

SDG14 Future of the Ocean

MM3: Offshore Renewable Energy



Micro-Module 3: Offshore Renewable Energy

Research and Development

Lesson 8: Learners Design Wind Turbine Foundations

Subjects: Climate Action and Sustainable Development, Design, English, Engineering Science

Lesson Title and Summary: Learners Design Wind Turbine Foundations

In this lesson, learners become offshore wind turbine engineers who design and construct strong and stable foundations for wind turbines at sea. Working in small groups, they are provided with materials to create their turbine foundations. The learners are challenged to think critically about stability, the weight of the turbine, the depth in the sand that their foundation will be buried, and the ability to withstand waves and strong winds. After a brief building time, the groups present their designs.

Vocabulary: Prototype, Design and Build, Offshore Wind Turbine, Stability, Foundation

In this lesson, the learner will:

- Develop hands-on prototyping skills
- Environmental awareness and responsibility
- Basic engineering concepts, adaptability and refinement
- Critical thinking and problem-solving

Materials

- Worksheet: Turbine Foundation Options
- Straws
- Match sticks/ lollipop sticks
- Markers/ stickers,
- Playdough or clay
- Tape
- String
- Cardboard
- Scissors
- Rulers/ measuring tapes
- Mini-turbines (in any form – could be some lollipop sticks stuck together)

7 AFFORDABLE AND CLEAN ENERGY



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



11 SUSTAINABLE CITIES AND COMMUNITIES



13 CLIMATE ACTION



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ACTIVITY INSTRUCTIONS

Activity 1: Introduction (10 minutes)

1. Use the image provided in the worksheet and have learners brainstorm the pros and cons of each design.
2. Have learners discuss what the qualities of a strong offshore wind turbine might be, and what they need to consider (i.e. wind, tide, waves) when building a wind turbine. Remind learners of their last two lessons as the information discussed may be useful.
3. Share as a class.

Activity 2: Group Formation and Materials (5 minutes)

1. Divide the class into small groups of 3-4 learners.
2. Provide each group with the materials, including straws/matchsticks/lollipop sticks, playdough or clay, tape, string/cardboard, scissors, mini-turbines (e.g., lollipop sticks), a large plastic crate filled with water, and sand.

Activity 3: Design and Construction (25 minutes)

1. Instruct the learners to collaboratively design and construct their wind turbine foundations using the provided materials. They may refer to their brainstorming from the previous lesson.
2. Encourage them to consider stability, weight distribution, and the foundation's ability to withstand waves and strong winds.

Activity 4: Presentation (10 minutes)

1. Give each group a few minutes to present their foundation designs to the class.
2. During the presentation, have the other learners ask questions or provide feedback on each design.

REFLECTIVE EXERCISE: 3-2-1

- Three things they feel they have learnt from the exercise
- Two things they found most interesting and would like to explore more
- One – their opinion they have about the site / exercises

Use Post-its or a Mentimeter survey - [mentimeter.com](https://www.mentimeter.com) to gather reflections

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EXTENSION / REDUCTION ACTIVITIES:

Reduction: For a shorter class, reduce the number of materials provided to the groups to simplify the activity and save time. Skip the presentation part and instead, have each group explain their foundation design briefly to the class while showing it in action during the testing phase in Lesson 5. Instead of having each group present their design choices, facilitate a brief group discussion where learners share one thing they learned from designing their turbines and foundations.

Extension: For a longer class, after the initial 25-minute building time, give groups an additional 5 minutes for modifications and improvements to their foundations based on feedback from other groups. Introduce additional variables for testing, such as varying the wind speed or changing the angle of the turbine blades to explore how these factors impact the stability and performance of the turbine and foundation. Have groups record their observations and create charts or graphs to compare to different foundation designs.

MEDIA BOX: (materials, online video links, extra resources, case studies etc)

The Foundation of Wind Turbines - IN 60 SECONDS – DOB Academy [1:22 mins]
https://www.youtube.com/watch?v=NQwuRV2MFs8&ab_channel=DOB-Academy

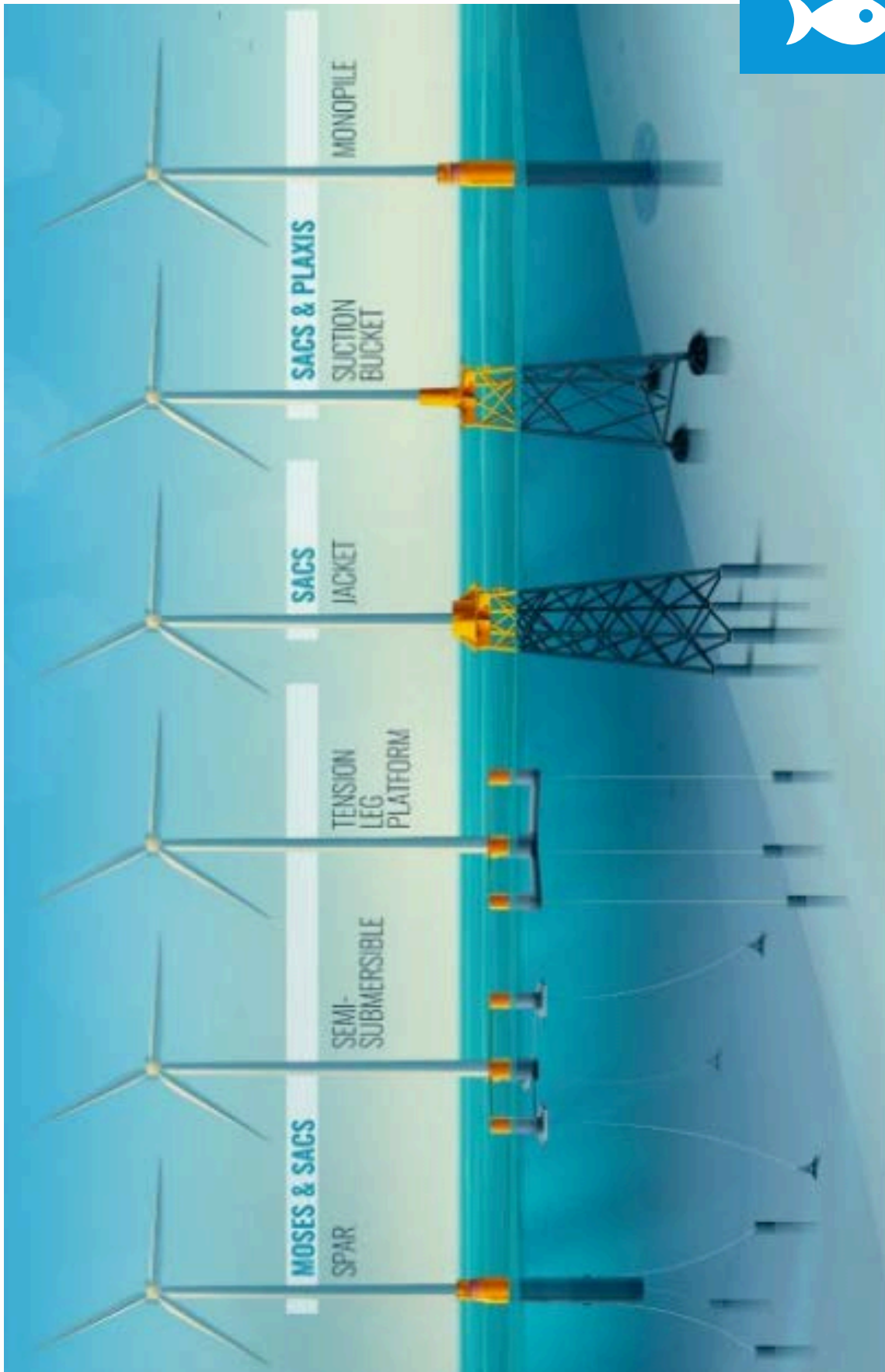
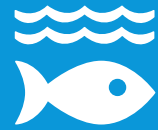
Watch the World's First Floating Wind Farm Ride the Waves | National Geographic [2:23 mins]
https://www.youtube.com/watch?v=sgCA5e7K7r8&ab_channel=NationalGeographic

Wind Energy Ireland wants more renewable energy targets [1:51 mins]
https://www.youtube.com/watch?v=52AR4W1vc10&ab_channel=RT%C3%89News

Report (22 pages): Erosion of foundations of Arklow Bank Wind Farm:
https://eprints.hrwallingford.com/595/1/HRPP320_Seabed_scour_assessment_for_offshore_windfarm.pdf

Local Trip / Expertise / Additional Work and Assessments

- Organize a trip to your local beach to see if you can pick a spot where you might construct a wind farm.
- Contact your county council and ask what their offshore plans are? Are offshore wind farms a county-level decision or a national level decision?
- If you have access to a 3D printer, have learners design and print their offshore wind turbine with the 3D printer.



Types of wind turbine foundations, and Bentley software to address each type of foundation, <https://blog.bentley.com/software/all-about-offshore-wind-turbine-foundations/>