**Renewable Energy: Chapter 5**

***A gateway to clean energy...***

**Chapter Overview**:

In this chapter, students will encounter the various innovations that enable humans to capture energy from nature to generate electricity, cleanly. Different technologies will be described including the most exciting renewable sources. Students will link energetic natural resources to different regions of the planet and will explore how a diverse energy grid can support our needs. This lesson will provide more context for the students own scientific measurements of sunlight and wind at their school.

[*Leading into Nature: Chapter 6*].

**Topics:**

**Physics, Geography, Technology**

**Essential Questions:**

* How is nature energetic?
* What is **renewable** energy?
* How do we capture energy from nature?
* Where should we build energy structures and why?

**Enduring Understandings:**

* In order to protect our climate and have reliable power sources, we must use clean energy
* There is **so much energy** in the natural processes of the earth
* Our energy grid is strong if it is diverse
* Everyone can be a scientist, engineer, and problem solver

**Vocabulary:**

nature, renewable, clean energy, resources, engineer, diversity, sustainable

**Chapter 5a – Energy from nature**

**To run throughout the day (Activity)**

**Actvity: Sea level change experiment**

Motivation for today’s lesson: *Why do we want to stop burning fossil fuels?* To stop the temperature of our planet rising.

*What happens when the temperature rises?* Ice at the Arctic and Antarctic will melt!

In this experiment, students will observe the effect of melting ice on islands and low-lying countries. [See slides for details, equipment and diagrams]

Inspired by:

<https://www.dynamicearth.co.uk/media/1238/sea-level-change-experiment.pdf>

*Islands* in a tray of water will be flooded as an ice block representing the *polar ice cap* melts. The students can place objects in the tray as their *islands*. Lego or something similar would be good for this to give some height variation.

**This experiment would be best to set up early in the day, then come back to it every so often to measure the sea level with the ruler.**

Smaller ice cubes can be placed on land as pretend *glaciers*.

**Reminder from Chapter 2b**

**00 min - 15 min (Intro + discussion + video)**

**Interactive: Things that are energetic**

There are lots of things on earth that are **energetic**: Things that are energetic can make *stuff* happen – we say they can *do work*.

People are energetic. When we eat food, it gives us energy so that we can *do* all the things that we do.

What things on earth are energetic?

**[Prompt students towards energy within nature]**

Remember some of the types of energy we have talked about before: **heat**, **light**, **motion…** Can you think of things that happen in nature that show these types of energy?

**[Heat from volcanoes, hot springs, the sun]**

**[Light from the sun, moon (reflected from sun, even at night) and stars – note that the moon and stars are much less bright because we are receiving much less light energy from them]**

**[Motion from the wind, the waves, the tide & rivers]**

All of this energy is also **renewable**. We call it renewable because it will never run out. Here is a [5 minute video](https://sustaineducation.sharepoint.com/:v:/s/SustainEd/EZ3Tzx-KB19OkdM9apLqij4BXCxjkQd1gGgLnorz9MatCA?e=AAW4BV) showing non-renewable and renewable energy sources.

*We can get energy from nature, without burning fossil fuels. That means we can power our homes (we can still heat, cook and use appliances) without creating* **CO2**. *This is good news for the planet :)*

*Reminder of why we want clean energy*: To reduce the damage to our earth’s climate, we are trying to generate all of our electricity using clean, *renewable* energy instead of burning fossil fuels. Solar panels and wind turbines are being built in many locations around the UK and the country is using less and less fossil fuels. Building and running these technologies also provides new jobs for people. Some members of society are against the building of these technologies as they might disrupt the local environment or animal populations, whilst also being an eyesore on the landscape.

**New content**

**15 min - 40 min (Interactive + video + activity)**

**Interactive:** **Harnessing the power of nature**

*Nature has so much energy that we could capture and use*

We already know what we could use this for – to power our homes, towns and cities.

So how do we take energy from things like **sunlight** and the movement of the **wind** and turn it into useful energy like electricity?

**We need the help of science and technology…**

The first important invention that we can use is the solar panel – this converts light from the sun into useful electricity.

The dark surface of the panels **absorb** all of the visible sunlight (all the colours of the rainbow).

The energy of this light is given to charges which can travel out through wires and give this energy to whatever is connected (e.g. a lightbulb).

**We need to choose carefully where we put solar panels!** Where in your school playground would be best to put them?

The next important invention is the wind turbine – this converts kinetic energy from the wind into useful electricity.

When wind is blowing on the blades, they are forced to move. They rotate on a shaft which is connected to something called a **generator**.

(Old windmills had shafts connected to a grind-stone, for grinding wheat into flour)

When a **generator** spins, it gives energy to charges just like in a solar panel. These charges can be extracted as electricity.

**We need to choose carefully where we put wind turbines!** Where in your school playground would be best to put them?

To build, maintain and operate these cool technologies we need engineers!

These are the people in charge of capturing renewable energy from nature.

**Would you like to be an engineer?** Why don’t we meet some and find out more…

**Video:** **A day at sea**

See slides for info and video about Stephen, an offshore wind turbine engineer: <https://www.youtube.com/watch?v=vfUhBKZR4sU>

**Video:** **Catching the sun**

See slides for info and video about Stefania, a solar design engineer: <https://www.youtube.com/watch?v=4oGo8P8CtJw>

**Activity: Build a wind machine**

**Engineers, we need you!**

This activity allows students to build their own windmill which can be used to lift objects on a string (*a wind-powered machine).*

Video instructions: <https://www.youtube.com/watch?v=qiQ3Zbm1Z2c>

**40 min - 55 min (Online resources)**

**Interactive: Energy mapping**

Use this Met Office resource to show sunshine data from the UK, for different months of the year [See slides for examples]: [UK actual and anomaly maps](https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps)

**What do the students notice about different regions? Can the students remember any months that had particularly good/bad weather last year?**

Use this resource to show the students live wind data from all over the world (*it is amazing*):

<https://earth.nullschool.net/>

**How does the wind look across the UK? Can the students find any storms anywhere on the globe? Explore some of the extra features in the lower left panel e.g. Ocean currents.** Slides are provided as a tutorial for using and interpreting the maps.

Students can be allowed to explore this final resource themselves on individual computers, as a homework exercise, or as groups.

Go to the data-logging website here: [Primary School Energy Mapping Challenge](https://energymap.oe.phy.cam.ac.uk/data)

This should show the wind and sunlight measurements from schools across the UK – can the students predict how their measurements will compare to other schools? *Do they expect to have more wind or sun than schools in parts of the country that are far away?*

**Additional work…**

**Data handling exercise** (extra time required):

Students are shown maps of a small storm in the north Pacific Ocean. Data of wind speed and wave height at different locations within the storm are provided. Using the templates provided, ask students to draw graphs of the wind speed and wave height inside the storm.

**Interpretation:** Can the students identify a relationship between the strength of the wind and the height of waves in the sea? Are there any anomalies in the data (things that stand out and perhaps don’t make sense)?

**Chapter 5b – Earth Energy Company**

Last time we discovered ways to generate **clean energy**. Now we need to decide where to use the different technologies…

**00 min - 50 min (Activity)**

**Activity: Earth Energy Company (Groups of 4-8 students)**

Congratulations - you just got a new job at the ***Earth Energy Company***!

Your first job is a big one: 4 places in the world need more electricity to power homes and businesses but they don’t want to burn fossil fuels. Can you work as a team to figure out what renewable energy sources to build in each location?

Split into 2 teams:

Team 1 are **politicians** for our locations in need of energy. Using the maps provided **[see slides]** they should present their locations to team 2 and give them some facts about what **natural** features their land has.

Team 2 are the **engineers** who build renewables for the Earth Energy Company. Using their *brochure* of renewables **[see slides]** they should be able to negotiate with team 1, what to build and where.

*Learning about renewables:* The brochure contains info about each renewable technology. Some diagrams are taken from this resource which is excellent -

<https://archive.epa.gov/climatechange/kids/solutions/technologies/index.html>

*Problem solving:* The teams must use the details of each renewable technology and the details of each map to figure out what resources can be used.

*What renewables can be used in each country* ***and*** *where should they be placed on the maps (can be multiple on each!)?*

*Advanced task:* Ask the teams to work together to complete a planning proposal for building the best renewable energy source at their favourite location **[template and example provided]**.

The teams are pitching the building plans for a renewable energy development to the rest of the class. They must choose the technology, location (explain why), cost, benefits, drawbacks (solutions) and future ideas. The students can be as creative as possible with this (*e.g. New design in the area could attract eco-tourists, building could include an education centre or a nature reserve/wild area to protect local habitats, etc…)*

**See slides for descriptions of each technology and location.**

**Activity: Final thoughts…**

When they have finished this activity, students should write in their **eco-diaries** about their plans to power their own neighborhood with renewable energy.

What sorts of jobs could they do to help?

What skills would they need to do the job?

**Now complete Quiz 3**

**Teacher survey chapter 5:** [FORM HERE](https://forms.office.com/r/weLJL91zi9)

**Resources:**

* Information about renewables, for kids:

<https://archive.epa.gov/climatechange/kids/solutions/technologies/index.html>

* Instructional video: <https://energymap.oe.phy.cam.ac.uk/>
* Data logging page: [Primary School Energy Mapping Challenge](https://energymap.oe.phy.cam.ac.uk/data)
* UK sunshine and weather data: [UK actual and anomaly maps](https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-actual-and-anomaly-maps)
* Interactive worldwide weather data: <https://earth.nullschool.net/>