An tSraith Shóisearach do Mhúinteoirí

Junior CYCLE for teachers

Resource Booklet

Science

Cluster Day

2019/2020

Ionad Oideachais Mhuineachain

An Roinn Oideachais agus Scileanna
Department of Education and Skills

Contents Page

Reading Strategy: Focused Reading

GREENMATCH

Adapted from GreenMatch which provides information on different types of renewable energy sources. https://www.greenmatch.co.uk/solar-energy/solar-panels

Solar Panels

Are you worried about the environment? Or do you want to lower your carbon footprint? With the growing effects of global warming and carbon pollution, protecting our environment has become a priority.

What are solar panels? Solar panels work by allowing photons, or packets of light, to knock electrons free from atoms. This generates a flow of electric current. This is used to provide electricity or heat for homes or buildings. Solar panels are built as a collection of lots of small solar cells. These cells are spread over a large area. The larger the amount of light that hits the cell the more electricity or heat is produced.

How Do Solar Panels Work?

Solar PV Systems

(Source: TedEd: Lessons Worth Sharing)

Solar panels work by transferring light energy electrically through the solar photo-voltaic (PV) effect. This allows for direct conversion of the energy in sunlight into electricity. Solar panels use layers of semi-conducting material. The most common material used is silicon.

Solar panel cells can either be fixed on rooftops or on the ground. You could have solar tiles fitted instead. These completely replace the tiles on a rooftop that is already there.

Glossary

Environment: everything around us

Global warming: a gradual increase in the overall temperature of the earth's atmosphere. Generally caused by the increase of the levels of carbon dioxide, CFCs, and other pollutants

Solar Cells: electric devices which convert the energy transferred by light into electricity

Carbon footprint: the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organisation, or community

Solar Thermal Systems

(Source: EnergyConservationTV)

Solar thermal systems work based on the process of solar thermal heating. They absorb the energy from the sun. It is then converted into thermal energy that can be transported into your home or business to be used for hot water heating and room heating. The heat is generated from solar panels that are placed on rooftops.

Why choose solar panels?

- **High Savings:** Save more on your electricity bills.
- **Renewable Energy Source:** It captures energy from direct sunlight.
- **Low carbon footprint:** Low carbon emissions allow you to cut back on your carbon footprint.
- **Easy to maintain:** Trees should not overshadow solar panels.
- **Long Life Span:** Solar panels can last up to 25 years or more with proper care and maintenance.
- **Property Value:** Solar panels increase the value of your property in the future.
- **A Silent System:** They don't make any noise.

Some things to think about before installing solar panels

- **Absorbs sunlight during the day:** As solar panels require sunlight to produce electricity they can only be used in the day time.
- **Needs large space:** In order to benefit from the power of solar panels you would need a large area to install the solar panels.
- **Hidden Pollutants: Silicon** and other materials used to make the photovoltaic panels cause pollution. Environmental pollutants can damage the solar panels.
- **Location:** Certain areas are better suited for solar panels than others. For example, city houses compared to mountains or highland areas.

Reading age: 13-15 years

Glossary

Emissions: the production and discharge of gases

Carbon footprint: the amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organisation, or community

Pollutants: something that is harmful to the environment

Reading Strategy: Read and Explain

KIDS DISCOVER | SEARCH | ONLINE | APPS | PRINT TITLES | RESOURCES

Adapted from an article by Robin Koontz. An Author and illustrator for early reader and non-fiction books. Kids Discover Online provides a cross-curricular experience for the modern classroom

https://www.kidsdiscover.com/teacherresources/whats-good-whats-bad-wind-energy/

Wind turbines at the Royd Moor Wind Farm in South Yorkshire, England. (Stephen Meese / Shutterstock)

The movement of wind is caused by the sun. As solar radiation heats the earth's surface, hot air rises and cool air fills the space left behind. This air movement is called wind. Wind that is captured and controlled by mechanical means is also referred to as wind energy.

Modern windmills that use a wind turbine can create electricity.

Most modern windmills are flat axis turbines. These turbines are mounted on a tall tower to take control of the faster wind. This can be hundreds of feet in the air. Propeller-like blades, usually two or three, act like aeroplane wings. They are attached to a rotor, which behaves much like an aeroplane propeller. A combination of (air) lift and drag on the blades causes the rotor to spin. A shaft attached to the rotor spins a generator and electricity is produced. The amount of electricity depends on the size of the wind turbine, and the quality of the wind supplied. A standard 2 megawatt turbine in the right place can provide electricity to power about 500 average homes for a year. It can also be used for charging an electrical storage device.

Glossary

Wind turbine: a device that transfers the energy of wind to an electric current

Generator: something that converts energy transferred mechanically into energy being transferred electrically

It was reported in March 2015 that China is getting more electricity from wind than from its nuclear power plants. It has more of these than any other country. Despite lower windspeeds in 2014, Chinese wind farms produced enough power to provide electricity to more than 110 million homes. Meanwhile, according to the U.S. Department of Energy, the U.S. now has the wind power ability to produce up to 65,879 megawatts of power. In 2013, there was enough electricity generated to power 15.5 million homes in the U.S. Some energy experts feel that if we capture and control just a fraction of the available power from the energy of wind, there would be no need for any other source of electricity in the world!

What do countries need to consider before installing wind farms?

- It needs wind to work.
- It is believed to be a green source of energy. Wind itself does not pollute.
- It is a renewable source which is able to produce a lot of energy.
- Wind turbines only require occasional maintenance, unlike other power sources.
- Wind turbines do not take up a lot of space. Farmers can also rent their property for wind farms and continue to farm the land.
- Wind energy is not believed to be reliable. It is not a constant source of energy.
- Electricity generated from the energy of wind must be stored (i.e. in batteries).
- Wind turbines are a possible threat to wildlife e.g. birds and bats.
- Cutting down huge numbers of trees to set up a wind farm creates problems for the environment.
- Noise is a complaint with many wind farms that are close to communities.

Reading age: 11-13 years

Glossary

Reading Strategy: Illustrate your Understanding

NATIONAL GEOGRAPHIC

Vol 107

March 2014

Non-renewable energy

Non-renewable energy comes from sources that will eventually run out, such as oil and coal.

The **National Geographic Society** is an impact-driven global non-profit organization that pushes the boundaries of exploration, furthering understanding of our world and empowering us all to generate solutions for a healthy, more sustainable future for generations to come. Our ultimate vision: a planet in balance.

Non-renewable energy sources are those that will run out or will not be replenished in our lifetimes. It may not be replenished in many lifetimes.

Most non-renewable energy sources are fossil fuels such as coal, petroleum and natural gas. Carbon is the main element in fossil fuels. For this reason, the time period that fossil fuels formed (about 360-300 million years ago) is called the Carboniferous Period.

All fossil fuels formed in a similar way hundreds of millions of years ago. Before the dinosaurs, Earth had a different landscape. It was covered with wide, shallow seas and swampy forests.

Plants, algae and plankton grew in these ancient wetlands. They absorb sunlight and capture the energy in it as a chemical store through photosynthesis. When they died, the organisms drifted to the bottom of the sea or lake. There was energy stored in the plants and animals when they died.

Over time, the dead plants were crushed under the seabed. Rocks and other sediment piled on top of them, creating high heat and pressure underground. In this environment, the plant and animal remains eventually turned into fossil fuels. Today, there are huge underground pockets (called reservoirs) of these non-renewable sources of energy all over the world.

Glossary

Non-renewable: energy resources that are exhaustible relative to the human life span, such as gas, coal, or petroleum

Carboniferous Period: is a geologic *period* and system that spans 60 million years

Photosynthesis: a process by which plants turn water and carbon dioxide with the help of sunlight into water, oxygen, and simple sugars

Sediment: solid material transported and deposited by water, ice and wind

Reservoirs: natural or man-made lake

Fossil fuels are a valuable source of energy. They do not cost a lot of money to extract. They can also be stored, or shipped anywhere in the world.

However, burning fossil fuels is harmful for the environment. When coal and oil are burned, they release particles that can pollute the air, water and land. Some of these particles are caught and set aside, but many escape into the air.

Burning fossil fuels also upsets Earth's "carbon budget," which balances the carbon in the ocean, earth, and air. When fossil fuels are used, they release carbon dioxide into the atmosphere. Carbon dioxide is a gas that keeps heat in Earth's atmosphere, a process called the "greenhouse effect." The greenhouse effect is necessary to life on Earth, but relies on a balanced carbon budget.

The carbon in fossil fuels has been sequestered, or stored, underground for millions of years. By removing this sequestered carbon from the earth and releasing it into the atmosphere, Earth's carbon budget is out of balance. This adds to temperatures rising faster than organisms can adapt.

Reading age: 11-13 years

Glossary

Extract: to pull out

Environment: conditions that surround and influence an organism or community

Carbon budget: total amount of carbon and carbon compounds in the Earth and Earth's atmosphere

Sequestered: to isolate or remove

Reading Strategy: Skimming Pre-Reading Activity

Biomass Explained
Biomass and the Environment

Independent Statistics & Analysis
eia U.S. Energy Information Administration

The U.S. Energy Information Administration (EIA) collects, analyses, and communicates independent and balanced energy information. Adapted from an article by the E.I.A.

Using biomass for energy has positive and negative effects

Biomass and biofuels are different energy sources to fossil fuels (coal, oil, and natural gas). Burning either fossil fuels or biomass releases carbon dioxide (CO_2), a greenhouse gas. However, the plants that are the source of biomass capture nearly the same amount of CO_2. This happens through photosynthesis while they are growing. This can make biomass a carbon neutral energy source.

Burning wood

Using wood for heating and cooking could replace fossil fuels. It may result in lower CO_2 emissions overall. Wood can be gathered from forests or trees that fall. Wood smoke contains harmful gases. New wood-burning stoves can reduce the amount of pollution from burning wood. Wood and charcoal are major cooking and heating fuels in poor countries. If people harvest the wood faster than trees can grow, it causes deforestation. Planting fast-growing trees for fuel and using more efficient cooking stoves can help.

Collecting landfill gas or biogas

Biogas forms as a result of biological processes in sewage treatment plants, waste landfills and livestock manure. Biogas is composed mainly of methane (a greenhouse gas) and CO_2. Many facilities that produce biogas capture it and burn the methane for heat or to generate electricity. This electricity is considered renewable. This electricity may replace the production of electricity from fossil fuels. It could result in a reduction in CO_2 emissions. Burning methane produces CO_2, but because methane is a stronger greenhouse gas than CO_2, the overall greenhouse effect is lower.

Glossary

Fossil fuels: fuels that come from old forms of life that decomposed over a long period of time

Photosynthesis: the process used by plants to change the energy transferred from the sun into a chemical store

Emissions: the production and discharge of gases

Deforestation: permanent destruction of forests in order to make the land available for other uses

Greenhouse gas: a gas that absorbs infrared radiation, traps heat in the atmosphere and causes the greenhouse effect

Liquid biofuels: ethanol and biodiesel

Biofuels are transportation fuels such as ethanol and biodiesel. Biofuels may be carbon-neutral because the plants that are used to make biofuels (such as corn and sugarcane for ethanol and soy beans and oil palm trees for biodiesel) absorb CO_2 as they grow. This may offset the CO_2 emissions when biofuels are produced and burned.

Growing plants for biofuels are debated. This is because the land, fertilisers and electricity for growing biofuel crops could be used to grow food crops instead. In some parts of the world, large areas of natural plants and forests have been cut down to grow sugar cane. This is used for ethanol while soybeans are used for biodiesel. Many governments support efforts to develop other sources of biomass that do not compete with food crops and that use less fertiliser and pesticides than corn and sugar cane. Ethanol can also be made from waste paper. Biodiesel can be made from waste grease, oils and even seaweed. Biofuels burn cleaner and are better fuels. They evaporate easier from fuel tanks. These evaporated gases can cause air pollution.

Reading age: 13-15 years

Glossary

Transportation: movement of people or goods, usually involving trucks, trains, planes, ships, buses and cars

School One

Read the article using the reading strategy assigned. Then answer the questions.

Notes you would like to make while engaging with the reading strategy

1. How would you reference this article?

2. Write one advantage and one disadvantage of your energy source.

Advantage	**Disadvantage**

3. Explain how your energy source works. You can use words, pictures or diagrams to explain.

4. What new Science information have you learned?

School Two

Read the student activity, briefly look through the google site referenced, and then, at your table, discuss the reflection questions given.

Student Activity:

You have been asked by the local council to research different sources of energy and decide which would be best suited to meet the needs of your locality going forward. You must include information about <u>wind energy</u> and any <u>two</u> other sources.

For each energy source include:

1. An explanation of how the source works
2. A diagram or picture of the infrastructure needed
3. A list of the advantages and disadvantages of using this energy source

In developing your presentation take care to:

1. Avoid plagiarism
2. Evaluate all sources of information used. This evaluation is to be presented as part of your report

NOTE: You must recommend ONE of the energy sources researched as being most appropriate to this area. You might consider issues such as environmental impact, climate, social impact, cost etc.

YOU MUST BE READY TO SUBMIT YOUR PRESENTATION ONE WEEK FROM TODAY

The following steps will help you in completing this task:

1. Go to www.sites.google.com/view/researchingenergy/. Use the link or this qr code.

   Spend about 5 minutes exploring the site. Make a list of the **types of information** (e.g. websites/newspaper articles etc.) available on this website**.** Make a list of the different types of energy sources described on the website**.**

   This is the only website you will need to use for this task.

2. Decide which THREE sources of energy your group will research.

3. In your group you now need to develop a plan of action for carrying out research. Include class actions and homework actions. Each person must write down the list of actions in their copy. You might make a table like this one. Some examples of tasks are shown.

Action	Person Responsible	When it is to be completed
1. Find out how wind energy works **2. Get pictures of wind turbines**		**Before the end of today's lesson**

4. Consider how you might present the information you have collected. You can choose to use a report/posters/leaflets/animation or some other way. Decide now and add to your action plan, again deciding who is responsible and when parts should be completed.

During the process:

STOP, REVIEW and AMEND your plan at regular intervals to make sure you complete your work on time.

As you near the end of your work:

Carry out a final review before you hand up your work.

Before you submit your work and using the success criteria developed, check your work to see if you have:

1. Avoided plagiarism
2. Evaluated all sources (*Include your evaluation of sources used as part of your report)*

Discuss your responses to these questions at your table.

1. With respect to **carrying out research** what do you think was the learning focus for this activity?
2. The google site that accompanies this activity was **built by the teacher**. How might this support students in learning how to research? NOTE: information is given in this booklet on how to develop a google site.
3. How are students supported in taking ownership of their work?
4. What steps should a student take to evaluate a source? How might they present evidence of having evaluated sources?

School Three

Task Description **Part 1**

You will carry out research and then display your research findings on the notice boards in the canteen. Your research should help the rest of the school community to make informed choices about their use of energy.

You will choose one of the following areas as a focus for your research.

1. Energy sources
2. Electricity production in Ireland
3. Energy usage – meeting current and future needs

Getting Ready:

Working in pairs, use the headings below to recall the success criteria which will help to guide your work.

To avoid plagiarism, we should:

When evaluating a source, we should:

To present a balanced argument, we should**:**

Look back over previous research you and your partner have done. What else might be important to remember?

Getting Started - Working on your own

Part 2

1. Go to the class google site (**QR code and URL bottom of P21**)
2. Spend five minutes looking through it
3. Circle the area that most interests you

Energy Sources Electricity Production Energy Needs

Write down **what aspect** of your chosen area you would like to find out more about and **why** this might be useful for others in the school to learn about.

WHAT	**WHY**

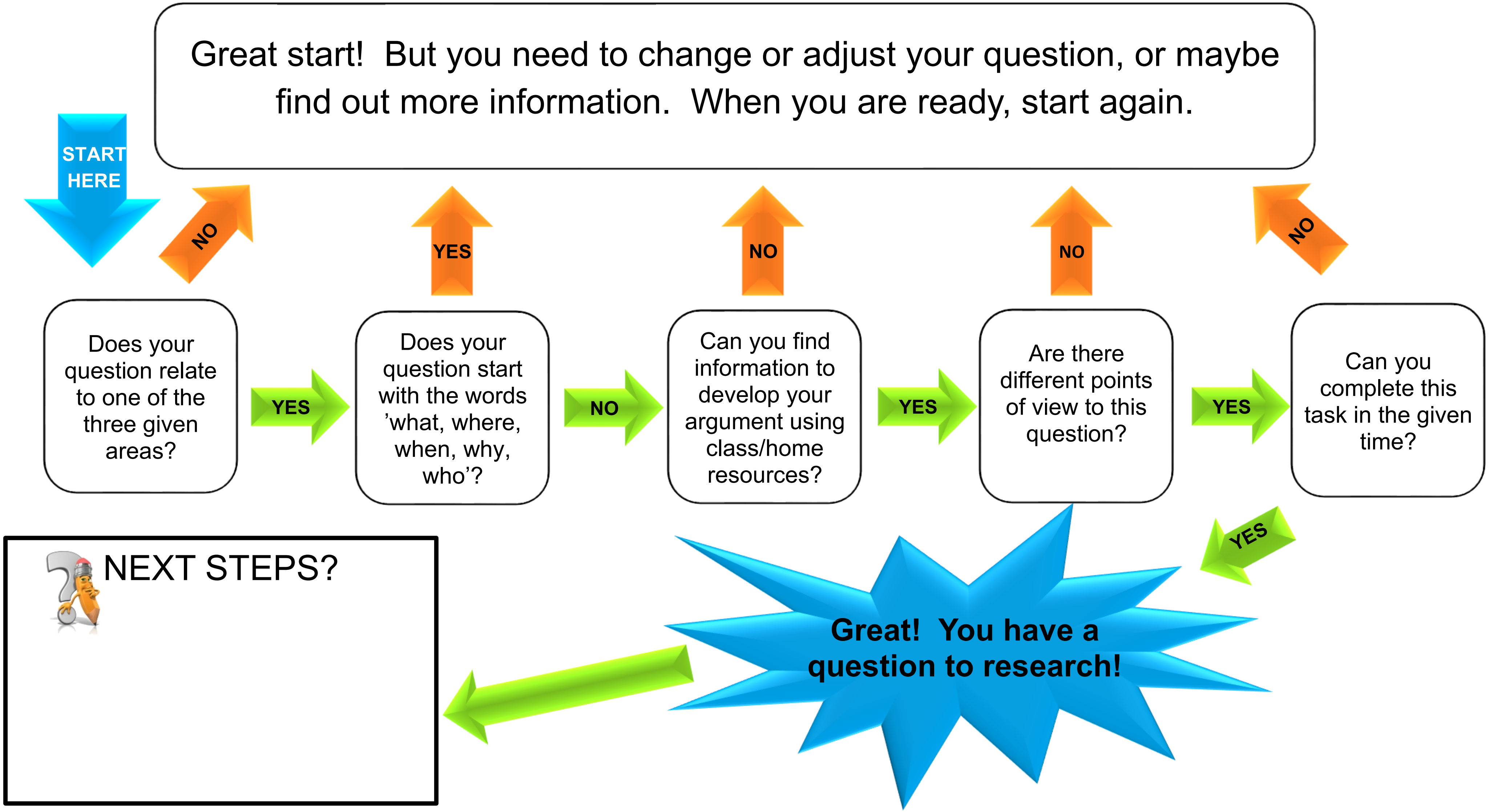
Working with your partner

1. Share what you have written with your partner. Consider these questions:
   - What do we already know about this?
   - Where could we find more information?
2. Decide one area to work on together. Moving forward you will both need to keep a record of what you do and your plans.
3. Now that you have decided on your topic, return to the google site. Together, look through the site. Read any articles or information that relate to your area. What questions can you come up with? Write some questions down.
4. Select a question and put it through the question flow chart. Do you need to adjust your question? Would you prefer to pick a different question? Is it possible to find an answer to your question in the given time? If you have more than one question that passed the flow chart test, select your favourite.

Write your research question here

Note: Your question may change as your research journey moves forward. Remember to trial your new questions using the flow chart.

Write your question here



School One Planning Document

Unit: Exploring Physical and Chemical Changes

Term: After Oct Midterm **Year:** 1st Years

Part of a Unit including CW 1 and E&S 5

Learning Outcome

Students should be able to research different energy sources; formulate and communicate an informed view of ways that future and current energy needs on earth can be met

Action Verb 1

Research- To inquire specifically using involved and critical investigation.

Key Learning for this Unit Unpacked (Understanding, skills and values)

- Energy sources are a source from which useful energy can be extracted to generate electricity
- Two categories – renewable and non-renewable
- Non-renewable sources are being depleted and so alternatives need to be found
- Burning of fossil fuels causes damage to the environment
- The pros and cons of the use of fossil fuels; nuclear power; wind energy; solar energy and biomass - in our locality and world-wide
- Understanding of plagiarism
- Extracting information from different sources
- Paraphrasing scientific ideas
- Referencing sources

Agreed Assessment Checks

- Can students give examples of different energy sources?
- Can students classify given energy sources as renewable and non-renewable?
- Can students give examples of renewable and non-renewable sources?
- Can students outline pros and cons of some energy sources?
- Can students paraphrase and give back in their own words some scientific information?
- Can students correctly reference.

Nature of Science- Agreed Assessment Checks

- Do students understand the concept of plagiarism when researching? (NoS 6)

School Two Planning Document

Unit: **Using Research to Inform our Opinions**

Term: **September** **Year:** **2^{nd} Years**

Part of a Unit including BW 6 and NoS 6

Learning Outcome

Students should be able to research different energy sources; formulate and communicate an informed view of ways that future and current energy needs on earth can be met

Action Verb 1

Research- To inquire specifically using involved and critical investigation.

Key Learning for this Unit Unpacked (Understanding, skills and values)

- Examples of energy sources (fossil fuels, solar energy, bioenergy, wind energy, nuclear energy, wave energy)
- Energy sources are sources we use to generate electricity
- There are 2 types of energy sources (renewable and non-renewable)
- There is a need to find alternative energy sources
- The disadvantages and advantages of different sources of energy
- How do our local energy sources compare to those used across the world
- Energy demand is on the rise and there is an energy crisis due to increased demand and our dependence on carbon-producing energy sources
- Evaluating a source
- Understanding a source might be biased
- Responses to research questions need to be justified

Agreed Assessment Checks

Students should be able to:

- Give different examples of energy sources
- Determine whether a source is renewable or non-renewable and give examples of both
- Give the advantages and disadvantages of the different energy sources
- Evaluate reliability of a source and state why they think a source is reliable or not reliable?
- Present a justified response to a question?

Nature of Science- Agreed Assessment Checks

1. Can students conduct research and show their understanding of bias and reliability of sources? (NoS 6)
2. Can students engage in scientific debate and discussion using informed argument? (NoS10)

School Three Planning Document

Unit: **Becoming Informed Global Citizens**

Term: **After Easter Holidays** **Year:** **2nd Years**

Part of a Unit including NoS 7

Learning Outcome

Students should be able to research different energy sources; formulate and communicate an informed view of ways that future and current energy needs on earth can be met

Action Verb 1

Research- To inquire specifically using involved and critical investigation.

Key Learning for this Unit Unpacked (Understanding, skills and values)

- Energy sources can be classified into renewable and non-renewable
- Energy sources are used to generate electricity
- Non-renewable sources will run out eventually and need to be replaced by alternatives
- Fossil fuels release harmful pollutants and green-house gases
- The advantages and disadvantages of different energy sources in a national and international context
- Energy needs are increasing, our current model of producing it is falling short of being sustainable and supporting climate change
- What makes a good research question?
- Communicating research related to scientific issues requires consideration of audience and use of varied representations and appropriate scientific terminology

Agreed Assessment Checks

- Can students name different energy sources?
- Can students classify given energy sources?
- Can students give advantages and disadvantages of some energy sources?
- Can students explain the problems around our dependence on non- renewables? Can students explain the impacts of increased demand for energy on our environment?
- Can students develop a research question? Do students know the criteria for a good research question?

Nature of Science- Agreed Assessment Checks

- Can students use scientific terminology and a variety of representations to communicate research about an issue? (NoS7)
- Can students justify their choices of modes of communication? (NoS 7)
- Can students appreciate the role of science in informing public behaviour? (NoS10)

Reading Strategies

"Many students have difficulty in science because they are passive readers, readers who receive information without understanding. Passive readers begin reading assignments without thinking about the subject. Their counterparts, known as active readers, interact with text to construct meaning. They make predictions, ask questions, generate questions, and vigorously seek answers. For active readers, reading is a means of actively pursuing knowledge. Active readers engage in metacognition, which is an awareness of how they think. Active readers use both ***pre-reading*** *and* ***during-reading*** *strategies to enhance their comprehension."*

Croner. Patrick E. (2003) Science Education Review 2 (4), pg. 104–118.

Pre-Reading Activity: Skimming

Read the **Title** and **first** paragraph and *skim* the rest of the headings.

1. Discuss with your partner what you already know that might connect with what you are about to read.
2. During your discussion, write down any questions that pop into your head about this topic. Write them in the space provided.
3. Read the rest of the article.

Focused Reading

Focused reading involves reading while engaging with a specific task such as answering specific questions. It promotes active reading. For this next section, think about how you are reacting to the text as you read. You will annotate your text with three letters as appropriate:

1. If you read a point that you find **interesting** write the letter **I** beside it.
2. If you read something that you find **confusing** write the letter **C** beside it.
3. If you read something that you have a **question** about write the letter **Q** beside it.

Use focused reading to read your article.

After reading, discuss the annotations you made on this section with your partner.

Read and Explain

Students engaging with science text need to actively try to assimilate information as they read. This next strategy encourages both active reading and listening skills.

Each of you silently read the first half of the article and then one person attempts to paraphrase aloud what they have read. The second person listens and asks for clarity if necessary and adds anything essential they think was omitted. Repeat with reversed roles for the second half of the article.

Illustrate your Understanding

In addition to the general reading skills which students need to understand narrative text, there are other skills necessary to engage with scientific text. One of these is the ability to make sense of text that is not always user friendly, e.g. the ability to move between text and diagrams in a non-linear fashion.

Read your article. Use the space on the page to capture the main points being made, either as a diagram or in words. Then share and clarify your understanding by explaining your representation with your partner.

Google Sites

What you need to create and edit a google site:
A google account

A web browser

What you need to view a google site:
Any web browser

Steps for starting your own website:

- Go to the following URL https://sites.google.com/
- Sign in to your google account if you have not already done so.
- Click the + at the bottom of the page to create your first site.
- Name your site by typing over the “Untitled Site” text on the top left section on the page.
- Use the pane to the right of your page to design, add other sections to your website and decide on themes.
- Decide who can view or edit your site by clicking this icon Choose the correct setting for your own site. This will depend on the purpose of your site, i.e. who can edit the site and who can only view the site without being able to edit it.
- Make your site live online so your audience can start accessing it by publishing your site. Do this by clicking the publish button. Every time you make a change to your site you must republish it.
- Click the icon at the top of your page to copy the URL of your page.
- For further instructions on building your website go to the following link https://support.google.com/sites#topic=

	Adding Content to your Page
Tт	Add titles and text
<>	Add content directly from the web, such as music and videos
	Add photos and other images
	Embed files from your drive, however they must be made available to the public
	Add buttons which can link to other sections of you site or other sites online
	Add YouTube videos
	Add calendars
	Add maps

Google site compiled by class oak

https://sites.google.com/view/classoak/home

Designing for All Learners

Everyone engages with text in different ways. Some people may find certain text, styles of fonts and colours more manageable than others. Here are some guidelines for making materials more accessible to all learners.

Universal Accessibility

- Include useful pictures and graphics.
- Use Alt Text to provide a written description of visuals, e.g. pictures for screen readers. Alt text is a text alternative for images which can provide a description of the image for people who are visually impaired.
- Flow charts may help to explain procedures.
- Lists of instructions can be more useful than long passages of text.
- A glossary will help to explain abbreviations, acronyms and jargon.
- Longer documents should have a content guide at the beginning and an index at the end.
- There is an accessibility checker in PowerPoint that will guide you to make changes to ensure the presentation is as accessible as possible.
- There is a readability checker on Microsoft Word to make sure documents are accessible to a group.

Font Style

- Use a sans serif font such as Arial, Comic Sans or Verdana.
- Use a minimum of 12pt or 14pt font size in a document. For presentation, the minimum font size is 18pt.
- Avoid unnecessary use of capitals.

Paper

- Use coloured paper, even cream or off white. Some individuals will have specific colour preferences, e.g. yellow or blue.
- Use matt paper to reduce glare.
- Don’t use paper which may allow text from the other side to show through.
- Avoid light text on a dark background.

Writing Style

- Keep sentences short and to the point (max 15-20 words per sentence).
- Give clear instructions and avoid lengthy explanations.
- Use short words and terms where possible – avoid unnecessary complex vocabulary.

Presentation Style

- Keep sentences and paragraphs short. Try to break text into short readable units.
- Use wide margins and headings.
- Use at least 1.5 line spaces between lines of text if possible.
- Use **bold print** to highlight. *Italics* and <u>underline</u> should be avoided as they can blur text.
- Highlight important text in a box or use colour.
- Use bullet points and numbers rather than long passages.
- Keep text left justified with a ragged right edge.
- Don't use unnecessary hyphenation as this can cause confusion.

Checking Readability

To set your spell checker in Word to automatically check readability:

1. Select 'File'
2. Select 'Options'
3. Click 'Proofing'
4. Make sure 'Check grammar with spelling' is selected
5. Under 'When correcting grammar in Word', select the 'Show readability statistics' box

This will give you the Flesch reading ease and the Flesch-Kincaid grade level score. These statistics can help identify how accessible your document is.
When working with a long document, check the document in sections.

Flesch Reading Ease and Flesch-Kincaid Grade Level Explained

- Flesch Reading Ease score: Rates text on a 100-point scale. The higher the score, the easier it is to understand the document. For most standard documents, aim for a score of approximately 60-80 for 12-15 year olds.
- Flesch-Kincaid Grade Level score: Rates text on a U.S. grade-school level. For example, a score of 6.0 means that a sixth grader, of average age 11, can understand the document. For most standard documents, aim for a score of approximately 6-8 by using short sentences, not by oversimplifying vocabulary.

Moving Students Forward

Notes on the work from student one

What are the strengths of this piece of work?

Read the student work. Think about the features of an investigation on your card.

How could you help this student to move forward?

Notes on the work from student two

Thinking about the success criteria, how could you help this student to move forward?

Money Analogy

You are given €100 for your birthday, which you put in your bank account. You buy a jumper which costs €70 and use an atm card to transfer the €70 to the shop's account.

What happens the other €30? Does it disappear or do you have it stored somewhere?

____

Does the €70 you paid/transferred disappear?________________________________

What might the shop use the money for?____________________________________

Will that €70 ever disappear? Explain your thinking. ___________________________

____

If you get another €100 for helping a neighbour and this time you want to buy something which costs €125, where could you get the extra money from?_________________________

____

Can you think of places that you could store money?

____________________, ____________________, ____________________

____________________, ____________________, ____________________

Do you have to have physical coins or notes to have money stored? Explain your thinking.

____

____

Can you transfer money without handing over a physical object like coins or notes? Explain your thinking.

____

____

Think about similarities you can see between the concepts of money and energy.

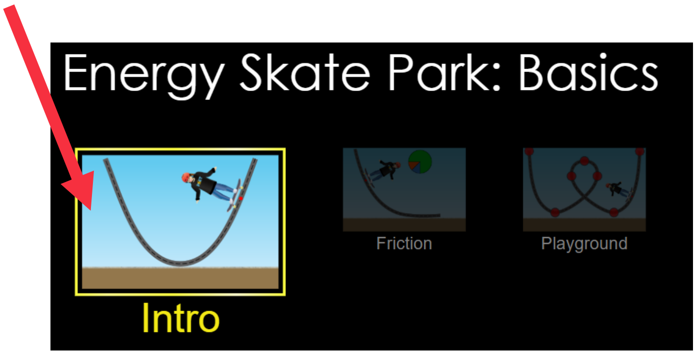
Money	Energy

Where does the analogy break down for you?

Exploring Energy

Setting up:

- Open the simulation using the QR code (https://phet.colorado.edu/sims/html/energy-skate-park-basics/latest/energy-skate-park-basics_en.html)
- Select Intro activity and use your phone in landscape view

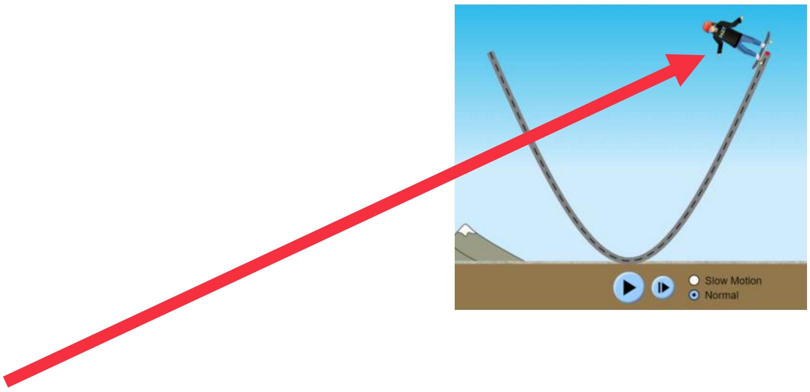


Before beginning the activity, predict what you think will happen when the skater is placed at the top of the ramp and released. Give reasons for your answer.

____

____

____



Place the skater on the ramp and observe what happens. How does your prediction match with your observation?

____

____

____

Does the simulation model what would happen in real life? Explain your answer.

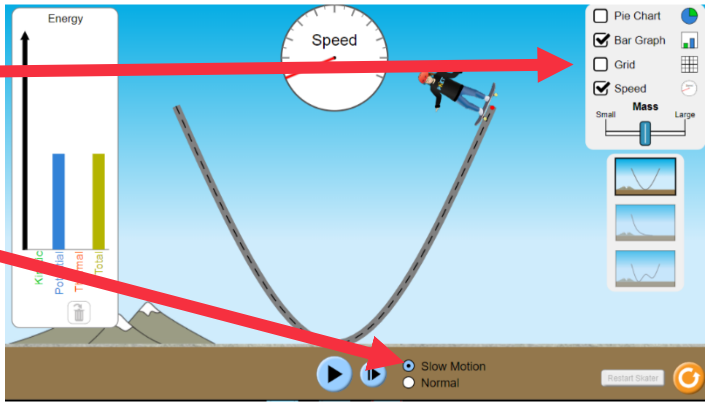
____

____

____

Select the bar graph and speed

Select slow motion



As the skater moves up and down the ramp, his total energy exists in two stores - a kinetic store and a (gravitational) potential store

Name the energy store of the skater at the top of the ramp. ______________________

As the skater moves down the ramp what energy store is:

Increasing? ____________________ Decreasing? _______________________

As the skater moves up the ramp, what energy store is:

Increasing? ____________________ Decreasing? _______________________

When is the kinetic energy store of the skater at its greatest? What do you notice about his speed at this time?

____

When is the potential energy store of the skater at its greatest? What do you notice about his speed at this time?

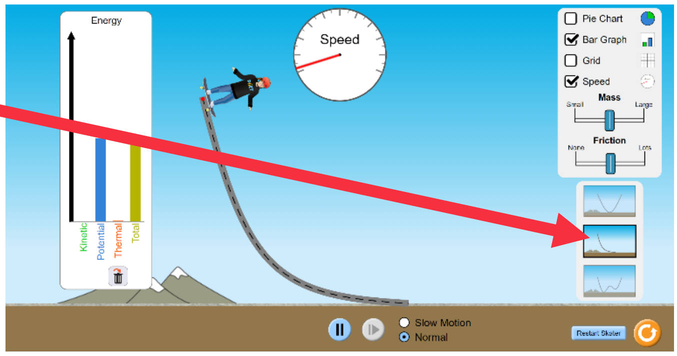
____

What do you notice about the total energy in the system as the skater moves up and down the ramp?

____

Discuss the potential of this computer simulation in modelling the process of energy transfers between stores? What are its strengths and its limititations?

Select the run with only one ramp



Before beginning the activity, predict what you think will happen when the skater is placed at the top of the ramp and released. Give reasons for your answer.

____

____

____

Carefully place the skater on the top of the ramp. How does your prediction match with your observation?

____

____

What energy store does the skater have as he leaves the ramp?

____

After he has left the ramp (and the screen) does this energy store change in value?

____

What do you notice about his speed after he leaves the ramp?

____

Does this replicate what would happen in real life? Explain your answer.

____

____

Select the FRICTION option

Select slow motion, bar graph and speed options as before

Explore how the simulation could further be used to develop student's understanding of The Law of Conservation of Energy.

Discuss the further potential of this computer simulation model in deepening student's understanding of the concept of Energy. What are its strengths and its limitations?

Pedagogical Considerations

Throughout the day we have explored and considered aspects of Pedagogical Content Knowledge (PCK) i.e. the integration of your subject expertise and the skilled teaching of science concepts. Some of the issues identified are further explored below and you will find references provided to direct you to where you can find out more.

Thinking about Language

"learning science is, in many respects, like learning a new language, with considerable complications not least because many of the "hard conceptual words" … have a precise meaning in science, and sometimes an exact definition but very different meaning in everyday life".

Wellington, J. & Osborne, J. (2001). Language and literacy in science education.

We have all experienced this barrier to learning in our science classrooms. The careful use of metaphors and analogies can help students come to terms with how the scientific community uses terminology[1], while at the same time connecting with student's own everyday life experiences. Students using the words in the correct context does not necessarily indicate understanding, which must be negotiated and will develop over time. Some techniques for probing understanding include having students paraphrase or explain something in their own words or asking students to explain their understanding of the concept or word in numerous contexts as was today illustrated in our exploration of energy across the strands.

[1]Blown, E.J, Bryce, T.G. (2017) Switching Between Every-day and Scientific Language. *Res. in Science Educ*.

Using Analogies

"A growing body of research suggests that analogies may be powerful tools for guiding students from their pre-instructional conceptions towards science concepts"

Duit, Roth, Komorek and Wilbers (2001) Fostering conceptual change by analogies Learning and Instruction, 11(4), 283-303

We frequently use analogies to help us explain new or abstract concepts. After all, much of our job involves communicating science ideas in a way that our students understand. Again, caution is advised in that research suggests while analogies can be very effective in fostering understanding, they can also lead to misconceptions. Glynn (2007) proposes an approach to analogies which helps to ensure analogies are used effectively[2]. You might note the following:

- Analogies that share many similar features with the target concept are the most effective.
- Discuss and highlight with students where the analogy breaks down or its limitations.
- Use focused questioning to ensure that students have not formed misconceptions.

[2]Glynn (2007) Making science concepts meaningful to students: teaching with analogies.

Computer Based Science Instruction

Computer based simulations have been shown to increase student's motivation and to deepen concept formation[2]. However, students can believe that the simulation replicates real life and is simply a visualisation. This is often not the case and again limitations of the simulation need to be identified to avoid misconceptions (e.g. that electrons are red dots.).

Interested in Finding Out More?

Why not follow these links to extend your PCK?

On this website you will find some information to guide you in using analogies and models and it also links to other pedagogical considerations for science teachers.

https://eic.rsc.org/feature/reflect-on-your-use-of-models/3010509.article

Both these websites offer considerable insight into science teaching and in particular to developing students as scientists.

https://ambitiousscienceteaching.org/

https://undsci.berkeley.edu/teaching/educational_research.php

An example of mapping an analogy to assess its usefulness in concretising science concepts (Source: http://Glynn2008MakingScienceConceptsMeaningful-Analogies.pdf)

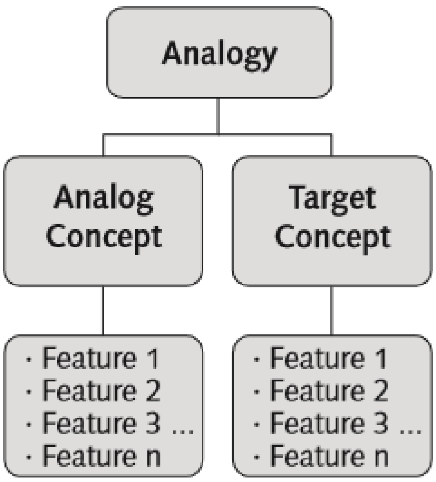


Figure 1: A conceptual representation of an analogy, with its constituent parts.

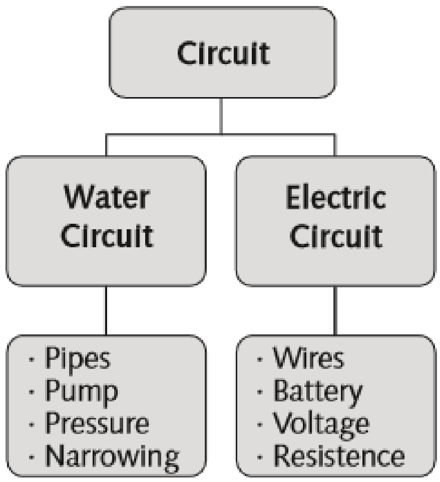


Figure 2: A conceptual representation of a water-electric circuit analogy.

Thinking about Designing Learning Experiences-Concepts

"The importance of the processes of science as well as knowledge and understanding of concepts are reflected throughout the learning outcomes…. It is recognised that the skills, knowledge and understanding of the scientific concepts as set out in the learning outcomes take time to develop and often need to be carefully revisited and reinforced."

Science Specification, 2016, pg.13

Students arrive into our classes with knowledge and understanding of scientific concepts. Sometimes their grasp of concepts is accurate and supports a deeper understanding of big ideas. Sometimes they are misinformed and things have to be 'unlearned'. Part of our role as Science teachers is to help our students undertake conceptual change–an altering of what has previously been learned. This can be achieved through making new ideas and approaches seem more logical, structured and coherent so that in time they become the students' new way of thinking and they no longer revert to their initial ideas.

One of the ways of going about this is to plan for learning and teaching that supports conceptual change. Consider:

What are the main ideas I want my students to learn?

For each main idea….

Why is it important for students to learn this idea?

What do I intend students to learn about this idea?

What else do I know about this idea (that I don't want students to know yet)?

What are the opportunities to develop student thinking through working as a scientist?

What approaches to learning and teaching could I use to engage students with this idea?

What are the difficulties/limitations connected with teaching this idea?

What knowledge do I have about students' thinking (e.g. misconceptions) which influences my teaching of this idea?

In Search of Pedagogical Content Knowledge in Science: Developing Ways of Articulating and Documenting Professional Practice, John Loughran, Pamela Mulhall, Amanda Berry, *Journal of Research in Science Teaching VOL. 41, NO. 4, PP. 370–391 (2004)*

Notes

Contact Information

Information and resources are available on our website: www.jct.ie

In particular, see CPD Workshops for resources used at today's workshop.

For any queries, please contact us on one of the following:

Email: info@jct.ie (Advisors' individual email addresses are available from the Meet the Team section of the website.)

Phone number: 047 74008

Follow us on Twitter @JctScience and @JCforTeachers

The Science Specification and Guidelines for Classroom-Based Assessments and Assessment Task are available at www.curriculumonline.ie

Feedback

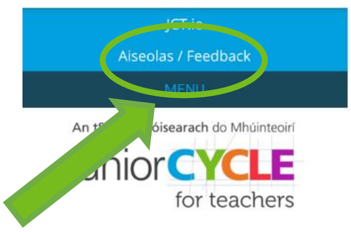
Please follow your choice of link below to give us feedback on today's workshop:

or

http://jctregistration.ie/

followed by

and



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