

Lesson 1: Learning Objective: To design and build a wind turbine.

Age range. 7-11

Outcomes:

- Learn about wind energy and wind turbines.
- Learn about engineering design.
- Learn about teamwork and problem solving.

Resources:

Video of the history of turbines and or existing turbines. **A model turbine (working?), fans/hair driers.** One set of materials for each group of students: e.g tubing, wooden stick, wooden spoons, small wooden (balsa) pieces, scissors, bendable wire, string, paperclips, rubber bands, toothpicks, aluminum foil, tape, dowels, glue, paper, cardboard, plastic wrap, or other materials you have available.

Overview:

In this lesson, students will build a model wind turbine and use concepts of engineering design. They will understand the function (the purpose) of a wind turbine. A wind turbine is a machine, which turns air (wind) into energy. This energy is then used to turn a generator, which creates clean electricity. Children will demonstrate a range of skills for life: team work, problem solving, communication, resilience, self-motivation and be safe.

Due to the issues already discussed concerning the pitch of blades when the model turbines are made by children, the purpose of this lesson is to serve as an introduction to the history, concept and purpose of turbines. Pitch and angle will be introduced later as will constructing costs etc.

Introduction:

Children to work with talk partners to discuss and write down anything they already know about turbines onto whiteboards. Ideas are then to be shared with the class and any misconceptions can be addressed.

Children to be shown a video and/or brief presentation on the history of turbines and to be introduced to the purpose, design and building of a turbine.

Design and building:

Children are to work with partners/in small groups to design a turbine. Mini plenary's to be used to discuss how the length/weight and number of blades will affect how well the turbine will turn and subsequently how much energy it could produce in order to make electricity.

Children to use their design to construct a turbine from the materials provided. Any changes made during the building phase are to be shown on the childrens designs.

Testing

Each team will test their windmill using a fan or hairdryer, each windmill will be tested using the same wind speed (medium -- at a distance of three feet?)

Evaluation/Plenary

Children to share their findings with the class.

Key Questions

If you could have had access to materials that were different than those provided, what would your team have requested? Why?

Would more blades have made your turbine better? Why might turbines you see only have 2 or 3 blades?

Lesson 2 Learning Objective: To investigate energy production and renewable energy.

Age range. 7-11

Outcomes:

- Learn about different methods of energy production.
- Learn about wind energy and wind turbines.
- Learn about renewable energy
- Learn about teamwork and problem solving.

Resources:

Video of different methods of energy production. Video of existing turbines. [A model turbine \(working?\)](#). Packs of photos/key facts/information linked to various forms of energy.

Overview:

In this lesson, children will investigate different methods of energy production and explore the benefits of renewable energy. Children to find a solution to the question 'Which are the best forms of energy for us to use?' Children will demonstrate a range of skills for life: team work, problem solving, communication, resilience, self-motivation and be safe.

Introduction:

Children to work with talk partners to discuss and write down anything they already know about energy production and renewable energy on their whiteboards. Ideas are then to be shared with the class and any misconceptions can be addressed.

Main activity:

Children are to work in teams to investigate types of energy and find a solution to the question 'Which are the best forms of energy for us to use?' Children to be introduced to a variety of concepts that will be staggered throughout the lesson.

Concepts

1. Most of our energy is originally derived from the sun.
2. Environmental impacts differ depending upon the energy source and conversion process.
3. Energy sources can be classified as renewable, nonrenewable or inexhaustible.

Currently, society is strongly dependent upon nonrenewable energy resources.

4. An energy source can be considered renewable if it is replenished within a short period of time.
5. The world's supply of nonrenewable resources is limited and their use can negatively affect our environment.
6. Different energy sources have different costs.

Mini plenaries to occur throughout the lesson and teams are to regularly share their ideas with the class. Staff to ensure that misconceptions are addressed and regular pros and cons with the different team ideas are to be shared.

Plenary

Children to share their findings with the class.

Key Questions

1. Where does energy come from?
2. Is our supply of energy infinite or finite?
3. How can we classify energy sources as renewable, nonrenewable or inexhaustible?
4. How can we show the trends of our fossil fuel consumption and supply?
5. What are the most significant environmental impacts associated with our most widely used energy sources?

Lesson 3

Learning Objective: To investigate the best location for wind turbines.

Age range. 7-11

Outcomes:

- Learn about turbine location.
- Learn about social factors and considerations of turbine location.
- Learn about teamwork and problem solving.

Resources:

Video of existing turbines and where they are located. **A model turbine (working?). Model of landscape (working)** (to include slots to place turbines to determine optimal locations?)

Overview:

In this lesson, students will investigate the best positions to locate turbines. Children will demonstrate a range of skills for life: team work, problem solving, communication, resilience, self-motivation and be safe.

Introduction:

Children to work with talk partners to discuss and write down anything they already know about turbines onto whiteboards. Ideas are then to be shared with the class and any misconceptions can be addressed.

Children to be shown a video and/or brief presentation on the location of turbines in Northumberland (ideally local turbines that the children may have seen). Information on social factors not to be discussed at this point as it will be introduced during the lesson to allow children to re-evaluate and adapt their ideas.

Main activity:

Children to work in groups to decide upon the best place to locate turbines.

New information to be staggered and given to the children throughout the lesson.

1. Information on the economical factors to be given to each group. Children to use information to discuss and determine the best location before testing using model.
2. Information on the social factors to be given to children. Children to re-evaluate based on this new information.

Evaluation/Plenary

Whole class discussion to analyse childrens findings and to explore in greater depth the different factors and considerations that need to be looked at when determining a location of wind turbines. (neighbours, conservation areas, 'spoilt' views, noise? Etc)

Lesson 4

Learning Objective: To compare and contrast wind and water sources of renewable energy.

Age range. 7-11

Outcomes:

- Learn about wind energy and wind turbines.
- Learn about tidal devices.
- Learn about teamwork and problem solving.

Resources:

Video of water turbines. **Video** of tidal devices. Resources packs of information (facts, photos, costs etc).

Overview:

In this lesson, students will compare and contrast wind and tidal devices as a source of renewable energy and explore the advantages and disadvantages of both. Children will demonstrate a range of skills for life: team work, problem solving, communication, resilience, self-motivation and be safe.

Introduction:

Children to work with talk partners to discuss and write down anything they already know about wind turbines and water devices onto whiteboards. Ideas are then to be shared with the class and any misconceptions can be addressed.

Children to be shown a video and/or brief presentation on wind turbines and water devices.

Main activity:

Children to work in groups/small teams to compare and contrast wind turbines and water devices.

New information to be staggered and given to the children throughout the lesson.

Children should be given information that allows them to compare and contrast wind turbines and water devices. Children should be able to examine the cost and viability of construction and maintaining both and the amount of electricity that they can generate. Advantages and disadvantages of both are to be investigated.

Evaluation/Plenary

Whole class discussion to analyse childrens findings and to explore their ideas in greater depth. Information/photos/videos on future wind turbines and/or water devices to be shown to children to generate additional questions and further discussion.

Activity

Given that blades are such a critical component of wind turbines, in terms of efficiently using the wind in order to turn a generator and create as much power as possible, we are asking you to build your very own blades, using only paper and sellotape.

You will be given an opportunity to design, build and test your 'first generation' blades. You will record the energy output that your blades produce, using the voltmeters attached to the turbines.

When designing and building your blades, it's important to think about the following:

- Length of your blade, relative to the turbine
- Stiffness of your blade
- Shape of your blade
- The angle of your blade, when you install it on the turbine

Once you have completed your first round of testing, you will then get an opportunity to review your design and see if you can build an improved 'second generation' version of your blades. Again, you will test them and see if you can produce an even greater energy output.

Think about how your blades need to change. Are they:

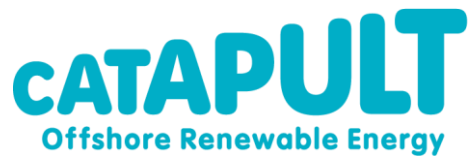
- Too long or short
- Too heavy or light
- Have the right shape
- Stiff and rigid enough

Model turbine practical session

1 hour

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|---------|---|
| 10 mins | Teams of 5-6 design '1 st generation' wind turbine blades. |
| 15 mins | Build 3x of their design. |
| 10 mins | Install blades on to the model wind turbine and begin testing; record two set of results using the voltmeter. |
| 10 mins | Review readings and redesign to make '2 nd generation' blades. |
| 5 mins | Install blades on to model wind turbine and begin testing a 2 nd time; record results using the voltmeter. |

If some groups advance quickly, get them to try and test 2 blades for comparison to 3



5 mins

Stop session and gather results from each group

5 mins

Announce winners and end the session

Record your results

First attempt

Distance 1 - closest	Voltage
Distance 2 - furthest	Voltage

Second attempt

Distance 1 - closest	Voltage
Distance 2 - furthest	Voltage

Third attempt

Distance 1 - closest	Voltage
Distance 2 - furthest	Voltage

