3. How does marine geomorphology contribute to our understanding of coastal environments?**
A) By analysing the chemical composition of seawater
B) By studying the landforms and processes that shape coastal areas
C) By mapping the distribution of marine life
D) By investigating the origins of sedimentary rocks

**4. Why is stratigraphy important for marine geoscientists?**
A) It helps in understanding ocean currents
B) It provides insights into the arrangement and distribution of sediment layers
C) It focuses on the study of marine ecosystems
D) It is irrelevant to the study of marine geology

**5. Which of the following is NOT a key area of knowledge for a marine geoscientist?**
A) Oceanography
B) Sedimentology
C) Meteorology
D) Marine Geomorphology

**6. In what way can data interrogation and modelling be beneficial for marine geoscientists?**
A) It can help in the classification of marine organisms.
B) It can inform decisions on cable routing and siting of offshore wind farms.
C) It can predict weather patterns in coastal regions.
D) It is only useful for academic research purposes.

**7. What role does environmental impact assessment play in marine geoscience?**
A) It assesses the economic viability of marine projects.
B) It evaluates the potential effects of projects on marine ecosystems and structures.
C) It focuses solely on the geological features of the seabed.
D) It is primarily concerned with the aesthetic aspects of coastal landscapes.

**8. Which of the following statements reflects the relationship between marine geoscience and coastal stability?**
A) Marine geoscience has no impact on coastal stability.
B) Understanding sediment movement is crucial for predicting coastal stability.
C) Coastal stability is only determined by weather patterns.

D) Marine geoscience only focuses on underwater features, not coastal areas.

**9. Which of the following activities would a marine geoscientist likely engage in during fieldwork?**
A) Analyzing sediment samples in a laboratory
B) Mapping seafloor geology and collecting data on marine ecosystems
C) Writing reports on marine life
D) Conducting theoretical research on ocean currents

**10. How does the study of sediment layers below the seabed contribute to marine geoscience?**
A) It helps in understanding the chemical properties of seawater.
B) It provides information about historical geological events and sediment formation.
C) It is only relevant for studying marine organisms.
D) It has no practical applications in marine engineering.

**End of Quiz**

**Answers:** (For teachers to check after students complete the quiz)

1. B
2. C
3. B
4. B
5. C
6. A
7. B
8. B
9. A, B, C, D
10. B