5. OCEAN ENERGY ENGINEERS – TRACKING THE POWER AND CREATING SMART CITIES!

Subject: Science, Technology, Engineering, Art, Mathematics (STEAM)
Framework Skills:
Grade Level: 10-12 years old
Time Allotment: 4 Sessions (45-60 minutes each – adaptable to extend as project work)

Aim:
The project plan includes four sessions / lesson activities including:

- TRACKING THE POWER - FROM SOURCE TO HOME
- PYLON POWER - DESIGNING THE INFRASTRUCTURE & LEARNING ABOUT ENERGY CONSUMPTION
- BUILDING THE SMART OCEAN CITY USING RENEWABLE OCEAN ENERGY RESOURCES
- PRESENTATIONS & EVALUATION

Students are "Ocean Energy Engineers" on a mission to save the planet by developing sustainable ocean energy devices, pylons, and renewable ocean energy solutions for a smart city. They will learn about the national grid system and the importance of infrastructure that enables everyone to have electric power. They will also learn about pylons and energy consumption in our homes.
As a more extensive project, the students will design and build smart cities, considering how their cities can run on renewable energy sources around Ireland.

Overall Learning Objectives:

- **Knowledge:**
  - Understand the basic principles of renewable ocean energy resources
  - Describe the national electrical grid and how energy is transmitted from source to their homes, schools, businesses etc.
  - Gain awareness of global and Irish energy consumption patterns.
  - Track and understand the electrical infrastructure and learn about the design and function of pylons and cables.

- **Skills:**
  - Collaborate effectively in teams.
  - Apply design thinking and problem-solving skills.
  - Communicate ideas clearly through presentations and visual representations.
  - Develop creative and innovative solutions – through citizen engagement (Earth Hour)

- **Attitudes:**
  - Develop an appreciation for renewable energy sources.
  - Foster a sense of responsibility towards energy conservation.
  - Encourage curiosity and critical thinking about sustainable solutions.

EXPLORERS
RENEWABLE OCEAN ENERGY
The Power of the Future

Materials:

- Whiteboard/ Screen
- Explorers Presentation: EXPLORERS OCEAN ENERGY – THE POWER OF OUR FUTURE CHAPTER 4: LEARNING ABOUT OUR ELECTRICAL GRID, CONSERVING ENERGY & DESIGNING A SMART CITY for the FUTURE
- Review other Explorers Ocean Energy presentations for introductions / recapping on the knowledge of the children.
- Markers/Pens
- Paper (various sizes)
- Cardboard, tape, glue, string, straws, building blocks (for pylon and city construction)
- Internet access for research
- Maps of Ireland and the world
- Data on energy consumption (Irish and global)
- Images/videos of ocean energy technologies and electrical grids
- Props, art materials, Lego blocks to create a Smart City
- Small led lights, coper wire for circuits, small motors, wind turbines
- **Provide students with access to relevant software and tools – e.g. coding platforms.**
- Set out **design thinking process (empathise, define, create concepts, prototype, test).**
- **Facilitate collaboration and communication among team members.**
- **Provide opportunities for students to present their designs and receive feedback from engineers, renewable ocean energy experts etc.**

Session Breakdown:

Session 1: TRACKING THE POWER - FROM SOURCE TO HOME

- **Introduction (15 mins):**
  - Brainstorm: Where does our electricity come from? / Recap on lessons learned from Explorers Energy resources.
  - Discussion: Fossil fuels vs. renewable energy.
  - Introduce the concept of the national electrical grid.

- **Tracking the Energy (25 mins):**
  - Interactive activity: Trace the path of electricity from the lightbulb to a power plant and the source of energy.
  - Discuss the importance of the national grid and getting energy to places all over Ireland. Highlight that Ireland needs a strong infrastructure / national grid to source energy from all around Ireland – so as to enable the renewable energy industry to develop.
  - Review renewable ocean energy (wave, tidal, ocean) activities completed (See Explorers lesson plan: RENEWABLE OCEAN ENERGY – A STEAM EXPLORATION OF WIND, TIDE & WAVE ENERGY
  - Discuss and recap on the advantages and disadvantages of ocean energy.
    - Discuss where in Ireland ocean energy would be most effective and identify where offshore windfarms are being placed (East coast and West coast)
    - Divide students into teams and brainstorm ideas of how to share the electricity generated all around Ireland - and how it could be sold to Europe.
    - Research pylon design and cable types.

Session 2: PYLON POWER - DESIGNING THE INFRASTRUCTURE & LEARNING ABOUT ENERGY CONSUMPTION

- **Pylon Design (15 mins):**
  - Discuss different pylon designs and cable types.
  - Explain the importance of safety and stability in pylon design.
  - Discuss the materials used in pylon construction

- **Design Challenge (30 mins):**
  - Teams design their own innovative pylons to transmit ocean energy.
  - Consider factors like height, stability, cable support, and aesthetics.
  - Sketch designs and create blueprints.
  - Use popsicle sticks and other crafts to make the pylons.

- **Energy Consumption (20 mins):**
- Discussion: How have we changed our energy use over the last 20-30 years
- Discuss global energy consumption and campaigns to promote turning off the lights – Earth Hour
- Interactive activity: Present image of consumption in the home and get the children to guess the energy consumption in the home.
- Create a pie chart showing the amount of energy used in Ireland.
- How can we reduce our energy consumption?

Session 3: BUILDING THE SMART OCEAN CITY

- **Smart City Concepts (45 mins – extend as project work):**
- Discuss the concept of a smart city and its benefits - Imagine a town or city that is completely run off renewable energy. There is no pollution. Solar devices come in all shapes and sizes to capture the energy from the sun. Buildings and cars are run from energy generated from the wind and ocean energy devices. There is an electric grid system the runs across the country, where everyone benefits from the renewable energy sources. All of the appliances that we use in our homes are energy efficient. Everyone is able to reduce their carbon emissions. Could our towns and cities look like this?

- Discuss how can renewable ocean energy power a smart city?
- Discuss energy conservation in a smart city.
- Split the class into teams to create a smart city – run form renewable ocean energy sources.
- The teams should consider:
  - How can energy be distributed throughout the city
  - How can micro-grids be useful in making sure everyone gets power e.g. particularly during storms cutting electricity across the country.
  - How could features in the city be smart e.g. streetlights that adjust to brightness based on pedestrian traffic, electric vehicle charging stations getting electricity from renewable sources. Energy-efficient buildings with integrated renewable energy systems that support the renewable ocean energy power grid such as solar panels and green roofs.
  - How can the city's transportation infrastructure prioritise electric vehicles and public transportation.
  - How factors like population density and growth, transportation routes, and proximity to ocean energy sources will impact their designs.

- Use coding to create a basic automated system

- Building the infrastructure: The teams should refine their pylon designs, considering factors like load-bearing capacity, wind resistance, and cable routing. The should also consider the underwater cable pathways from the ocean energy devices to the city.
- Introduce maps of the city and spatial data to plan the city's layout and infrastructure.
- Use a scale to create accurate models.

- **Construction (40 mins – extend as project work):**
- Teams build their smart city models, incorporating their pylon designs and ocean energy solutions.
- Encourage the use of recycled materials.
- Consider incorporating elements like smart lighting, electric vehicle charging stations, and energy-efficient buildings.
- Optional: use small led lights and small motors to add functionality to the cities.

Session 4: PRESENTATIONS & EVALUATION

- Invite local engineers or people who work in the renewable energy sector to speak to the students.

- **Presentations (40 mins):**
- Teams present their smart city models and explain their designs.
- Highlight the benefits of using renewable ocean energy.
- Discuss their design process and the challenges faced.

- **Evaluation & Discussion (20 mins):**
- Class discussion: What did we learn about renewable ocean energy?
- Evaluation: Assess the teams' designs, presentations, and teamwork.
- Reflect on the importance of sustainable energy solutions.

Assessment:
- Participation in class discussions and activities.
- Quality of pylon and smart city designs.
- Effectiveness of team presentations.
- Understanding of key concepts related to energy and the electrical grid.
- Team collaboration.

Differentiation:
- Provide varying levels of support for research and design tasks.
- Offer alternative presentation formats (e.g., posters, videos).
- Allow students to focus on specific aspects of the project based on their interests and strengths.
- Provide pre-drawn pylon design templates for students who need extra help.

Extension Activities:
- Research real-world ocean energy projects.
- Create a public awareness campaign about renewable energy.
- Investigate the environmental impact of different energy sources.
- Build a small working model of an ocean energy device.
- Investigate the careers involved in the renewable energy sector.