The Institution of Engineering and Technology

FIRST LEGO LEAGUE EXPLORE

Teacher Guide for Ireland

Developed by the DCU Institute of Education

FIRST® LEGO® League Explore

Presenting: SUPERPOWERED℠

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Welcome to the *FIRST*® LEGO® League Explore SUPERPOWERED℠ Teacher Guide for Ireland

Science Foundation Ireland

The development of this guide has been enabled by Science Foundation Ireland through the SFI Discover Programme.

Dublin City University Institute of Education

This guide has been developed by a leading team from the DCU Institute of Education to support teachers across Ireland to engage with *FIRST*® LEGO® League Explore within their classrooms.

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The Institution of Engineering and Technology

We're passionate about STEM (science, technology, engineering and maths) and inspiring children to follow their dreams, get creative and have fun whilst learning how the world around them works. Our programmes are for children aged 4 to 16 years and aim to bring their imaginations alive to inspire them to engineer a better world in the future.

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Since 2010 Learnit has been on a mission to 'inspire the creators of tomorrow by making learning fun for the children of today'. We are the delivery partners for *FIRST*® LEGO® League in Ireland. We are proud to partner with the IET and DCU to bring STEM to life through this hands-on, minds-on approach to learning.

Contents

Welcome to the SUPERPOWERED℠ Teacher Guide

This SUPERPOWERED℠ Teacher Guide aims to support Irish primary school teachers by connecting *FIRST*® LEGO® League Explore SUPERPOWERED with the Irish Primary School Curriculum. Through the SUPERPOWERED challenge learners will learn about how energy is sourced and distributed to homes, schools and businesses. They will identify issues and design solutions to create a better energy journey for their community with regard to energy sources, energy distribution and energy usage. There are strong inherent links to sustainability throughout the lessons. Through this authentic real-world issue, children learn to design, build and code, in order to create unique solutions made with LEGO elements and powered by a LEGO Education Set (SPIKE Essential or WeDo 2.0). *FIRST* LEGO League Explore SUPERPOWERED is embedded throughout the different subjects of the Irish Primary School Curriculum achieving both the curriculum objectives and skills in a holistic and integrated manner.

SUPERPOWERED℠ Challenge

Let's find out where we get energy and how we use it. This is an *energy journey*.

Now, explore the impact of our energy choices.

Then, create a better energy journey for your community.

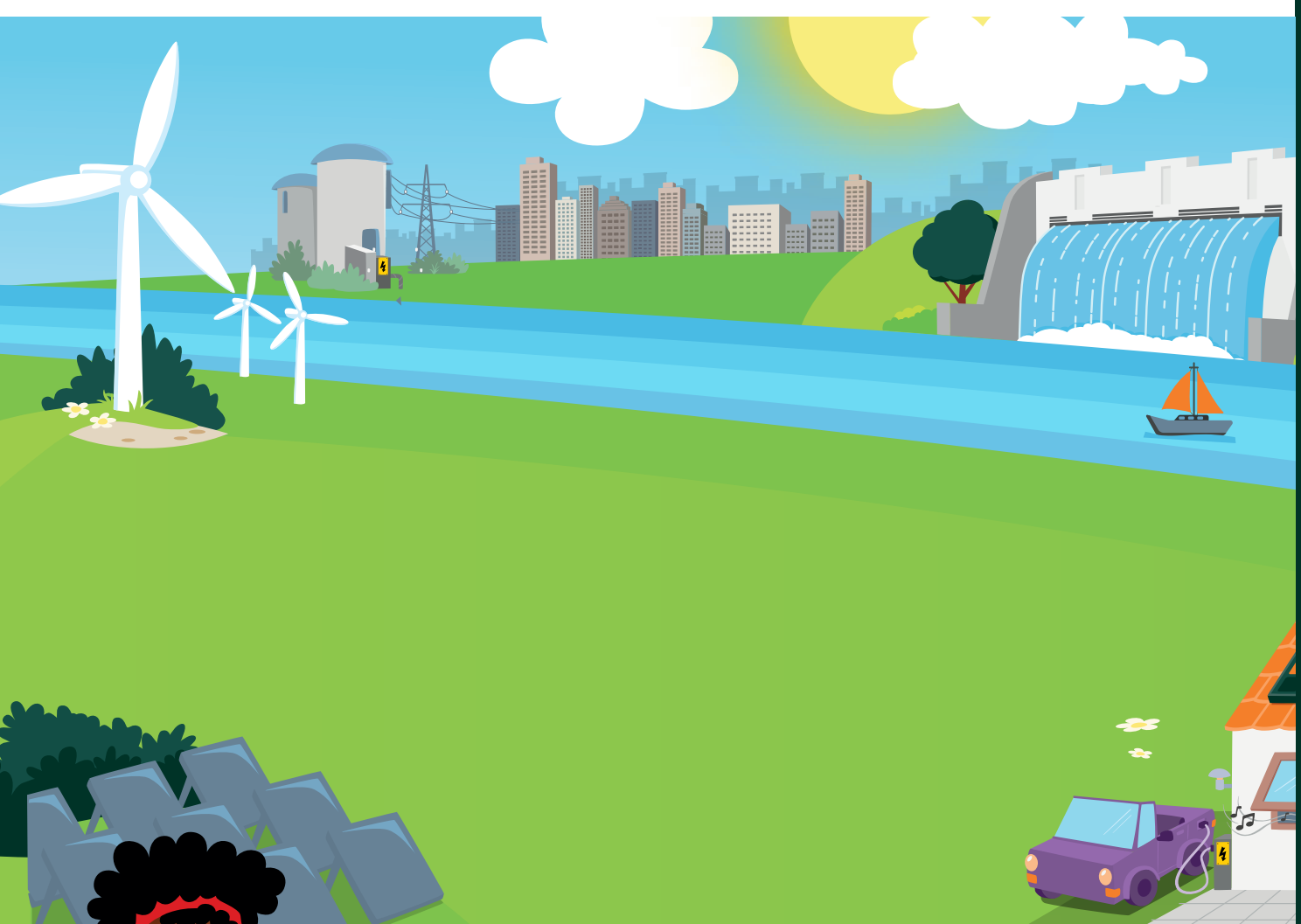
Finally, share what you have learned and celebrate with others.

This SUPERPOWERED Teacher Guide is supplemented and supported by the *FIRST* LEGO League Explore SUPERPOWERED Team Meeting Guide and Engineering Notebook. We advise you to ensure that you read pages 4-9 of the Team Meeting Guide before beginning your *FIRST* LEGO League Explore SUPERPOWERED classroom lessons.

This Teacher Guide is organised in two parts:

Part A provides a background to *FIRST* LEGO League Explore SUPERPOWERED. An overview of the Irish Primary Curriculum and Policy connections is presented alongside general support and advice for teachers.

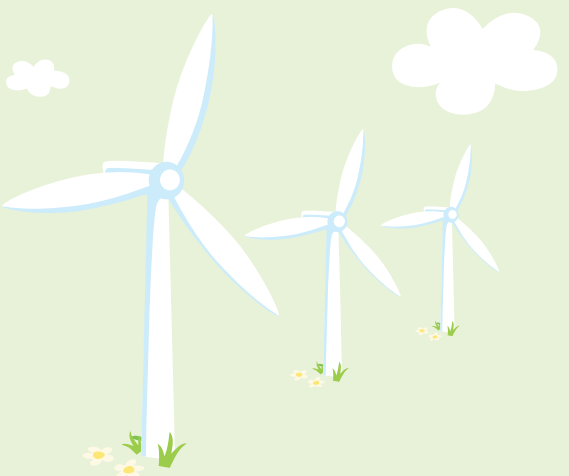
Part B is a detailed overview of each of the 14 lessons of the SUPERPOWERED Teacher Guide for Ireland. Primary curriculum links and skill development opportunities are highlighted in each lesson. Throughout the lessons, learners will be exploring themes and ideas, creating solutions, testing them, iterating on them and sharing with others what they have learned. The learning activities are specifically designed with plenty of scope for differentiation so the lessons can be adapted to suit each participating class. Resources required, details of coding, teacher support, and guiding questions are provided for each lesson. It is important to note that each lesson has core curriculum links that are necessary for the learners to learn about the journey of energy, where and how it is sourced, whether it is renewable or nonrenewable, and explicitly locates the SUPERPOWERED project in a relevant and meaningful context. Other curriculum links are presented as suggested learning activities which support the development of the children's knowledge and skills, thereby enhancing their understanding of this real-world context and achieving the aims of the curriculum simultaneously.



What is *FIRST* LEGO League Explore?

FIRST LEGO League Explore is a non-competitive, hands-on program geared towards primary school aged learners from 2nd class (aged 7-8) to 6th class (aged 11-12). The program aims to inspire learners to experiment and grow their confidence, critical thinking, and design skills through hands-on STEM learning activities. Each year *FIRST* LEGO League Explore focuses on a relevant, real-world theme with this year's challenge called SUPERPOWERED. Children work together in teams using elements from a LEGO Education Set (SPIKE Essential or WeDo 2.0) and a SUPERPOWERED Explore Set to learn about how energy is sourced and distributed to homes, schools and businesses. They will identify issues and design solutions to create a better energy journey for their community with regard to energy sources, energy distribution and energy usage. There are strong inherent links to sustainability throughout the lessons. In each lesson, learners are encouraged to collaborate, communicate, build and learn together, while having fun!

This SUPERPOWERED Teacher Guide has been designed to provide learners with authentic and meaningful curriculum connections while developing their understanding of energy journeys. The lessons in this Teacher Guide have been intentionally laid out so that learners build up their knowledge, understanding and skills, in advance of designing and building their Team Models in lessons 9-10, creating Team Posters to accompany their Team Models in lessons 11-12, preparing to present at an event in lesson 13, and reflecting upon their learning journey in lesson 14. Figure 1 provides an overview of SUPERPOWERED lessons 1-14.



Lessons 1-8	Context and knowledge	Developing familiarity and understanding of computational thinking and coding
Lessons 9-10	Designing Team Model	Building and coding Team Model
Lessons 11-12	Planning Team Poster	Creating Team Poster
Lessons 13-14	Reflecting on the SUPERPOWERED experience	Planning for what teams will share at their final event

Figure 1. SUPERPOWERED Lessons 1-14

Core Values of *FIRST* LEGO League

FIRST LEGO League Explore is underpinned by the six *FIRST* Core Values that are the cornerstones of the program. *FIRST* LEGO League envisions that through the Core Values, learners use discovery and exploration in each lesson and learn that helping one another is the foundation of teamwork. Throughout each lesson it is important that the learners have fun and are motivated. You will find reference to the six Core Values (see Table 1 below) throughout each of the lessons. You can take time to emphasise the Core Value when you see the symbol.

Core Value	Description
Teamwork	We are stronger when we work together.
Inclusion	We respect each other and embrace our differences.
Innovation	We use creativity and persistence to solve problems.
Fun	We enjoy and celebrate what we do!
Discovery	We explore new skills and ideas.
Impact	We apply what we learn to improve our world.

Table 1. Core Values of FIRST LEGO League

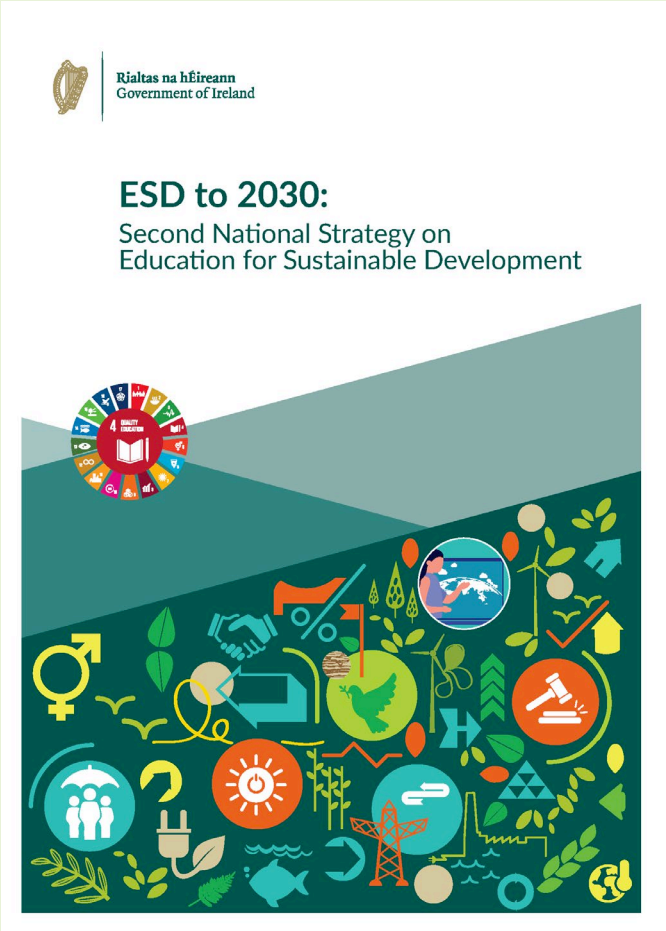
The Core Values have strong connections to the Irish SPHE curriculum:

Subject	Strands	Strand Units/Elements	Skills and Concepts
SPHE	Myself and others Myself and the wider world	My friends and other people Relating to others Developing citizenship	Communication skills Working collaboratively and co-operatively with others Personal and self management skills Confidence and competence using language Decision-making skills

Table 2. Irish SPHE curriculum

Sustainability and *FIRST* LEGO League

The Second National Strategy on Education for Sustainable Development (ESD) promotes and supports the development of the requisite skills, knowledge and attitudes that help everyone to take action for a sustainable future and planet. Education for sustainable development is at the core of SUPERPOWERED and is present throughout all lessons. Through engagement with the SUPERPOWERED lessons, learners are empowered with knowledge, skills, values and attitudes to make informed decisions and take responsible actions for the protection of the environment with regard to energy sources, energy distribution and energy usage.



Learning principles behind SUPERPOWERED

The Engineering Design Process underpins the entire SUPERPOWERED challenge, see Figure 2. Here, learners are encouraged to work like real engineers, using scientific, geographical and mathematical skills and understanding to investigate and think critically about real-world problems and propose creative solutions. The Engineering Design Process has four stages: Explore a problem; Create one or more solution(s); Test the solution(s); Share with others what you have learned.

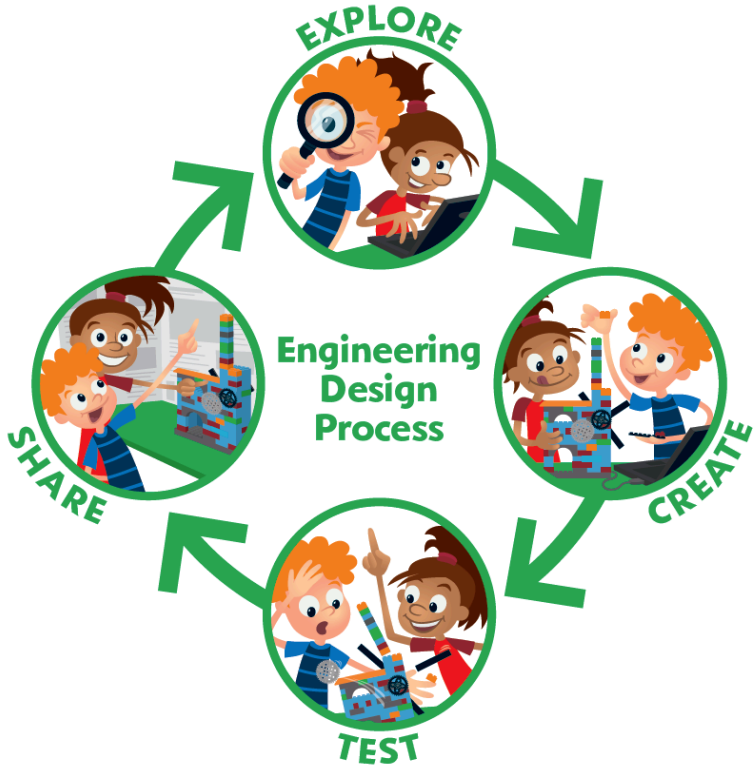


Figure 2. Engineering Design Process

There is no fixed order for this process. Learners may go through some or all parts several times throughout the lessons. These four stages of the Engineering Design Process align with the stages of enquiry-based learning, particularly for both science and geography.

The enquiry-based learning process comprises a child-centred, experiential, constructivist approach whereby learners are active in their learning and participate in the leading of investigations through posing questions and generating ideas before actively creating and collecting data to help develop their understanding. These teaching and learning approaches are advocated throughout the Irish Primary School Curriculum. Enquiry-based learning begins with a problem or obstacle to a learner's development; they analyse the situation; they identify possible solutions; they compare the implications of the different solutions and select the best course of action; they implement this in practice. Roberts' (2013) Framework for Enquiry (Figure 3) is an example of an enquiry-based learning process for teaching and learning in geography and science. As outlined below it has explicit correlations with the Engineering Design Process.

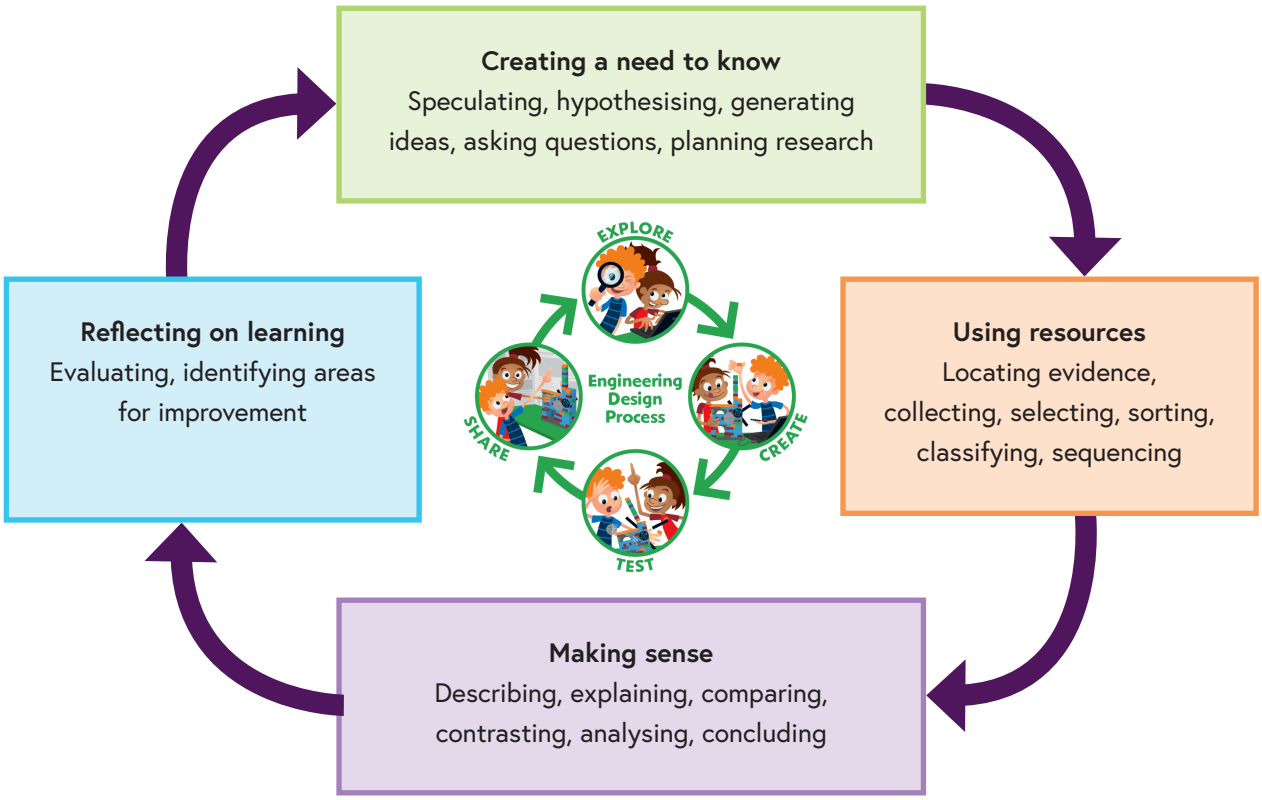
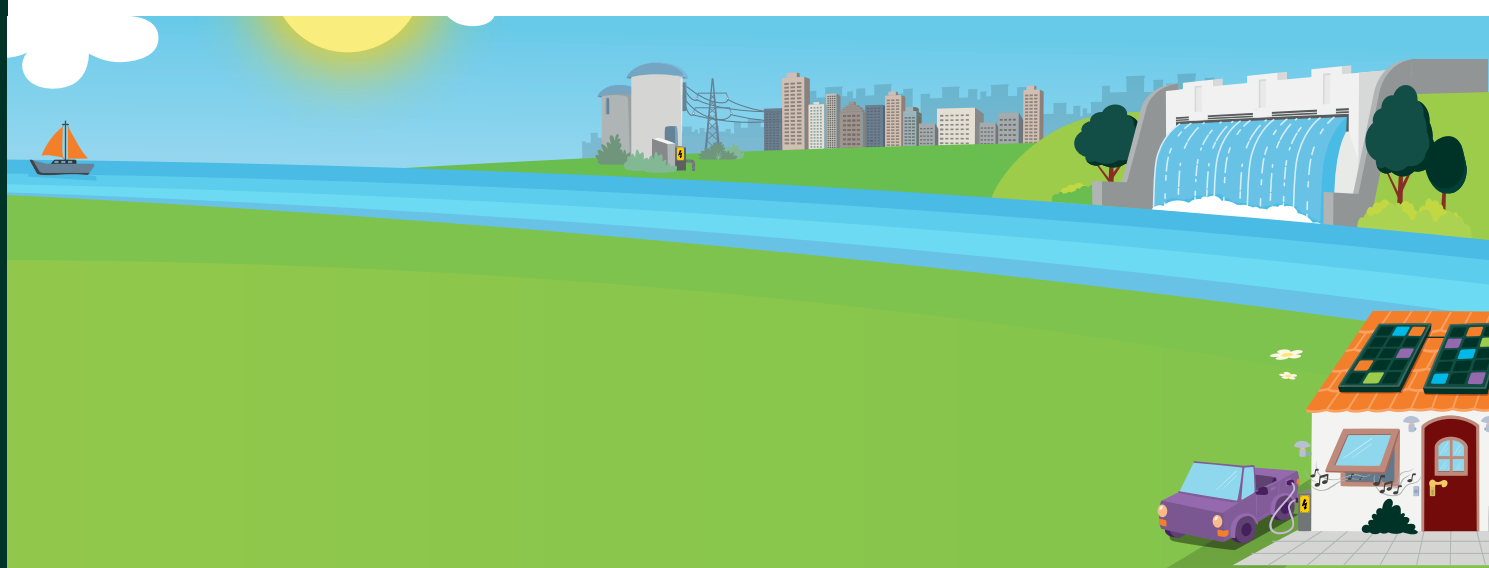


Figure 3. Enquiry-based learning framework (Roberts, 2013)

The Explore stage of the Engineering Design Process is directly aligned with the Creating a Need to Know stage of the enquiry framework. Here, the learners are introduced to the problem or scenario through a stimulus. This involves the learners hypothesising, speculating and generating ideas and questions for investigation drawing on their existing knowledge and everyday experiences. The Create stage of the Engineering Design Process is connected to the Using Resources stage of the enquiry framework. This involves the learners actively carrying out investigations on the issue at hand. Here they use a range of resources to both create and collect data to be used as evidence for their investigations. In both the Test stage of the Engineering Design Process and the Making Sense stage of the enquiry process, the learners analyse and interpret the data pertaining to their investigations, thus reflecting on and modifying their ideas and concepts and developing specific recommendations and solutions for issues. Finally, similar to the Reflecting on Learning stage in the enquiry process, the Share stage of the Engineering Design Process culminates in the learners presenting their work, reflecting on what they learned, and identifying areas where they were successful and areas in need of improvement.



Policy connections

FIRST LEGO League Explore has explicit and embedded connections across the Irish Primary School Curriculum.

FIRST LEGO League Explore is directly linked with a number of domains, standards and statements across both dimensions of the Digital Learning Framework (DLF). This is a school self evaluation process and aligns with the new Digital Strategy for Schools to 2027.

Engagement with *FIRST* LEGO League Explore enables the development of the Key Competencies of learners as detailed in the Draft Primary Curriculum Framework

FIRST LEGO League Explore has strong connections with a range of recent policy initiatives.

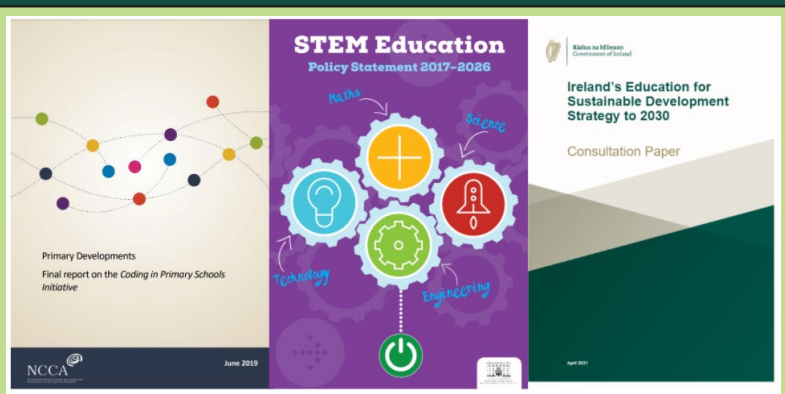


Table 3. Policy connections

How does *FIRST* LEGO League Explore SUPERPOWERED connect to the Irish Primary Curriculum?

Table 4 below presents the connections to the Irish Primary School Curriculum. Tables 5 and 6 provide a more explicit overview of the curriculum Strand and Strand Unit links in each of the SUPERPOWERED lessons. Figure 4 highlights connections to curriculum skills development.

Irish Primary Curriculum connections

Geography Human environments; Natural environments; Environmental awareness and care *Maps and globes; Geographical investigation skills*	**Science** Energy and forces; Environmental awareness and care; Materials *Designing and making; Working scientifically*	**Mathematics** Measures; Number; Shape and space *Applying and problem-solving; Understanding and connecting; Reasoning; Communicating*
Literacy Writing; Reading; Oral language *Communicating; Understanding; Exploring and using*	**Visual Arts** Construction; Drawing *An awareness of line; An awareness of form; An awareness of space*	**History** Continuity and change over time *Working as an historian*
Drama Drama to explore feelings, knowledge and ideas, leading to understanding *Developing empathy*	**Music** Composing *Musical concepts (pulse; duration; tempo; pitch; dynamics; structure; timbre; texture; style)*	**SPHE** Myself and others; Myself and the wider world *Communication; Co-operation; Decision-making*

Table 4. Irish Primary Curriculum connections

Curriculum connections matrix

Curriculum subjects and strands	**Lesson 1** Energy Journeys: (Context)	**Lesson 2** Renewable and Non-Renewable Energy Sources	**Lesson 3** Investigating Wind and Wind Energy	**Lesson 4** Examining How Wind Turbines Work	**Lesson 5** Energy Storage	**Lesson 6** Power On	**Lesson 7** Motorise Model: (Safety and Sensors)	**Lesson 8** Electric Car: (Energy Consumption)	**Lesson 9-10** Team Model	**Lesson 11-12** Team Poster	**Lesson 13** Let's Share	**Lesson 14** Let's Reflect
Geography												
Human environments	•	•	•	•	•			•				
Natural environments			•	•	•							
Environmental awareness and care	•	•	•	•	•			•			•	•
Science												
Energy and forces	•	•		•	•	•	•	•				
Environmental awareness and care	•	•	•	•	•			•			•	•
Materials						•	•	•	•			
Living things							•					
History												
Continuity and change over time		•		•								
Era of change and conflict		•										
Story		•										
Mathematics												
Shape and space	•						•	•	•			
Measures	•	•							•			

Curriculum subjects and strands	**Lesson 1** Energy Journeys: (Context)	**Lesson 2** Renewable and Non-Renewable Energy Sources	**Lesson 3** Investigating Wind and Wind Energy	**Lesson 4** Examining How Wind Turbines Work	**Lesson 5** Energy Storage	**Lesson 6** Power On	**Lesson 7** Motorise Model: (Safety and Sensors)	**Lesson 8** Electric Car: (Energy Consumption)	**Lesson 9-10** Team Model	**Lesson 11-12** Team Poster	**Lesson 13** Let's Share	**Lesson 14** Let's Reflect
Literacy												
Oral language	•	•	•	•		•	•	•	•	•	•	•
Writing	•	•	•	•		•			•	•	•	•
SPHE												
Myself	•	•					•					
Myself and others	•	•	•	•	•	•	•	•	•	•	•	•
Myself and the wider world	•		•	•	•	•			•	•	•	•
Visual arts												
Construction						•	•	•	•	•	•	•
Drawing						•	•	•	•	•	•	•
Drama												
Drama to explore feelings, knowledge and ideas, leading to understanding	•					•			•	•	•	•
Music												
Composing								•				•

Table 5. Curriculum connections matrix

Skills and concepts connections

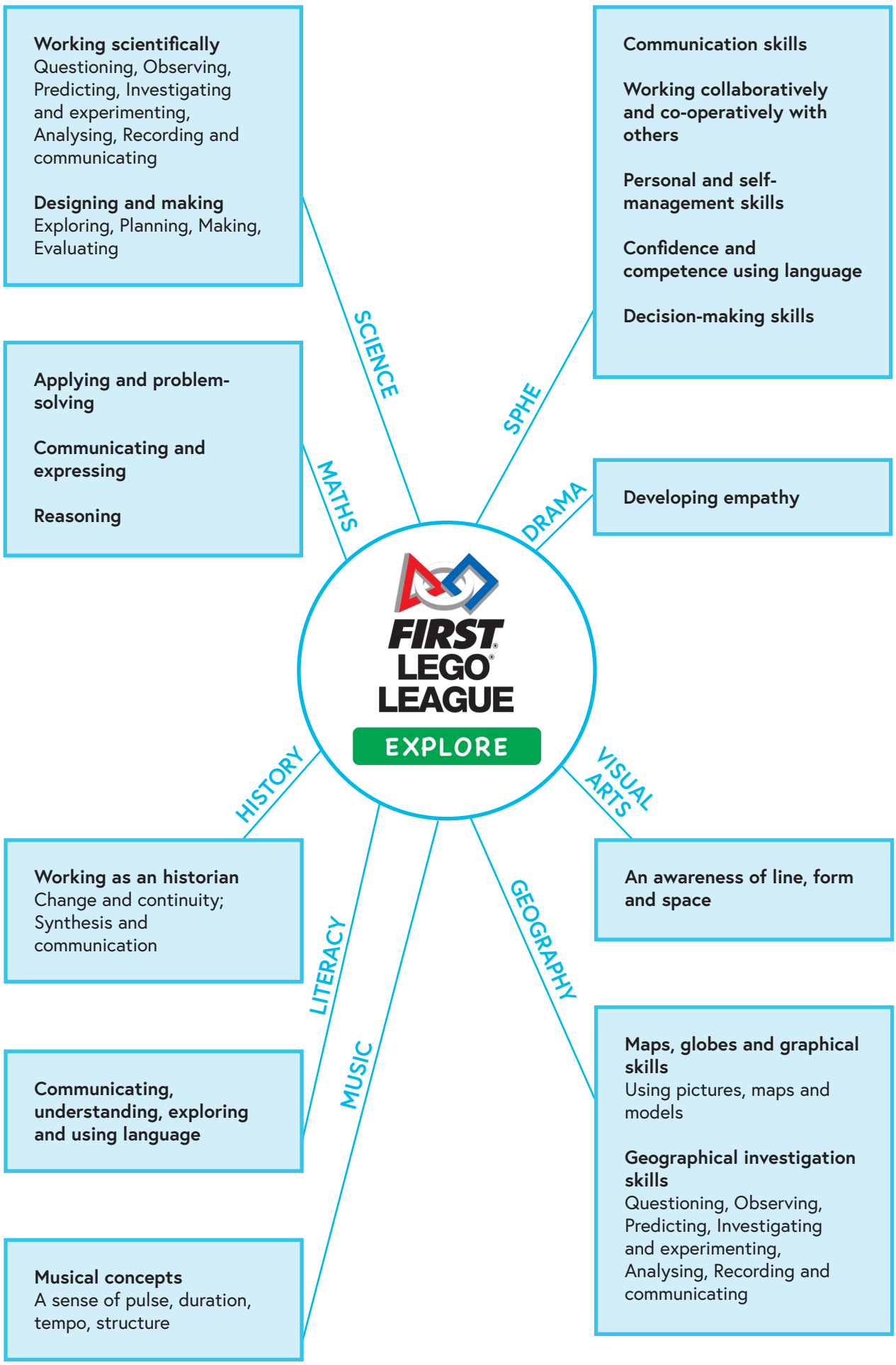


Figure 4. SUPERPOWERED skill connections

SUPERPOWERED curriculum connections

Lesson	Lesson 1: Energy Journeys (Context)	Lesson 2: Renewable and Nonrenewable Energy Sources	Lesson 3: Investigating Wind and Wind Energy	Lesson 4: Examining How Wind Turbines Work
Overview of the lesson	Learners will consider energy in their everyday lives including what energy is, where it comes from and how it travels.	Learners will identify and explore the advantages and disadvantages of renewable and nonrenewable sources of energy.	Learners will examine wind as a source of energy. They will develop an understanding of how wind is formed and consider the factors that impact the location of a wind farm.	Learners will examine how wind turbines function. Learners will build the LEGO wind turbine and explore how it works.
Curriculum connections	**Geography** Strands: Environmental Awareness and Care; Human Environments Strand Units: Caring for the environment; Environmental awareness; People at work; Transport and communications **Science** Strands: Energy and forces; Environmental awareness and care Strand Units: Forces; Electricity; Science and the environment; Caring for the environment; Environmental awareness **Literacy** Strands: Oral Language; Writing Strand Unit: Communicating	**Science** Strands: Energy and forces; Environmental awareness and care Strand Units: Forces; Electricity; Science and the environment; Caring for the environment; Environmental awareness **Geography** Strands: Environmental awareness and care Strand Units: Caring for the environment; Environmental awareness **Literacy** Strand: Oral Language; Writing Strand Unit: Communicating **Mathematics** Strand: Measure Strand Unit: Data **SPHE** Strand: Myself and Others Strand Unit: My friends and other people	**Geography** Strands: Natural environments; Environmental awareness and care; Human environments Strand Units: Weather, climate and atmosphere; Local natural environment; Caring for the environment; Environmental awareness; People at work; Transport and communications **Science** Strand: Environmental awareness and care Strand Units: Science and the environment; Caring for the environment; Environmental awareness **Literacy** Strands: Oral Language; Writing Strand Unit: Communicating **SPHE** Strands: Myself and Others; Myself and the wider world Strand Units: My friends and other people Relating to others Developing citizenship	**Geography** Strands: Natural environments; Environmental awareness and care; Human environments Strand Units: Weather, climate and atmosphere; Local natural environment; Caring for the environment; Environmental awareness; People at work; Transport and communications **Science** Strands: Energy and forces; Environmental awareness and care Strand Units: Forces; Science and the environment; Caring for the environment; Environmental awareness **Literacy** Strands: Oral Language; Writing Strand Unit: Communicating **SPHE** Strands: Myself and others; Myself and the wider world Strand Units: My friends and other people Relating to others Developing citizenship
Skills development	• Geographical investigation skills (Questioning, Hypothesising, Investigating, Analysing, Observing, Recording and Communicating) • Investigating and experimenting; Measuring; Questioning; Observing. • Communicating; Understanding; Exploring and using	• Investigating and experimenting; Measuring; Questioning; Observing. • Using maps and globes • Geographical investigation skills (Questioning, Observing, Investigating, Analysing, Recording and Communicating, Evaluating) • Communicating; Understanding; Exploring and using • Applying and problem-solving; Communicating and expressing • Communication; Co-operation; Decision-making	• Using maps and globes • Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating) • Investigating and experimenting; Measuring; Questioning; Observing; Predicting; Recording and communicating. • Communicating; Understanding; Exploring and using • Communication • Co-operation • Decision-making	• Using maps and globes • Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating) • Investigating and experimenting; Measuring; Questioning; Observing. • Communicating; Understanding; Exploring and using • Communication • Co-operation • Decision-making

Lesson	Lesson 5: Energy Storage	Lesson 6: Power On	Lesson 7: Motorise Model (Safety and Sensors)	Lesson 8: Electric Car (Energy Consumption)
Overview of the lesson	Learners will explore how energy is stored and distributed.	Learners will be introduced to the LEGO Education Set (SPIKE Essential or WeDo 2.0). Learners will be introduced to a simple block-based coding language. Learners will build and code a motorised LEGO robot.	Learners will be introduced to sensors and their associated coding blocks. Learners will build and code a LEGO robot which uses/responds to a sensor. Learners will begin to consider how sensors could enhance the safety of their LEGO builds.	Learners will build and code a motorised LEGO vehicle and then adapt it into an 'Electric Car' in order to explore an example of energy consumption.
Curriculum connections	**Geography** Strands: Natural environments; Environmental awareness and care; Human environments Strand Units: Local natural environment; Caring for the environment; Environmental awareness; People at work; Transport and communications **Science** Strands: Energy and forces; Environmental awareness and care Strand Units: Forces; Caring for the environment; Environmental awareness **SPHE** Strands: Myself and others; Myself and the wider world Strand Units: My friends and other people Relating to others Developing citizenship	**Literacy** Strand: Oral Language Strand Unit: Communicating **Visual Arts** Strands: Construction, Drawing Strand Units: Making constructions, Making drawings **Science** Strands: Materials, Energy and forces Strand Units: Properties and characteristics of materials, Forces **SPHE** Strands: Myself and others Strand Units: My friends and other people Relating to others	**Literacy** Strand: Oral Language Strand Unit: Communicating **Visual Arts** Strands: Construction, Drawing Strand Units: Making constructions, Making drawings **Mathematics** Strand: Shape and space Strand Units: 2-D shapes, 3-D shapes **Science** Strands: Energy and forces; Environmental awareness and care Strand Units: Forces; Science and the environment **SPHE** Strand: Myself Strand Unit: Safety and protection	**Literacy** Strand: Oral Language Strand Unit: Communicating **Visual Arts** Strands: Construction, Drawing Strand Units: Making constructions, Making drawings **Mathematics** Strand: Shape and space Strand Units: 2-D shapes, 3-D shapes **Science** Strands: Energy and forces; Environmental awareness and care Strand Units: Forces; Science and the environment **SPHE** Strand: Myself Strand Unit: Safety and protection **Geography** Strands: Environmental awareness and care; Human environments Strand Units: Caring for the environment; Environmental awareness; People at work; Transport and communications
Skills development	• Using maps and globes • Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating) • Investigating and experimenting; Questioning; Observing • Communication • Co-operation • Decision-making	• Communicating; Understanding; Exploring and using • An awareness of line; An awareness of form; An awareness of space • Design and make • Communication; Co-operation; Decision-making	• Communicating; Understanding; Exploring and using • An awareness of line; An awareness of form; An awareness of space • Applying and problem-solving; Communicating and expressing • Investigating; Observing; Design and make • Communication; Co-operation; Decision-making	• Communicating; Understanding; Exploring and using • An awareness of line; An awareness of form; An awareness of space • Applying and problem-solving; Communicating and expressing • Design and make • Communication; Co-operation; Decision-making • Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)

Lesson	Lesson 9-10: Team Model	Lesson 11-12: Team Poster	Lesson 13: Let's Share	Lesson 14: Let's Reflect
Overview of the lesson	In teams, learners will create a Team Model that shows 'Better ways to source, store, and use energy'. Their Team Model can address a specific part of the energy journey, or all of it.	In teams, learners will plan, design and create their Team Poster.	In teams, learners will plan for how they will share their Team Model and Team Poster at the final event.	Learners will reflect upon the SUPERPOWERED lessons, their Team Model and Poster, and their understanding of energy journeys.
Curriculum connections	**Mathematics** Strand: Shape and space Strand Units: 2-D shapes, 3-D shapes **Science** Strands: Energy and forces; Materials Strand Units: Forces; Properties and characteristics of materials **Literacy** Strand: Oral Language Strand Unit: Communicating **Visual Arts** Strands: Construction, Drawing Strand Units: Making constructions, Making drawings **SPHE** Strand: Myself Strand Unit: Safety and protection	**Literacy:** Strand: Oral Language; Writing Strand Unist: Communicating; Understanding; Exploring and using **Visual Arts:** Strands: Construction, Drawing Strand Units: Making drawings; Making constructions	**Literacy:** Strand: Oral Language Strand Units: Communicating; Understanding; Exploring and using **Visual Arts:** Strands: Construction, Drawing Strand Units: Making drawings; Making constructions **Science** Strands: Environmental awareness and care Strand Unit: Environmental awareness **Geography** Strands: Environmental awareness and care Strand Unit: Caring for the environment	**Literacy:** Strand: Oral Language Strand Unit: Communicating **Visual Arts:** Strands: Construction, Drawing Strand Units: Making drawings; Making constructions **Science** Strands: Environmental awareness and care Strand Unit: Environmental awareness **Geography** Strands: Environmental awareness and care Strand Unit: Caring for the environment
Skills development	• Applying and problem-solving; Communicating and expressing • Design and make; Observation; Investigating and experimenting; Recording and communicating • Communicating, understanding, exploring & using language • An awareness of line; An awareness of form; An awareness of space • Communication; Co-operation; Decision-making	• Communicating, understanding, exploring and using language • An awareness of form; An awareness of space.	• Communicating, understanding, exploring and using language • An awareness of form; An awareness of space • Working scientifically; Analysing; Designing and making • A sense of place; Geographical investigation skills	• Communicating, understanding, exploring and using language • An awareness of form; An awareness of space • Working scientifically; Analysing; Designing and making • A sense of place; Geographical investigation skills

Table 6. SUPERPOWERED curriculum connections

Digital Learning Framework (DLF) and School Self-Evaluation (SSE) connections

As part of the process in writing a digital learning plan, schools should firstly familiarise themselves with the Digital Learning Framework (DLF). Having reviewed the domains and standards, the school should identify the standard or standards on which it wishes to focus. This could be one standard, but not more than three. In some instances a school might identify one standard from the Teaching and Learning Dimension, and one standard from the Leadership and Management Dimension. For each standard there are a number of statements of effective practice and highly effective practice.

This SUPERPOWERED Teacher Guide will only refer to statements of effective practice, however a school may feel the statement of highly effective practice is more suitable to their context.

For further information on the Digital Learning Framework and the process of completing a Digital Learning Plan for your school visit **dlplanning.ie**. The **Digital Learning Planning Guidelines book** is a very useful guide in creating a Digital Learning Plan.

Figure 5 gives an overview of the connections between SUPERPOWERED and the DLF and SSE.

Teaching and Learning

Learner Outcomes

- Pupils enjoy learning, are motivated to learn and expect to achieve as learners
- Pupils demonstrate the knowledge, skills and understanding required

Learner Experiences

- Pupils engage purposefully in meaningful learning activities
- Pupils reflect on their progress and develop a sense of ownership of and responsibility for their learning

Teachers' Individual Practice

- The teacher has the requisite subject knowledge, pedagogical knowledge and classroom management skills
- The teacher selects and uses planning, preparation and assessment practices that progress pupils' learning

Teachers' Collaborative Practice

- Teachers value and engage in professional development and professional collaboration
- Teachers work together to devise learning opportunities for pupils across and beyond the curriculum
- Teachers contribute to building whole-staff capacity by sharing their expertise

Leadership and Management

Leading, Learning and Teaching

- Promote a culture of improvement, collaboration, innovation and creativity in learning, teaching, and assessment
- Manage the planning and implementation of the curriculum
- Foster teacher professional development that enriches teachers' and pupils' learning

Managing the Organisation

- Manage the school's human, physical and financial resources so as to create and maintain a learning organisation

Leading School Development

- Manage, lead and mediate change to respond to the evolving needs of the school and changes in education

Developing Leadership Capacity

- Empower staff to take on and carry out leadership roles

Figure 5. SUPERPOWERED Digital Learning Framework (DLF) and School Self-Evaluation (SSE) connections

For a school beginning to use a LEGO Education Set (SPIKE Essential or WeDo 2.0) and *FIRST* LEGO League Explore for the first time, one or two of the following standards and statements could be considered when preparing your Digital Learning Plan:

	Teaching and Learning	
Subject	**Detail from DLF**	**Guidance**
Pupil	**Domain 1:** Learner Outcomes **Standard:** Pupils enjoy their learning, are motivated to learn and expect to achieve as learners. **Statement:** Pupils use appropriate digital technologies to foster active engagement in attaining appropriate learning outcomes.	Through engagement with SUPERPOWERED, pupils will use appropriate digital technologies (SPIKE Essential or WeDo 2.0 and digital devices) to actively explore the 'challenge question' and create Team Models.
	Domain 1: Learner Outcomes **Standard:** Pupils enjoy their learning, are motivated to learn and expect to achieve as learners. **Statement:** Pupils use digital technologies to collect evidence and record progress.	Pupils will use digital devices (e.g. tablet/ camera) and a digital portfolio tool (e.g. Google Sites/SeeSaw, etc.) to document the Engineering Design Process while exploring the challenge question in SUPERPOWERED.
Teacher	**Domain 3:** Teachers' Individual Practice **Standard:** The teacher selects and uses planning, preparation and assessment practices that progress pupils' learning. **Statement:** Teachers use appropriate digital technologies to design complex, real-world problems and structure them in a way that incorporates key subject matter concepts.	Teachers adapt and use the SUPERPOWERED learning activities (from Team Meeting Guide and this Teacher Guide) in order to provide pupils with complex, real-world problems which incorporate key subject matter concepts.
	Leadership and Management	
Leaders	**Domain 1:** Leading Learning and Teaching **Standard:** Promote a culture of improvement, collaboration, innovation and creativity in learning, teaching, and assessment **Statement:** The principal and other leaders in the school encourage teachers to use digital technologies to enhance their learning, teaching and assessment practices, and to share their practice.	School leaders actively encourage and support teachers in their use of SUPERPOWERED with pupils. Teachers are encouraged and facilitated to share their *FIRST* LEGO League Explore practice with colleagues.

For schools who have previously engaged with a LEGO Education Set (SPIKE Essential or WeDo 2.0) or *FIRST* LEGO League resources, or schools who would like to take a different focus within their DL plan, the following section identifies several standards which could be met through participating in *FIRST* LEGO League Explore. **Remember**, in order for the DL plan to be achievable, a school should ideally only select one/two standard(s) in a given DL planning cycle.

	Teaching and Learning	
	Detail from DLF	**Guidance**
DOMAIN 1	**Domain 1:** Learner Outcomes **Standard:** Pupils enjoy their learning, are motivated to learn and expect to achieve as learners. **Statement:** Pupils use appropriate digital technologies to foster active engagement in attaining appropriate learning outcomes.	Through engagement with *FIRST* LEGO League Explore, pupils will use appropriate digital technologies (LEGO Education Set and digital devices) to actively explore the 'challenge question' and create team models.
	Domain 1: Learner Outcomes **Standard:** Pupils enjoy their learning, are motivated to learn and expect to achieve as learners. **Statement:** Pupils use digital technologies to collect evidence and record progress.	Pupils will use digital devices (e.g. tablet/ camera) and a portfolio tool (e.g. Google Sites/SeeSaw, etc.) to document the engineering design process while exploring the challenge question in SUPERPOWERED.
	Domain 1: Learner Outcomes **Standard:** Pupils demonstrate the knowledge, skills and understanding required by the primary curriculum **Statement:** Pupils can use a range of digital technologies to demonstrate the knowledge, skills and understanding required by the Primary School Curriculum.	Through engagement with the SUPERPOWERED challenge question, pupils will use a range of digital technologies (LEGO Education Set, tablet/laptop, etc.) to demonstrate knowledge, skills and understanding in the form of team models, team posters and other tasks included in SUPERPOWERED.
	Domain 1: Learner Outcomes **Standard:** Pupils demonstrate the knowledge, skills and understanding required by the primary curriculum **Statement:** Pupils use digital technologies effectively to develop their knowledge, skills and understanding in accordance with the content objectives, learning outcomes, skills and concepts of the Primary School Curriculum.	Pupils develop their knowledge, skills and understanding through engagement with the SUPERPOWERED challenge question; specifically through the Engineering Design Process, in designing and building Team Models and in preparing a Team Poster.
DOMAIN 2	**Domain 2:** Learner Experiences **Standard:** Pupils engage purposefully in meaningful learning activities **Statement:** Pupils use digital technologies for sourcing and exchanging information to develop understanding and support basic knowledge creation.	While engaging with the SUPERPOWERED challenge question and tasks, pupils use digital technologies (tablet/laptop etc.) for sourcing, exchanging of information to develop understanding and support the creation of their Team Model and Team pPoster.
	Domain 2: Learner Experiences **Standard:** Pupils reflect on their progress as learners and develop a sense of ownership of and responsibility for their learning **Statement:** Pupils use digital technologies to collect evidence, record and reflect on their progress, and develop their competence as self-directed learners.	The SUPERPOWERED challenge question and focus on engineering design process enable pupils to engage in self-directed learning activities which involve the collection, recording and reflection on their projects, including Team Models and Team Posters.

	Teaching & Learning	
	Detail from DLF	**Guidance**
DOMAIN 3	**Domain 3:** Teachers' Individual Practice **Standard:** The teacher has the requisite subject knowledge, pedagogical knowledge and classroom management skills **Statement:** Teachers design or adapt learning experiences that incorporate digital technologies and make learning activities relevant and meaningful to support pupils' learning.	Teachers adapt and differentiate the SUPERPOWERED learning activities which incorporate digital technologies (LEGO Education Set, tablet/laptop, camera) to support pupils' learning.
	Domain 3: Teachers' Individual Practice **Standard:** The teacher selects and uses planning, preparation and assessment practices that progress pupils' learning **Statement:** Teachers use appropriate digital technologies to design complex, real-world problems and structure them in a way that incorporates key subject matter concepts.	Teachers adapt and use the SUPERPOWERED learning activities (from Team Meeting Guide and this Teacher Guide) in order to provide pupils with complex, real-world problems which incorporate key subject matter concepts.
DOMAIN 4	**Domain 4:** Teachers' Collaborative Practice **Standard:** Teachers value and engage in professional development and professional collaboration **Statement:** Teachers engage in professional development and work with colleagues to help them select and align digital technologies with effective teaching strategies to expand learning opportunities for all pupils	Teachers engage with professional development (PDST/Learnit/DCU) in order to develop confidence and competence in making use of LEGO SPIKE Essential or WeDo 2.0 and *FIRST* LEGO League resources to design learning opportunities for all pupils.
	Domain 4: Teachers' Collaborative Practice **Standard:** Teachers work together to devise learning opportunities for pupils across and beyond the curriculum **Statement:** Teachers participate in professional online communities to help them design learning opportunities for pupils across and beyond the curriculum.	Teachers engage with outside agencies (PDST/Learnit/DCU) in order to develop confidence and competence in making use of the LEGO SPIKE Essential or WeDo 2.0 and *FIRST* LEGO League resources to design learning opportunities for pupils across and beyond the curriculum.
	Domain 4: Teachers' Collaborative Practice **Standard:** Teachers contribute to building whole-staff capacity by sharing their expertise **Statement:** Teachers collaborate in determining how digital technologies can be used effectively for teaching, learning and assessment (TLA).	Teachers collaborate (i.e. staff meetings) to discuss and determine how the SUPERPOWERED resources and equipment can be used effectively for TLA.

Leadership and Management		
Detail from DLF	**Guidance**	
Domain 1: Leading Learning and Teaching **Standard:** Promote a culture of improvement, collaboration, innovation and creativity in learning, teaching, and assessment **Statement:** The principal and other leaders in the school encourage teachers to use digital technologies to enhance their learning, teaching and assessment practices, and to share their practice.	School leaders actively encourage and support teachers in their use of SUPERPOWERED with pupils. Teachers are encouraged and facilitated to share their SUPERPOWERED practice with colleagues.	DOMAIN 1
Domain 1: Leading Learning and Teaching **Standard:** Manage the planning and implementation of the curriculum **Statements:** The principal and other leaders in the school plan for and implement a broad and balanced curriculum using digital technologies that offer new opportunities for learning. They are committed to ensuring that the school curriculum is implemented in a way that provides valuable learning experiences designed to exploit the potential of digital technologies.	School leaders plan to implement SUPERPOWERED in order to provide valuable learning experiences which both exploit the potential of digital technologies and facilitate a broad and balanced curriculum with new opportunities for thematic teaching.	
Domain 1: Leading Learning and Teaching **Standard:** Foster teacher professional development that enriches teachers' and pupils' learning **Statement:** The principal and other leaders in the school support teachers' continuing professional development to develop teacher competence in the use of digital technologies, to support high-quality teaching and learning.	Teachers are encouraged and supported to engage with professional development which supports their engagement with SUPERPOWERED.	
Domain 2: Managing the Organisation **Standard:** Manage the school's human, physical and financial resources so as to create and maintain a learning organisation **Statements:** The board of management ensures the provision and maintenance of digital teaching aids and equipment to a good standard. Physical learning spaces have been designed or adapted to harness and optimise the use of a range of digital technologies for learning.	All required digital technologies (LEGO Education Set, tablet/laptop, SUPERPOWERED Explore Set) are available to the teacher and pupils. Considerations are made to the maintenance of this equipment. Considerations have been made to the layout of the classroom/multi-purpose space to best facilitate the Engineering Design Process and engagement with the SUPERPOWERED learning activities.	DOMAIN 2

Leadership and Management		
Detail from DLF	**Guidance**	
Domain 3: Leading School Development **Standard:** Manage, lead and mediate change to respond to the evolving needs of the school and to changes in education **Statement:** The principal and other leaders in the school are informed by national policy and technological developments, and see their relevance to the school.	School leaders support and encourage teachers in use of SUPERPOWERED due to its clear alignment with policy and relevance to the school.	DOMAIN 3
Domain 4: Developing Leadership Capacity **Standard:** Empower staff to take on and carry out leadership roles **Statements:** The principal and other leaders in the school encourage teachers to take on leadership roles and to lead the use of digital technologies for learning, teaching and assessment, and are willing to distribute significant leadership responsibilities. They develop organisational structures to facilitate and encourage the sharing of practice and peer mentoring in the use of digital technologies for learning, teaching and assessment.	School leaders encourage teachers to participate in SUPERPOWERED. Teachers are then facilitated to share their experiences and expertise with colleagues in order to enable another teacher and class to participate in SUPERPOWERED.	DOMAIN 4

The proposed Draft Primary Curriculum Framework

The Seven Key Competencies of the new Primary Curriculum Framework

In order to support learners interacting with and engaging in the social world of their home, school and community, the new primary curriculum in Ireland includes seven 'key competencies' which are inextricably interconnected. These competencies were identified specifically in order to support and enable learners to develop a deep appreciation for the natural world and an understanding of how the world works. Here, learners will be equipped with the essential knowledge, skills, concepts, dispositions, attitudes and values which enable them to adapt and deal with a range of situations, challenges and contexts in support of broader learning goals. These Seven Key Competencies are presented in Figure 6.

Figure 6. The Seven Key Competencies of the new Primary Curriculum Framework.

This *FIRST* LEGO League Explore SUPERPOWERED Teacher Guide has been designed to support the development of all seven of the key competencies of the Primary Curriculum Framework in an integrated way as presented in Figure 7 and outlined below:

The '**Being an Active Citizen**' competency fosters within learners the knowledge, skills, concepts, attitudes, values and dispositions that motivate and empower them as citizens to take positive actions to live justly and sustainably. It enables learners to question, critique and understand what is happening in the world and how aspects of our lives can be improved. It places democratic practices at the centre of the learning process. Through engaging in *FIRST* LEGO League Explore SUPERPOWERED, learners are facilitated in understanding the interconnectedness and interdependence of people and places both locally and globally. *FIRST* LEGO League Explore SUPERPOWERED encourages and enables learners to question and critique our use of energy, where our energy comes from, and sustainable and unsustainable energy sources at local and national levels. Learners are working collaboratively to identify and solve problems, and make decisions through democratic practices. The '**Being an Active Citizen**' competency is embedded within *FIRST* LEGO League Explore SUPERPOWERED in that the challenge and associated lessons develop learners' capacity and foster their ability to contribute positively and compassionately towards the creation of a more sustainable and just world.

The '**Being Creative**' competency focuses on recognising and nurturing learners' innate creativity, providing learners with opportunities for meaningful creative experiences through exploring and expressing ideas and reflecting on experiences. *FIRST* LEGO League Explore SUPERPOWERED holds that learners are creative learners, and as such, should be encouraged to be curious, open-minded and imaginative. It comprises the attributes of '**Being Creative**' such as participating in and enjoying creative experiences, being curious, being imaginative, being innovative, using creative processes and exploring alternative ways of communicating. Throughout the learning activities and lessons on this challenge, learners are encouraged to share and challenge each others' ideas, to reflect upon new learnings and their own experiences and to think critically about realistic solutions to real-world problems associated with the sources, distribution and use of energy locally, nationally and globally.

The '**Being a Digital Learner**' competency in the new Primary Curriculum Framework aims to support learners in becoming creative, confident and critical users of digital technology. Throughout *FIRST*

LEGO League Explore SUPERPOWERED, learners will develop their knowledge, skills, concepts, attitudes, values and dispositions through problem-solving, experimenting and creating, using a wide range of digital technologies including digital mapping, collaborative planning, coding and communication software. *FIRST* LEGO League Explore SUPERPOWERED develops learners' responsible, safe and ethical use of technology by embedding digital technologies in the learning process.

The '**Being Mathematical**' competency aims to aid learners in developing and applying mathematical thinking to solve a range of problems in everyday situations. In order to participate in today's world, learners need to be able to think and communicate quantitatively, to make sense of data, to have spatial awareness and to recognise and understand patterns and sequences. Being mathematical involves learners drawing upon a range of knowledge, skills, concepts, attitudes, values and dispositions as they recognise, interpret real-world information presented mathematically. Core attributes of the 'Being Mathematical' competency are inherently ingrained throughout the lessons for *FIRST* LEGO League Explore SUPERPOWERED. In each lesson, learners are challenged to solve problems and make sense of real-world context situations using mathematics by recognising relationships, trends,

connections and patterns and interpreting and processing information and data

According to the new Primary Curriculum Framework, the '**Communicating and Using Language**' competency develops learners' understanding and enjoyment of interacting with others. Communicating and using language means being able to understand, interpret and use different forms of communication including gesture, expression, spoken language, printed text, broadcast media, and digital media. *FIRST* LEGO League Explore SUPERPOWERED involves learners engaging purposefully with different text types including spoken, print and electronic formats. Here learners are encouraged to share and reflect upon their experiences, thoughts, ideas and feelings in a variety of ways as well as learning how to observe, listen to, interpret and show respect for the perspectives of others.

The '**Fostering Wellbeing**' competency fosters self-awareness and promotes the importance of learners seeing themselves as capable and resourceful. It helps children become positive and engaged in their learning and realise their own uniqueness and potential. It supports healthy relationships with themselves, their peers, their family and the wider world. The Core Values of *FIRST* LEGO League Explore SUPERPOWERED facilitate learners in being self-aware and resilient, acting responsibly and showing care towards themselves and others and

being persistent and flexible in solving problems. The investigative, problem-based approach of the challenge is conducive towards fostering co-operation, positive team relationships and self-betterment.

Finally, the '**Learning to be a Learner**' competency is aimed at aiding learners to develop themselves as learners, individually and in collaboration with others. It promotes the development of the knowledge, skills, concepts, attitudes, values and dispositions needed for being an active and continuous learner. The structure of *FIRST* LEGO League Explore SUPERPOWERED facilitates learners in learning to be learners whereby they learn how to communicate, set personal and collaborative learning goals, solve problems, and manage complex situations and challenges. The real-world context of the content and learning activities enables learners to make sense of people, things and places around them and in the wider world. Through developing this competency, learners also learn to reflect on their learning. Reflection is a major feature of *FIRST* LEGO League Explore SUPERPOWERED. Learning with and about others also enables children to develop empathy.

Figure 7. The Seven Key Competencies of the Draft Primary Curriculum Framework.

Concepts and approaches of computational thinking and coding

Curriculum areas and subjects of the Draft Primary Curriculum

The redeveloped curriculum will be presented in five broad curriculum areas.

These are:

1. Language
2. Mathematics, Science and Technology Education
3. Wellbeing
4. Arts Education
5. Social and Environmental Education

Stages 1 and 2 Junior Infants - 2nd Class	Language (Irish and English)	Mathematics Science and Technology Education	Wellbeing	Arts Education	Social and Enviromental Education	Religious/ Ethical/ Multi-Belief Education - Patron's Program
Stages 3 and 4 3rd - 6th Class	Irish English Modern Foreign Languages	Mathematics Science and Technology	Physical and Health Education Social, Personal and Values Education	Visual Arts Music Drama (and other aspects e.g. Dance, Film and Digital Media)	History Geography	Religious/ Ethical/ Multi-Belief Education - Patron's Program

The NCCA worked with 40 schools between 2017 and 2019 as part of the Coding in Primary Schools Initiative. The findings from that initiative have informed thinking in relation to Mathematics, Science and Technology Education.

See **www.ncca.ie/en/primary/primary-developments/coding-in-primary-schools/research** for the final report on the coding initiative.

Computational thinking is about looking at a problem in a way in which a computer can help us to solve it. This is a two-step process:

1. First, we think about the steps needed to solve a problem.
2. Then, we use our technical skills to get the computer working on the problem.

(Barefoot Computing, 2021)

"Computational Thinking can be defined as competence in problem solving & design to create useful solutions, informed by the possibilities that Computing offers"

(Millwood et al., 2018, p. 8)

Computational thinking and coding are key elements of all SUPERPOWERED lessons. At the heart of these lessons is a process of testing and learning, whereby learners work logically by changing and testing one variable (or code block) at a time, and documenting this. In so doing, learners can reflect upon the process and debug (or fix) any program that may not be having the intended result. This process can be scaffolded by probing questions from the teacher. The intention is to help learners in thinking about the problem differently; I wonder if..., how might you…, have you considered… Examples of guiding questions are provided in each lesson.

While engaging in coding and computational thinking it is important to assist learners in using the correct **terminology** to describe the concepts and approaches they are developing. Table 7 below details five concepts and approaches of computational thinking and coding which are developed across the *FIRST* LEGO League Explore SUPERPOWERED lessons.

Concept or approach	Explanation	Example of the concept or approach in use
Algorithms	Making steps, rules, and/or instructions	Creating the code or program within the LEGO App (SPIKE Essential or WeDo 2.0). Creating algorithms. Writing instructions.
Debugging	Finding and fixing 'bugs' in a logical and methodical manner	Iteratively making small changes to the code or program and testing the outcome in order to overcome a problem. Creating tests, evaluating program outputs and statements.
Decomposition	Breaking down into parts	Organising information, creating representations of relationships and systems in diagrams, e.g. labelling the parts of a plant, creating a mindmap on a topic.
Logic	Predicting, analysing	Evaluating for correctness.
Tinkering	Trying things out	Creating systems and playing with 'variables'. Experimenting and playing with the code or program.

Table 7. Five concepts and approaches of computational thinking developed across the SUPERPOWERED lessons

Other concepts and approaches of computational thinking and coding include:

- Pattern recognition - looking for similarities among and within problems
- Abstraction - focusing on the important information only, ignoring irrelevant detail
- Evaluation - making judgements
- Creating - planning, making and evaluating things
- Persevering - never giving up, being determined, resilient and tenacious
- Collaborating - working with others to ensure the best results

(Adapted from Millwood et al., 2018)

The Barefoot Computing curriculum (**www.barefootcomputing.org**), see Figure 8, includes a useful graphic which summarises the key concepts and approaches of computational thinking and coding.

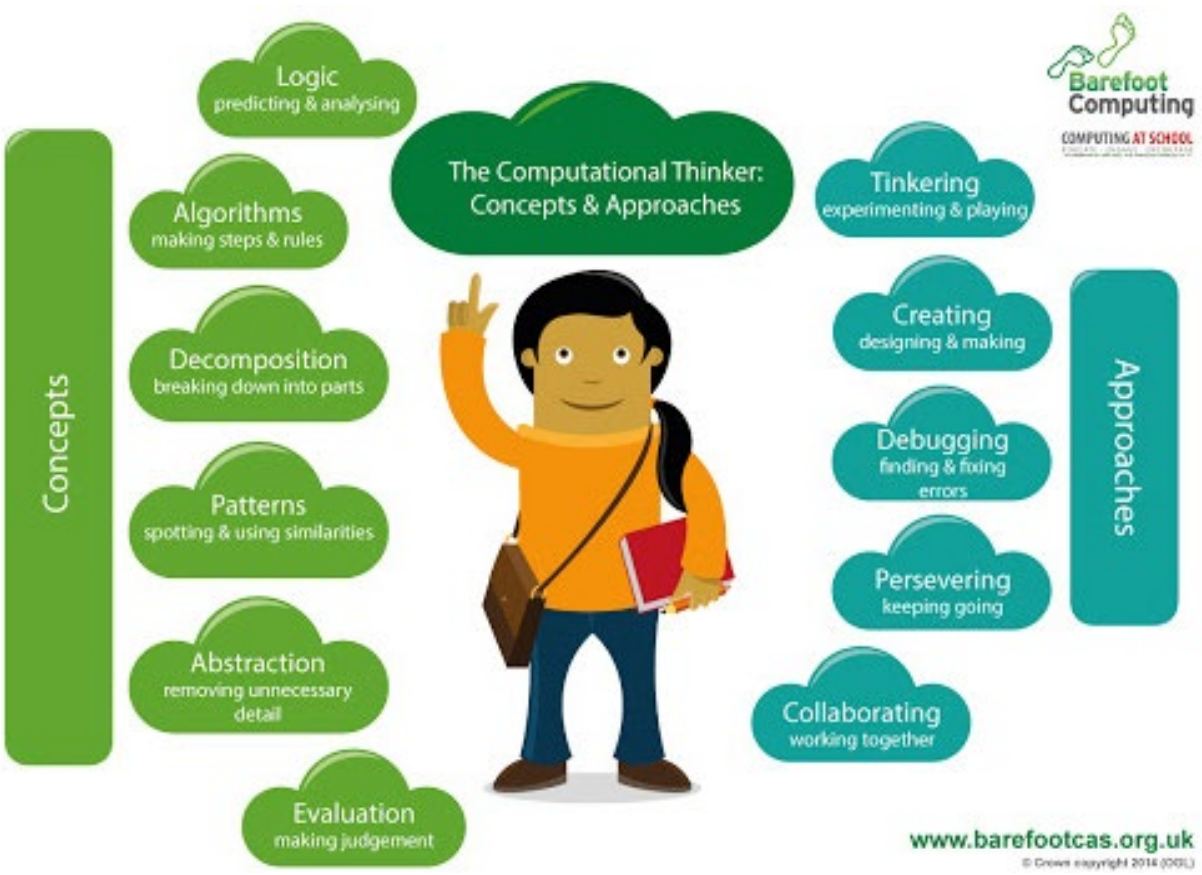


Figure 8. The Computational Thinker: Concepts and Approaches

Further help and support to schools

Help and support is available to teachers and schools. The PDST and PDST Technology in Education are available to provide a range of support to teachers and schools, including training, technical support, and ongoing sustained school support. Where available, sustained support is recommended as it provides for ongoing training and support to teachers engaged in *FIRST* LEGO League Explore.

> PDST Sustained School Support is a deeper form of teacher professional learning aimed at building internal capacity and enabling schools to drive and embed change as independent communities of learners. The support is provided over a period of time, as part of a deliberately planned process, involving the school and teachers working towards clear and agreed-upon goals. In this context, our advisors will support teachers to collaboratively reflect, identify strengths and needs before deciding on the best way forward for your school.
>
> (PDST, 2021)

Visit **pdst.ie** for further information, and to request school support.

Help and support is also available from your local **Education Centre**. This support can include training sessions, cluster groups of schools and teachers, and the loan of equipment and devices. Visit their website for further information, including details of upcoming training events.

LEGO Education Support: For replacement parts, additional kits, workshops and teacher CPD visit our partners **www.creative-hut.com**.

General information: using this Teacher Guide

Organisation of teams

Learners work together in teams of four to six using elements from a LEGO® Education Set (SPIKE Essential or WeDo 2.0) and a SUPERPOWERED Explore Set. They will collaborate and communicate to build, learn, and play together. Please refer to the Team Meeting Guide (page 5) for details of Team Roles. Learners should remain in the same teams for all lessons.

Engaging with professionals

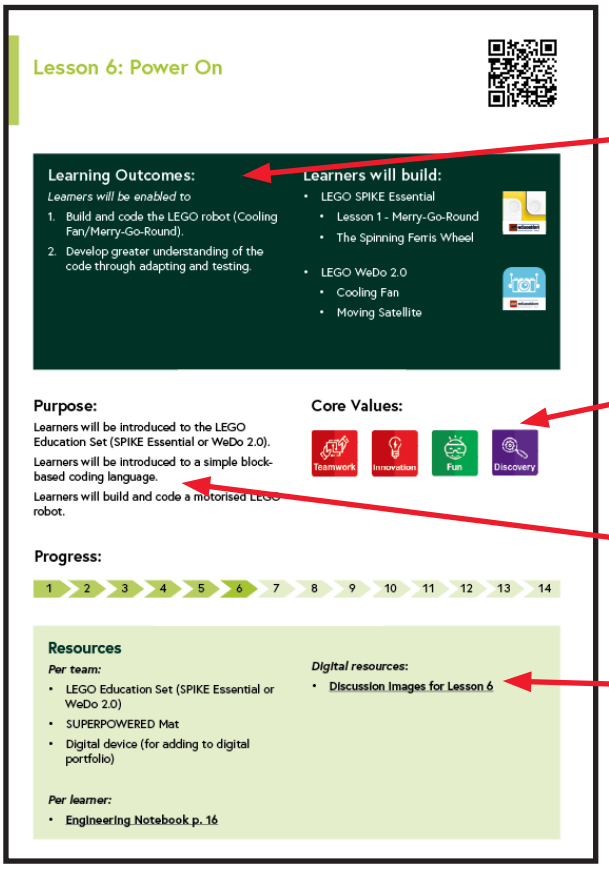
There are opportunities to engage with professionals over the course of the season through school visits, Zoom etc. Refer to the Career Connections pages in the back of the Engineering Notebook for some of the jobs that are linked to the SUPERPOWERED season.

Managing equipment

FIRST LEGO League Explore SUPERPOWERED Team Meeting Guide provides useful advice on the management of materials (page 7). The following are further recommendations:

Before	Ongoing	After
If the sets have been previously used - each team checks that they are not missing any elements before completing their first lesson. This can be done by comparing the contents against the cover insert (pictured below). Designate one LEGO Education Set (SPIKE Essential or Wedo 2.0) and SUPERPOWERED Explore Set per team. Where possible, label these to avoid confusion or swapping of sets.	A large lunchbox per team could be used to store the prototyping pieces between lessons. Any LEGO elements found on the floor could be placed in a box on the teacher's desk. Teams missing elements can then check this box. Move all school bags and personal belongings of learners to the back of the room while completing lessons involving the LEGO materials. This is to avoid any elements accidentally falling into bags or pockets. After building the Explore models, store the printed books containing building instructions for future use.	After the showcase event: Each team checks that their LEGO Education Set (SPIKE Essential or WeDo 2.0) is not missing any elements. Disassemble the SUPERPOWERED models and place the pieces (and printed building instructions) into zip lock bags for future use. Prototyping pieces can be resealed into storage containers.

Lesson overview



Lesson 6: Power On

Learning Outcomes:

Learners will be enabled to

1. Build and code the LEGO robot (Cooling Fan/Merry-Go-Round).
2. Develop greater understanding of the code through adapting and testing.

Learners will build:

- LEGO SPIKE Essential
  - Lesson 1 - Merry-Go-Round
  - The Spinning Ferris Wheel
- LEGO WeDo 2.0
  - Cooling Fan
  - Moving Satellite

Purpose:

Learners will be introduced to the LEGO Education Set (SPIKE Essential or WeDo 2.0).

Learners will be introduced to a simple block-based coding language.

Learners will build and code a motorised LEGO robot.

Core Values:

Teamwork Innovation Fun Discovery

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- LEGO Education Set (SPIKE Essential or WeDo 2.0)
- SUPERPOWERED Mat
- Digital device (for adding to digital portfolio)

Digital resources:

- Discussion Images for Lesson 6

Per learner:

- Engineering Notebook p. 16

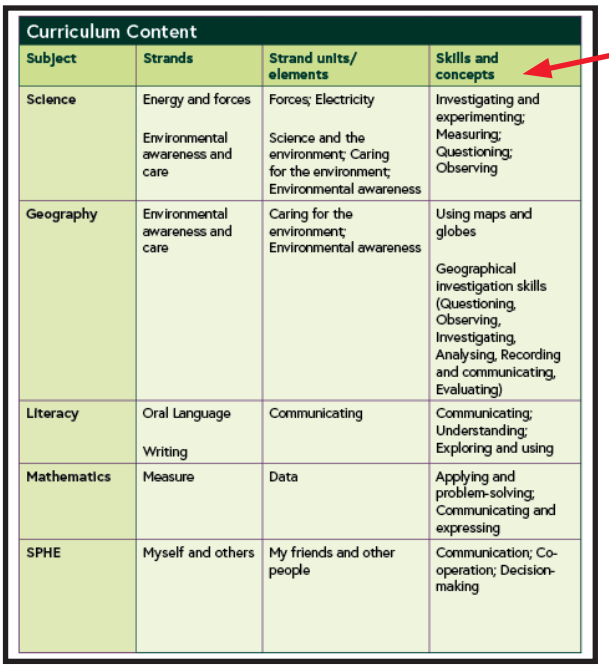
Each lesson follows the same format.

Learning Outcomes: Learning outcomes for each lesson are provided. These are indicative learning outcomes and should be adapted to meet the needs of your learners.

Core Value: Each lesson will focus on a specific Core Value.

Purpose: The purpose of each lesson is provided.

Resources: This includes Team Resources, Digital Resources and any Printable Resources. All digital resources can be accessed via the link provided



Curriculum Content

Subject	Strands	Strand units/ elements	Skills and concepts
Science	Energy and forces Environmental awareness and care	Forces; Electricity Science and the environment; Caring for the environment; Environmental awareness	Investigating and experimenting; Measuring; Questioning; Observing
Geography	Environmental awareness and care	Caring for the environment; Environmental awareness	Using maps and globes Geographical investigation skills (Questioning, Observing, Investigating, Analysing, Recording and communicating, Evaluating)
Literacy	Oral Language Writing	Communicating	Communicating; Understanding; Exploring and using
Mathematics	Measure	Data	Applying and problem-solving; Communicating and expressing
SPHE	Myself and others	My friends and other people	Communication; Co-operation; Decision-making

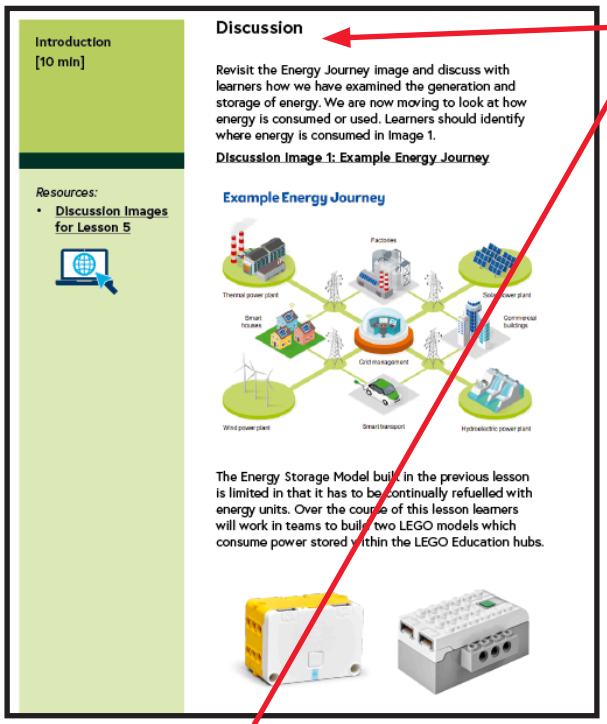
Curriculum Connections: This includes reference to (i) Strands, (ii) Strand Units/ elements and (iii) skills and concepts.

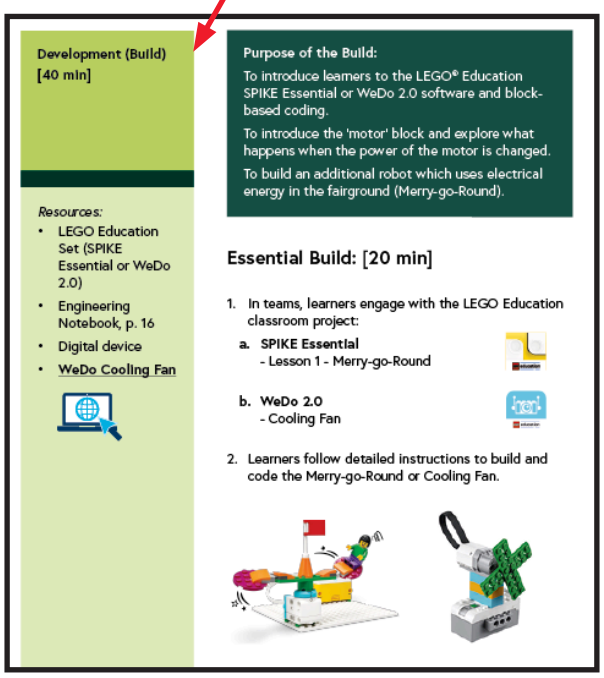
Icon to indicate visiting a website

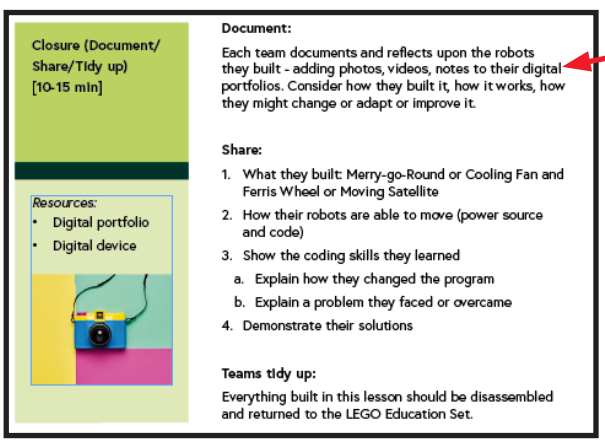
Icon to indicate watching a video

Resource icons:

Resources that require visiting a website or watching a video will have icons under them in the resource section to indicate that a link must be clicked on to access the resource.







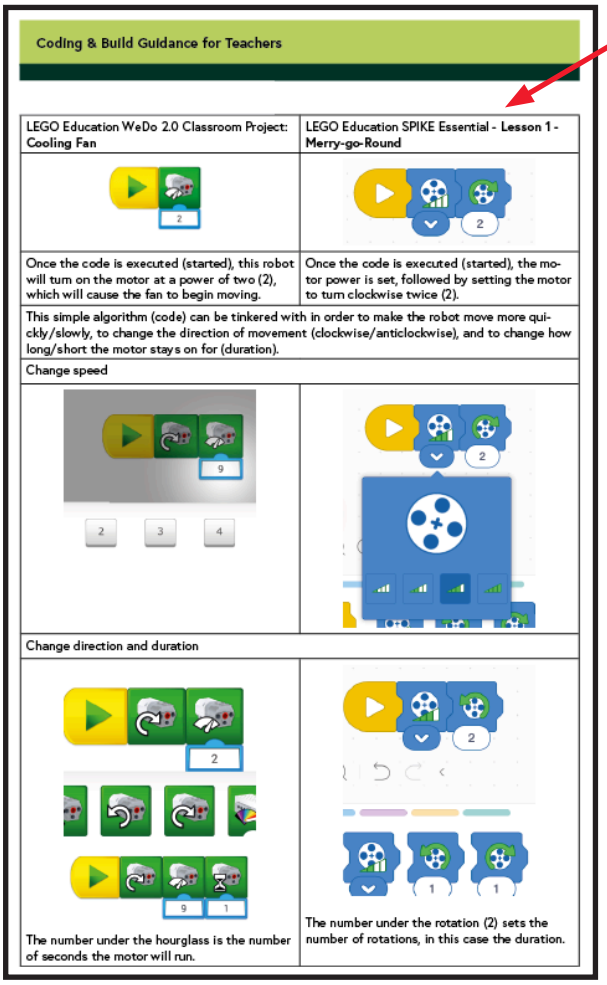
Key Activities:

Learning activities, resources, key discussion points and suggested time frame for each key activity provided. Digital resources are also linked throughout this section and will also be available online at:
fll.learnit.ie/superpowered

(The QR code for this link is also displayed at the start of each lesson.)

Closure:

This is an important feature of every lesson as it allows learners time to reflect upon their new learnings and understandings. The portfolio or learning diary being kept will be invaluable when learners begin to design their Team Models. Further details and teacher guidance is provided in the next section.

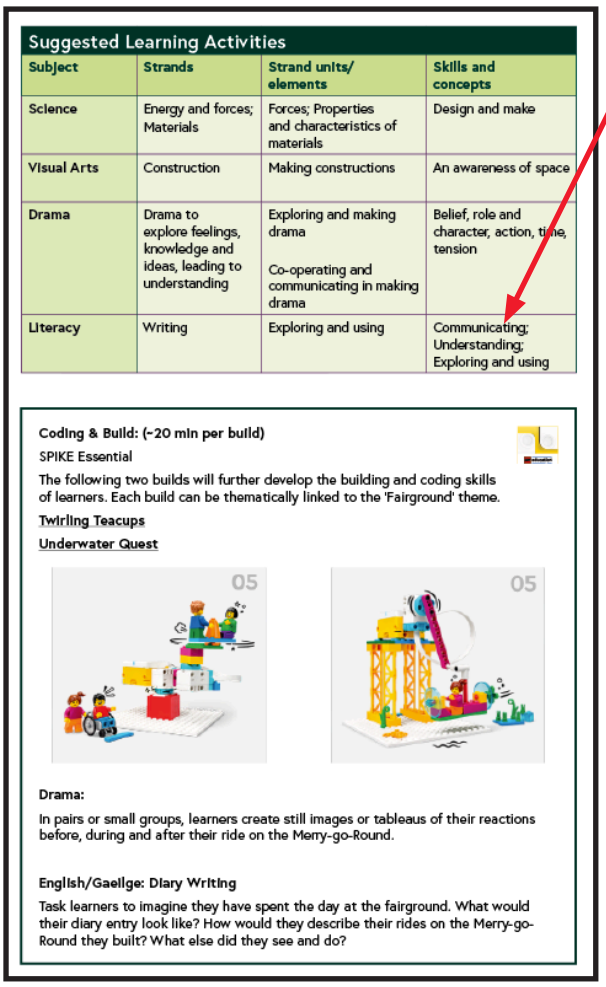


Coding & Build Guidance for Teachers

LEGO Education WeDo 2.0 Classroom Project: Cooling Fan	LEGO Education SPIKE Essential - Lesson 1 - Merry-go-Round
Once the code is executed (started), this robot will turn on the motor at a power of two (2), which will cause the fan to begin moving.	Once the code is executed (started), the motor power is set, followed by setting the motor to turn clockwise twice (2).
This simple algorithm (code) can be tinkered with in order to make the robot move more quickly/slowly, to change the direction of movement (clockwise/anticlockwise), and to change how long/short the motor stays on for (duration).	
Change speed	
Change direction and duration	
The number under the hourglass is the number of seconds the motor will run.	The number under the rotation (2) sets the number of rotations, in this case the duration.

Coding and build:

Details of the build and code are provided. Teacher Guiding Questions and Important Points to Note will support the learners' development of computational thinking and coding skills.



Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
Science	Energy and forces; Materials	Forces; Properties and characteristics of materials	Design and make
Visual Arts	Construction	Making constructions	An awareness of space
Drama	Drama to explore feelings, knowledge and ideas, leading to understanding	Exploring and making drama Co-operating and communicating in making drama	Belief, role and character, action, time, tension
Literacy	Writing	Exploring and using	Communicating; Understanding; Exploring and using

Coding & Build: (~20 min per build)

SPIKE Essential

The following two builds will further develop the building and coding skills of learners. Each build can be thematically linked to the 'Fairground' theme.

Twirling Teacups

Underwater Quest

Drama:

In pairs or small groups, learners create still images or tableaus of their reactions before, during and after their ride on the Merry-go-Round.

English/Gaeilge: Diary Writing

Task learners to imagine they have spent the day at the fairground. What would their diary entry look like? How would they describe their rides on the Merry-go-Round they built? What else did they see and do?

Suggested Learning Activities:

These highlight connections to the Curriculum which develop the learners' skills and knowledge in a specific subject area within the context of *FIRST* LEGO League Explore SUPERPOWERED. These are optional but recommended lesson ideas.

Lesson Closures: Document, Share, Reflect

Every lesson ends with an opportunity for learners to document, share, and tidy up. This is a pivotal part of the Engineering Design Process as it enables learners to reflect and think about what they have learned through the lesson, in order to build upon this in future lessons.

These lesson closures have been designed to build toward lessons 13 and 14. By engaging fully with the lesson closures learners will have completed a lot of reflection in advance of the final lessons, which will make these more effective.

Below is a general overview of what is intended in these lesson closures. Lesson-specific details are provided in the lesson guides.

Document

It is recommended that learners use digital devices (e.g. tablet/camera) and/or portfolio tools (e.g. Google Sites/SeeSaw, etc) to document the Engineering Design Process while exploring the lessons in *FIRST* LEGO League Explore.

The process of documenting their progress and ideas can support the learners in learning to be learners, and aids in retention of skills and knowledge.

The use of digital devices and digital portfolio tools is also linked to the Digital Learning Framework and the Key Competency of Being a Digital Learner in the Draft Primary Curriculum Framework.

Share

Teams are invited to share what they did during the lesson, including demonstrating their model and explaining how their code works. The focus of these sharing activities is to enable learners to explain their thinking and use the correct vocabulary in their explanations. In the initial lessons the teacher may need to model the types of questions that could be asked. As the class progresses through the lessons, learners from other teams could be called upon to pose questions.

The sharing could be organised in many ways, two recommendations include:

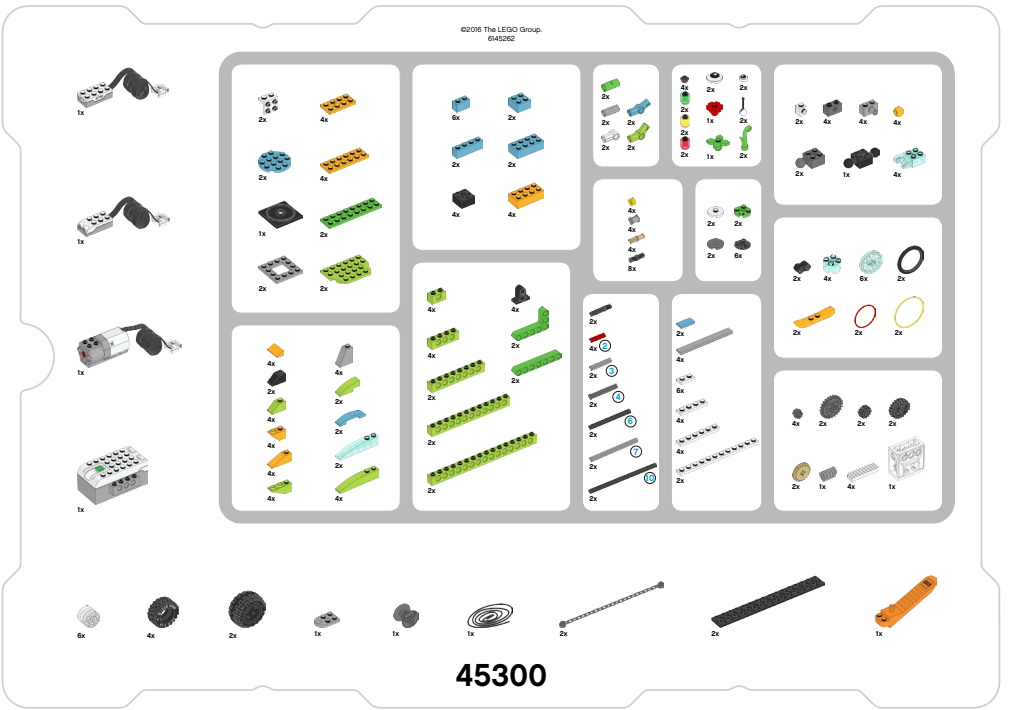
- The team who are sharing bring their LEGO model and digital device to the front of the class - option to connect to the digital display/ interactive whiteboard.
- The presenting team stays at their work area and all other learners physically move to this work station for the duration of the sharing.

Tidy up

It is recommended that each team be assigned a specific LEGO Education Set (SPIKE Essential or WeDo 2.0) for the duration of *FIRST* LEGO League Explore.

It is important to build up an expectation of learners that each team deconstructs and replaces all parts into the correct section of their LEGO Education Set at the end of each lesson, unless directed otherwise. This will facilitate the following lessons to run smoothly, and avoid the loss of required pieces.

As illustrated in the picture, the LEGO Education Set (SPIKE Essential or WeDo 2.0) has specific sections for different categories of pieces, with these pictured on the stickers and on the cover insert.



WeDo 2.0 Element Overview

SPIKE Essential Element Overview

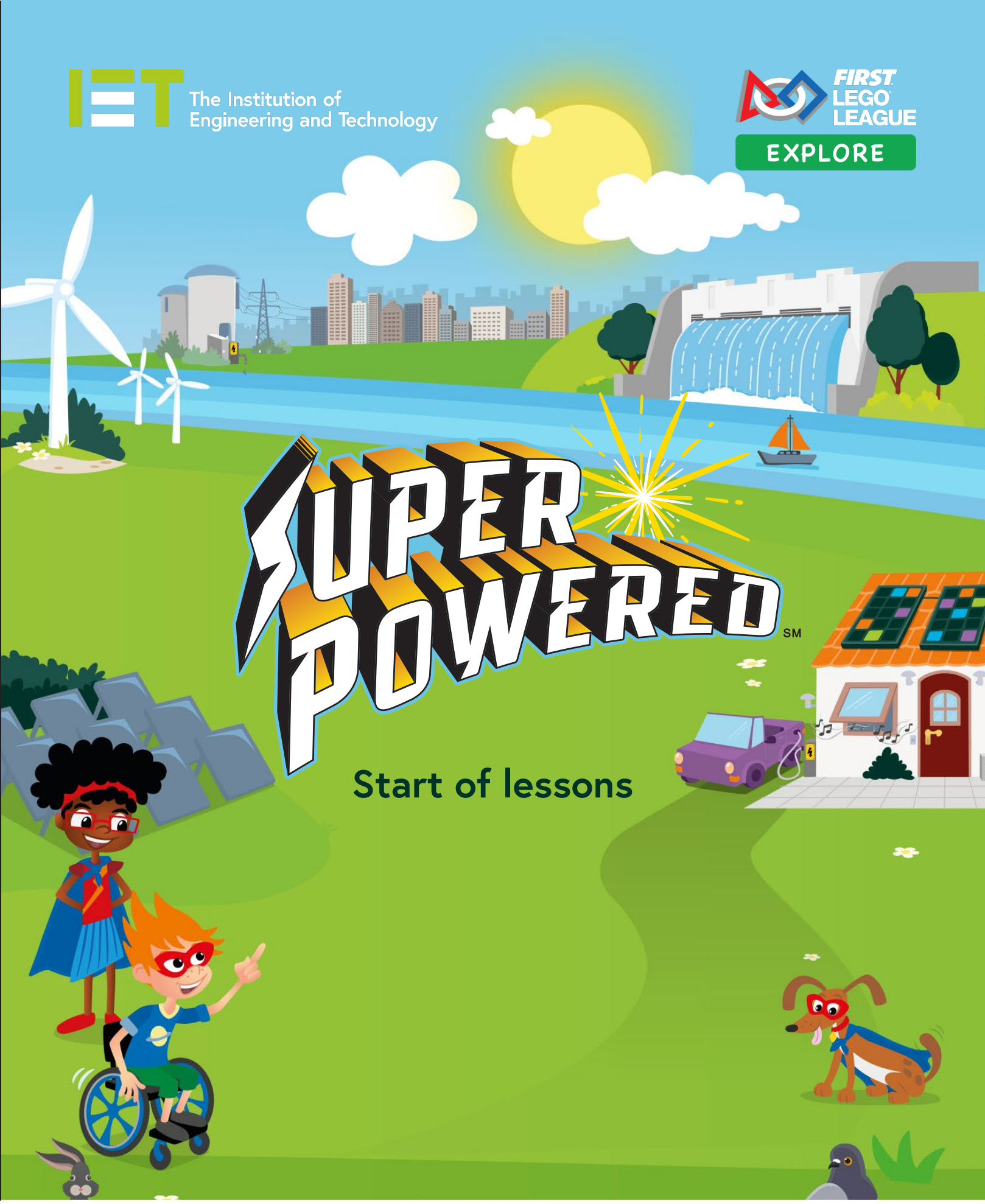
Don't forget to share your progress with us where possible through:

Twitter: *@FLLUK, @Learnit_Ireland, @scienceirel, @DCU*

Instagram: *@TheIET, @learnit_eire, @scienceireland, @dublincityuniversity*

The Institution of Engineering and Technology

FIRST LEGO LEAGUE EXPLORE



SUPER POWERED SM

Start of lessons

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SUPER POWERED

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DCU

Science Foundation Ireland sfi For what's next

Lesson overview

Lesson 1: Energy Journeys (Context)

Learners will consider energy in their everyday lives including what energy is, where it comes from and how it travels.

Time: 1 hour | Page: 42

Lesson 2: Renewable and Nonrenewable Energy Sources

Learners will identify and explore the advantages and disadvantages of renewable and nonrenewable sources of energy.

Time: 1 hour **| Page: 52**

Lesson 3: Investigating Wind and Wind Energy

Learners will examine wind as a source of energy. They will develop an understanding of how wind is formed and consider the factors that impact the location of a wind farm.

Time: 1 hour **| Page: 62**

Lesson 4: Examining How Wind Turbines Work

Learners will examine how wind turbines function. Learners will build the LEGO wind turbine and explore how it works.

Build: Wind Turbine

Time: 1 hour **| Page: 74**

Lesson 5: Energy Storage

Learners will explore how energy is stored and distributed.

Build: Energy storage model and Carousel

Time: 1 hour **| Page: 86**

Lesson 6: Power On

Learners will be introduced to the LEGO Education Set (SPIKE Essential or WeDo 2.0). Learners will be introduced to a simple block-based coding language. Learners will build and code a motorised LEGO robot.

Build: Cooling Fan/Merry-go-Round

Time: 1 hour **| Page: 98**

Lesson 7: Motorise Model (Safety and Sensors)

Learners will be introduced to sensors and their associated coding blocks. Learners will build and code a LEGO robot which uses/responds to a sensor. Learners will begin to consider how sensors could enhance the safety of their LEGO builds.

Build: Animal Alarm/Spy Robot

Time: 1 hour **| Page: 108**

Lesson 8: Electric Car (Energy Consumption)

Learners will build and code a motorised LEGO vehicle and then adapt it into an 'Electric Car' in order to explore an example of energy consumption.

Build: Milo the Science Rover/Snowmobile

Time: 1 hour **| Page: 118**

Lesson 9-10: Team Model

In teams, learners will create a team model that shows 'Better ways to source, store, and use energy'. Their team model can address a specific part of the energy journey, or all of it.

Build: Team Model

Time: 2 hours each **| Page: 132**

Lesson 11-12: Team Poster

In teams, learners will plan, design and create their Team Poster to support their Team Model.

Time: 1 hour **| Page: 144**

Lesson 13: Let's Share

In teams, learners will plan for how they will share their Team Model and Team Poster at the final event.

Time: 1 hour **| Page: 150**

Lesson 14: Let's Reflect

Learners will reflect upon the SUPERPOWERED lessons, their Team Model and Poster, and their understanding of energy journeys.

Time: 1 hour **| Page: 156**

fll.learnit.ie/superpowered

Lesson 1: Energy Journeys (Context)

Learning Outcomes:

Learners will be enabled to

1. Understand what energy is.
2. Identify different sources of energy.
3. Consider their use of energy in the classroom.
4. Understand and recall the journey of electricity from source to home using key vocabulary (source, distribution and consumption of energy).

Purpose:

Learners will consider energy in their everyday lives including what energy is, where it comes from and how it travels.

Core Values:

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- SUPERPOWERED Mat
- A3 paper and markers for concept map
- Digital device (for adding to digital portfolio)

Additional useful links:

- Video: How is energy made and delivered to your home
- Video: Solar energy for kids: Learn how electricity works
- Video: The path of electricity

Digital resources:

- Images for Discussion Lesson 1
- Picture and caption matching activity - Journey of Electricity
- Energy Audit for Classroom/School
- Google Earth Project: Journey of Electricity to Oldcastle Co Meath
- Google Earth Project: Journey of Electricity from Aghada Gas Power Station to Cobh Co Cork
- Energy Journey: Video: How is energy generated and how does it get to our homes

Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Geography	Environmental awareness and care Human environments	Caring for the environment; Environmental awareness People at work; Transport and communications	Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)
Science	Energy and forces Environmental awareness and care	Forces; Electricity Science and the environment; Caring for the environment; Environmental awareness	Investigating and experimenting; Measuring; Questioning; Observing
Literacy	Oral Language Writing	Communicating	Communicating; Understanding; Exploring and using

Introduction to SUPERPOWERED Explore program (Teacher Explanation)

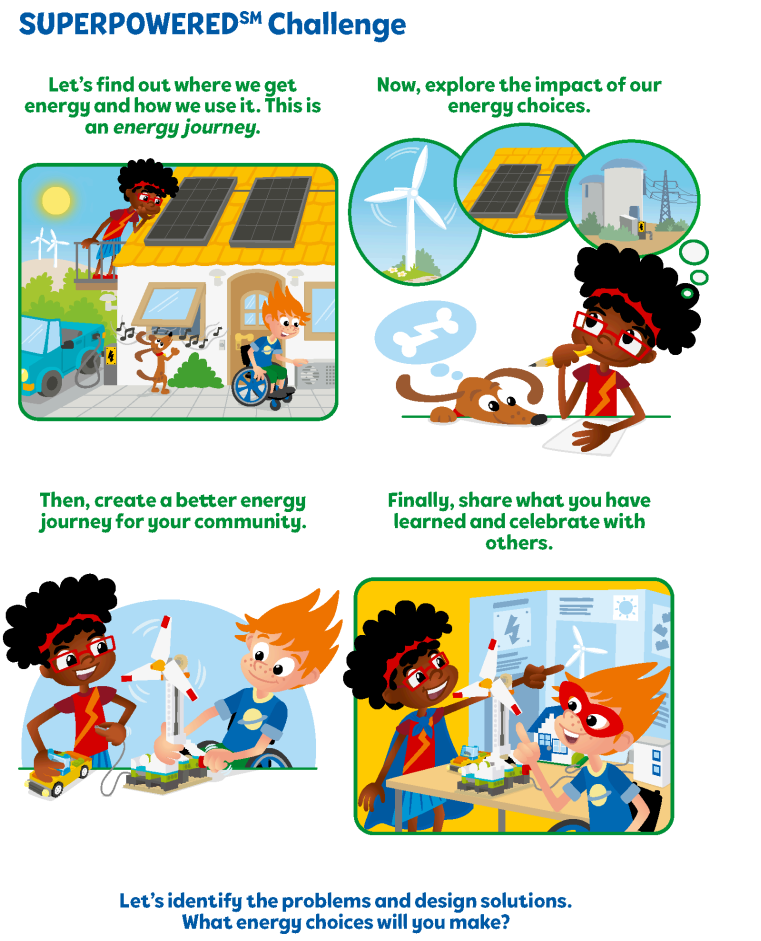
Teachers should share the purpose of the SUPERPOWERED Explore program with the learners:

The purpose of this program is that the learners will engage in 14 lessons where they will learn how energy is sourced and distributed to homes, schools and businesses. They will identify issues and opportunities for improvement of this process and design solutions to create a better energy journey for their community with regard to energy sources, energy distribution and energy usage. Through building and coding with LEGO Education Sets, learners will demonstrate their ideas, knowledge and understanding. The image on next page will support this discussion.

Image 1 for Discussion: SUPERPOWERED Challenge

Introduction
[10 min]

Energy in our Everyday Lives



Teacher introduces energy to learners through a whole class discussion.

Do you play sports? Do you enjoy watching TV and playing video games? Do you play an instrument? There is one thing that you need to do all of these things: energy.

Definition:
Energy is the ability to do work. Work does not mean school work or homework, it is everything. It takes energy to cook food, drive to school and to jump in the air.

Thinking about today, learners make a list of all the different ways they have used energy so far.

Development
[45 min]

Resources:

- Energy Audit for School/Classroom
- Image 2 for Discussion: SUPERPOWERED Mat
- 
- Journey of Energy Video: **How is power generated and how does it get to our home**

Sources of Energy in our Everyday Lives

Travelling to School [10 mins]

Key questions to promote discussion:

- How did you get to school today?
- If you travelled by foot/bicycle/scooter, where did the energy come from?
- If you travelled by car/bus/train? If by car, what type of car was it? What energy source did it use?
- What is the most environmentally friendly way to get to school? Why do you think this?

Energy Use in the Classroom [15 minutes]

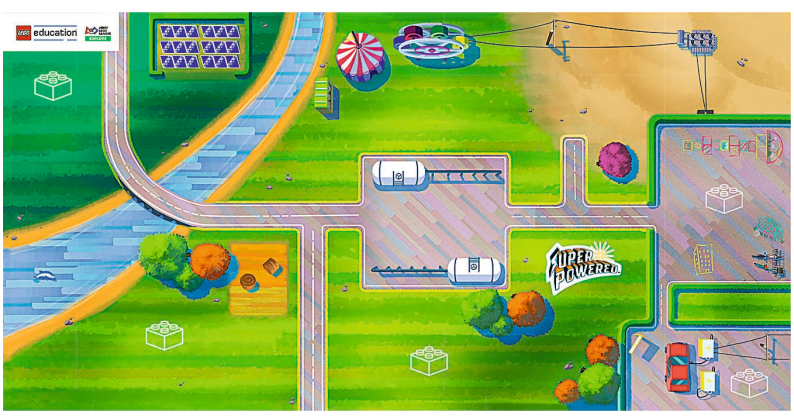
Key questions to promote discussion:

- Make a list of things in the classroom that use energy
- How do you know these use energy?
- Where does the energy come from?

Conduct an energy audit to identify ways that we use energy in the classroom. Learners then consider ways they can reduce their energy usage in the classroom. The energy audit for the classroom/school can be found here: **Energy Audit for School/Classroom**

Journey of Energy (source, distribution and consumption) [20 minutes]

Learners explore the journey of energy from source to place of consumption such as a school/home using this video. The Example Energy Journey (taken from the Engineering Notebook p.6) and/or the SUPERPOWERED Mat below can be used for learners to identify sources, distribution and consumption of energy.

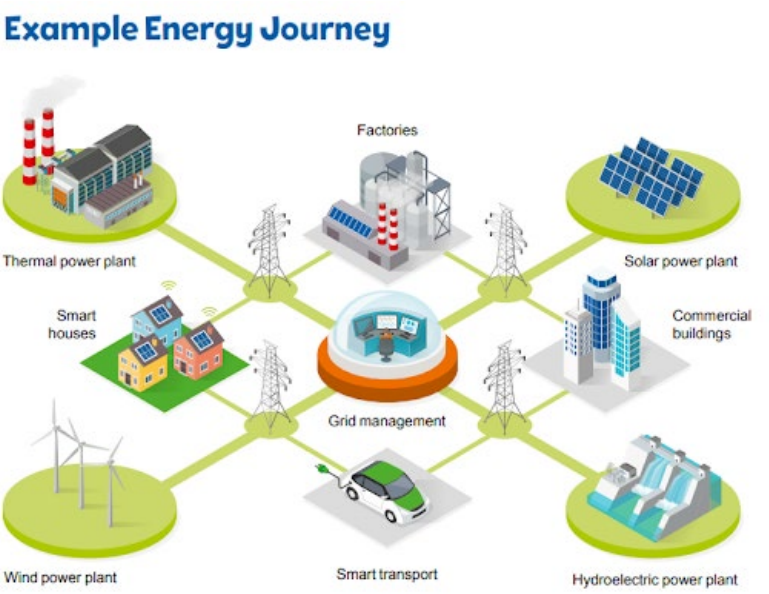


Development
[Continued]

Resources:

- **Image for Discussion: Example Energy Journey**
- **Journey of Energy Matching Cards**
- Google Earth Project Link: **Oldcastle Energy Journey** [Rural example]
- Google Earth Project Link: **Cobh Energy Journey** [Urban example]

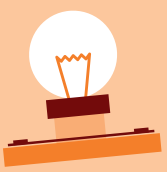
Image 3 for Discussion: Example Energy Journey



Learners can explore a more detailed and real-world energy journey by observing and engaging with the journey of electricity from Ardnacrusha Hydroelectric Power Station to Oldcastle, Co. Meath (using this Google Earth Project Link: **Oldcastle Energy Journey**) or from the Aghada Gas Power Station to Cobh, Co. Cork (using this link: Google Earth Project Link: **Cobh Energy Journey**), identifying the source, distribution methods and consumption of energy.

Learners should also examine the journey of electricity by matching the captions to the images for the detailed energy journey that is applicable nationwide (**Journey of Energy Matching Cards**). Here they should discuss the source, distribution and consumption of energy.

Closure
[5 min]



Whole class discussion on what energy is. In pairs/ small groups, learners choose one way they have used electrical energy that day and discuss the journey of the electrical energy with reference to the correct terminology/vocabulary of source, distribution and consumption.

Suggested Learning Activities			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Mathematics	Measure	Data	Applying and problem-solving; Communicating and expressing
Drama	Drama to explore feelings, knowledge and ideas leading to understanding	Exploring and making drama; Reflecting on drama; Co-operating and communicating when making drama	Prerequisites for making drama: content, the fictional lens, creating a safe environment
SPHE	Oral Language Writing	Safety and protection	Communication; Co-operation; Decision making

Mathematics: Data

This learning activity should be completed alongside the Energy Audit for school/ classroom. Learners draw a graph(s) to illustrate the use of energy in their home/ school. Learners could then take action to reduce energy usage and record the energy saved. Graphs could also be used to illustrate this and communicate findings to the school community.

Drama: Drama to explore feelings, knowledge and ideas leading to understanding

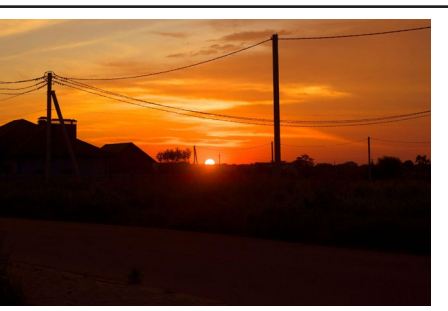
Divide the learners into groups. Allow the groups to illustrate the journey of energy through movement. For example one learner could take on the role of energy moving through the circuit; other learners could generate the energy; other learners consume the energy. Each group should present their journey to energy to the class.

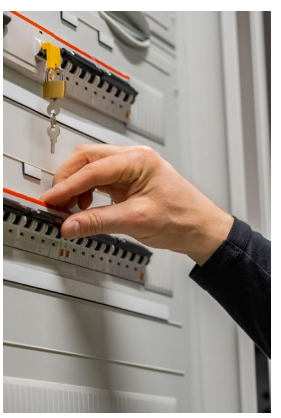
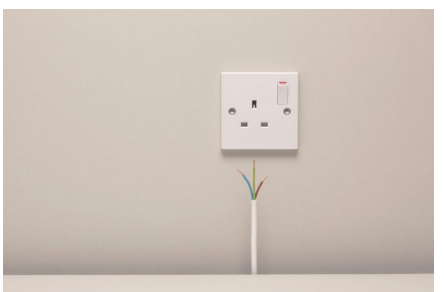
SPHE: Myself: Safety and protection

Learners could explore signs of the journey of electricity in their immediate locality through a walking trail. Here they should observe features on their walk such as overhead power lines, substations and minipillars. Particular attention should be paid to the warning signs on these features (yellow stickers). The ESB Staying Safe link could be used to emphasise this in the classroom.

ESB Staying Safe (Safety Hazards for the Community)

Lesson 1: Journey of Energy Printable Cards

Electricity is formed at a generating station by huge generators. These stations use different sources of energy [e.g. wind, hydro, coal, solar, oil, gas].	
The electrical current is sent through transformers to increase the voltage to push the power long distances.	
The electrical charge goes through high-voltage transmission lines carried by pylons that stretch across the country.	
It reaches a substation where the voltage is lowered so it can be sent on smaller power lines.	
It travels through distribution lines (electricity poles and overhead lines or can travel through lines underground) to your city/town/village.	

Smaller transformers reduce the voltage again to make the power safe to use in our homes and other buildings. These smaller transformers may be mounted on the poles, or sitting on the ground.	
If the electricity is travelling underground you might see grey or green units with warning stickers. These are substations to reduce the voltage and make the power safe to use in our homes and other buildings.	
Electricity goes into your home through a meter that measures how much electricity your family uses.	
The electricity goes to the service panel in your home, where fuses protect the wires inside your house from being overloaded. (Never touch a service panel! It is only to be operated by your parents or a professional.)	
Electricity travels through wires inside the walls and through outlets and switches all over your house.	

Classroom/School Energy Audit

Learners should answer the following questions in relation to your classroom/school. Additional questions can be added if needed. There is a meter reading activity at the end also.

Does the classroom/school make the most of natural daylight? (e.g. open blinds fully)	
Do we turn off lights when they are not needed? (e.g. on a sunny day or when we go outside).	
Are the lights/bulbs clean? (dust and dirt can dim the brightness of the lights leading us to put more lights on)	
Are electrical appliances turned off when not in use?	
Is the standby button turned off on electrical appliances?	
Are there radiators left on unnecessarily? (e.g. when we are not there or when there are windows open?)	
Is the temperature right in the classroom/school? Not too hot? Not too cold?	
Does the school have temperature sensors and thermostats? Where are they? What temperature are they set to?	
Are the windows and doors draught proofed? Do they have double or triple glazing?	
Is the heat timer turned off when the school is closed over the holidays/weekends?	
Are the water pipes and the water tank insulated?	
Are there any leaking taps?	
Do the toilets have percussion taps (push/pop taps)?	
Do the toilets have a dual flush system so you only use the right amount of water when flushing the toilet?	

Meter Reading Activity

Keep a weekly record of your electricity and gas meter readings in the school. It is important to keep this meter reading fair and consistent:

- Make sure to take the reading at the same time and day every week (why do you think this is important?)
- Keep all your readings in a safe place
- Make a note of any events that may have increased your usage (why would this be important to note?)

Electricity Meter		**Gas Meter**		**Notes**
Date	Meter Reading	Date	Meter Reading	

Lesson 2: Renewable and Nonrenewable Energy Sources

Learning Outcomes:

Learners will be enabled to

1. Understand and differentiate between renewable and nonrenewable sources of energy
2. Consider the advantages and disadvantages of renewable and nonrenewable sources of energy

Purpose:

Learners will identify and explore the advantages and disadvantages of renewable and nonrenewable sources of energy through research and discussion.

Core Values:

Teamwork | Inclusion | Discovery

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

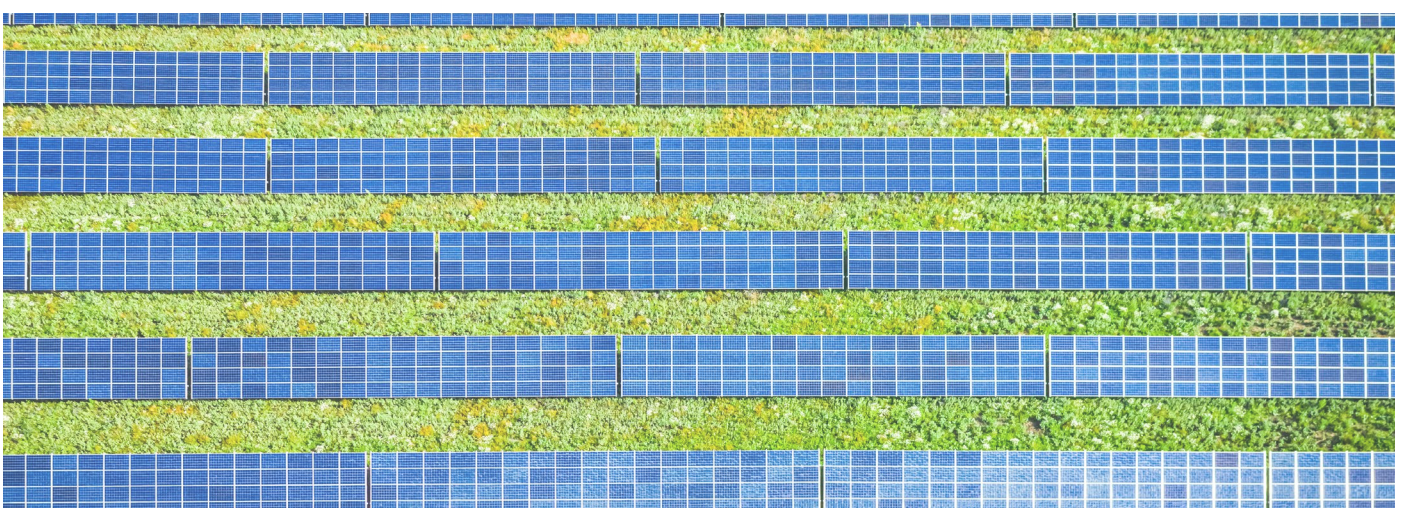
Resources

Per team:

- Webquest document with links for learners
- Digital device (for adding to digital portfolio)

Digital resources:

- Images for Discussion Lesson 2



Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Science	Energy and forces Environmental awareness and care	Forces; Electricity Science and the environment; Caring for the environment; Environmental awareness	Investigating and experimenting; Measuring; Questioning; Observing
Geography	Environmental awareness and care	Caring for the environment; Environmental awareness	Using maps and globes Geographical investigation skills (Questioning, Observing, Investigating, Analysing, Recording and communicating, Evaluating)
Literacy	Oral Language Writing	Communicating	Communicating; Understanding; Exploring and using
Mathematics	Measure	Data	Applying and problem-solving; Communicating and expressing
SPHE	Myself and others	My friends and other people	Communication; Co-operation; Decision-making

Introduction
[10 min]

Resources:

- Image 1 for Discussion: SEAI Energy Usage in Ireland Report
- Image 2 for Discussion: Renewable Energy Target for 2023

Energy in Ireland

Teachers should introduce the learners to Ireland's climate ambition of having 80% of our energy coming from renewable sources by 2030. Display graph below to the learners.

Image 1 for Discussion: SEAI Energy Usage in Ireland

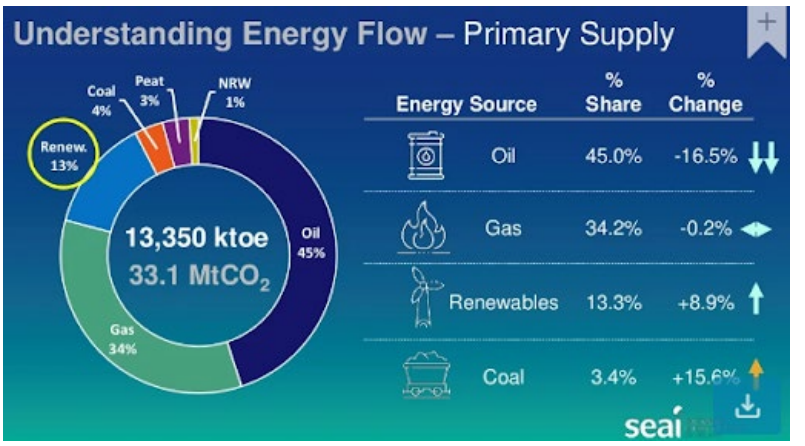


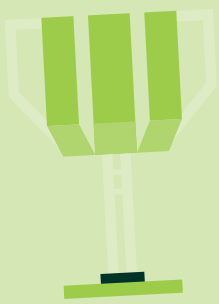
Image 2 for Discussion: Renewable Energy Target for 2023

Here learners should discuss and interpret both images.

Key questions:

- What types of energy are considered renewable?
- Can you identify any trends in the data (image 1)?
- Do you think the target of 80% is a realistic one? Why/why not?

Introduction [Continued]



Key terms should also be discussed here, where necessary:

Fossil Fuels: Fossil fuels are made from decomposing plants and animals. These fuels are found in the Earth's crust and contain carbon and hydrogen, which can be burned for energy. Coal, oil, and natural gas are examples of fossil fuels.

Nonrenewable Energy Source: A nonrenewable energy source is a natural resource that cannot be replaced after it is used. This means that it exists in a fixed amount on Earth. Rock, minerals, metals, uranium, and fossil fuels such as petroleum, coal, and natural gas are all nonrenewable resources.

Renewable Energy Source: A renewable source is an energy source that cannot be depleted and is able to supply a continuous source of clean energy. Solar energy and wind energy are examples of renewable energy sources.

Development
[45 min]

Resources:

- **Webquest document with QR codes**
- Digital device with internet access [graphic for weblink]
- Some suggested websites or apps for designing a digital product:
  Book Creator
  Adobe Express/ Adobe Spark
  Canva
  Vocaroo

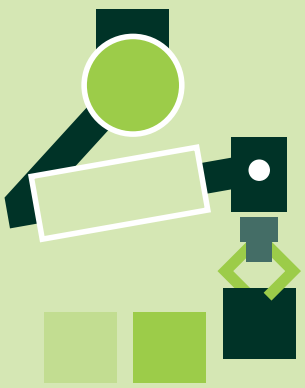
Conducting Research: Renewable and Nonrenewable Sources of Energy [30 minutes]

Divide the learners into groups of 4 or 5. Assign each group a source of energy to research [e.g. solar; wind; oil; gas; hydro; coal]. Each group must design an artefact (e.g. a physical or digital product/poster) about their source of energy. This product could include photos, voice recordings, drawings, videos, or any other media that best supports the activity. Each group becomes experts on their own area and shares this with the rest of the class (hence putting the pieces of the jigsaw together). Sources of information for each energy source can be found **here**. Website articles can be viewed on digital devices (tablets/laptops). Teacher as a facilitator circulates the class and aids groups and learners as appropriate using the key questions below.

Key questions:

1. Is your energy source renewable or nonrenewable?
2. Is your energy source environmentally friendly?
3. How does this energy source provide energy?
4. Do you know any examples of this in Ireland? Is this source of energy available near you? Google Earth can be used here to investigate this question.
5. What are the advantages/disadvantages?

Development [Continued]



Webquest document with QR codes	
Solar	**What is Solar Energy?** (Video) **Solar Energy Information** (Text) **Information for children - solar energy** (Text)
Wind	**Wind Energy Ireland** (Text and Video) **Let the Wind Blow** (Book) **Visit a Wind Farm** (Video)
Hydro	Video: **How does hydropower work?** Website: **Hydro Power Fact File and 4minPodcast for Kids** Website: **Kids Britannica: hydro power**
Oil	Video: **What are fossil fuels?** Website: **Crude Oil Fact File** Website: **Kids Britannica: oil/petroleum** Website: **Oil Facts**
Gas	Video: **What are fossil fuels?** Website: **Kids Britannica: natural gas** Website: **Natural Gas Fact File** Website: **How gas is made**
Coal	Video: **What are fossil fuels?** Video: **Where do we get coal from?** Website: **Coal Fact File** Website: **Coal Facts**

Sharing Information [15 minutes]

Provide each group time [approx 3/4 minutes] to share their findings and present posters to the class.

Closure
[5 min]

Whole class discussion on what the class has learned and understood about different sources of energy focusing on the correct terminology/vocabulary (e.g. renewable/nonrenewable, fossil fuels, source, etc.). The learners could have a vote and brief discussion about which form of energy they think would be best for providing electricity in their local area and why (considering natural features and local landscape).

Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
Geography	Human environments	People at work; Transport and communications	Geographical investigation skills (Questioning, Investigating, Analysing, Recording and communicating, Evaluating)
Mathematics	Measure	Data	Applying and problem-solving; Communicating and expressing
History	Era of change and conflict Continuity and change over time	The Industrial Revolution Energy and power	Change and continuity Cause and effect

Geography: People at Work

Learners could interview a person in the community who works in the area of energy provision (e.g. fuel tanker driver, ESB, Gas Networks Ireland, Eirgrid, a worker from a private energy company such as Bord Gáis, electrician, filling station worker, etc.). As a class, the learners could collaboratively generate interview questions pertaining to what the person does everyday, what they like/don't like about their job, how they got that job, etc. Learners could interview this person as a guest speaker in class (in person or via video link). Alternatively this could be a home research task.

Additionally, learners could explore the important jobs that workers in energy provision do such as wind turbine technicians, solar installers etc. They could observe and record key information from the below video links:

- **Day in the life of a Wind Turbine Technician**
- **Day in the life of an Offshore Wind Turbine Technician**
- **Life on an Oil Rig**
- **Day in the life of a Solar Panel Installer**
- **Day in the life of a Hydroelectric Power Station Operator**

Mathematics: Interpreting Data

In groups learners review the **SEAI Energy in Ireland website**. This report contains a number of graphs to illustrate Ireland's energy usage for 2021. Learners could analyse and interpret a number of these graphs summarising key findings for the class.

History: The Industrial Revolution

The influence of coal on the Industrial Revolution could be explored in history. Links could also be made to the evolution of transport during this time such as steam trains and steamboats.

Coal Mining in Castlecomer Co Kilkenny

Image 1 for Discussion: SEAI Energy Usage in Ireland

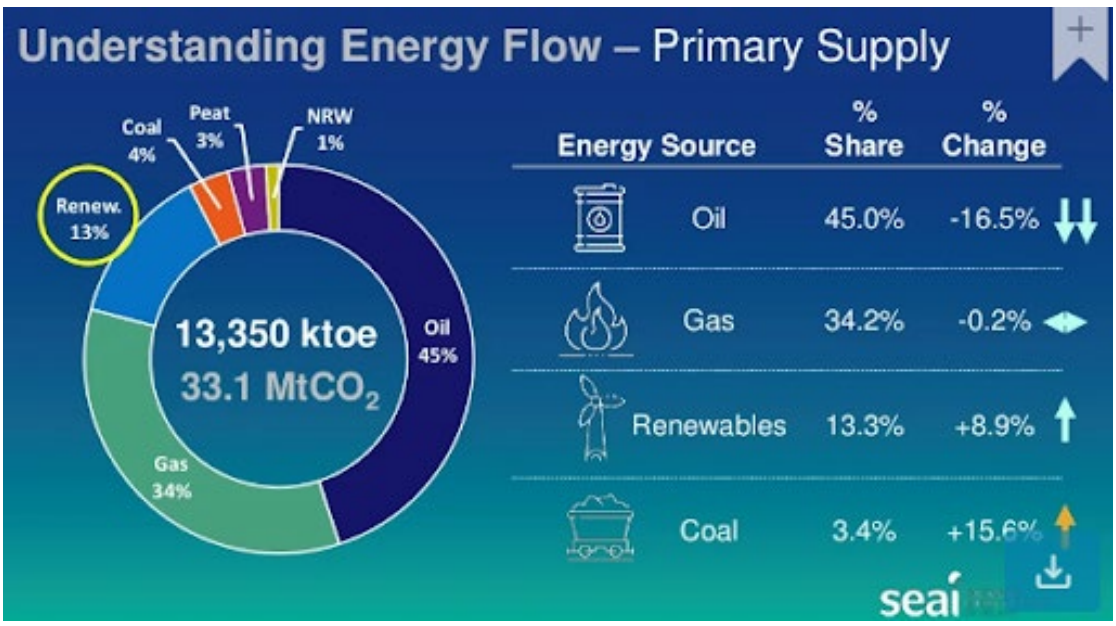


Image 2 for Discussion: Renewable Energy Target for 2023

Lesson 3: Investigating Wind and Wind Energy

Learning Outcomes:

Learners will be enabled to

1. Understand how wind is formed
2. Identify and use instruments for measuring wind speed and wind direction
3. Recognise the importance of measuring wind speed and wind direction
4. Consider the factors that impact the location of a wind farm.

Purpose:

Learners will examine wind as a source of energy. They will develop an understanding of how wind is formed and consider the factors that impact the location of a wind farm.

Core Values:

Teamwork | Inclusion | Fun | Discovery

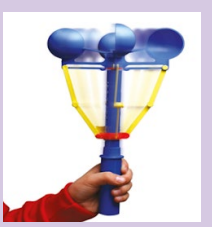
Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- Investigation sheet: **Measuring Wind around Our School: where is the best location for a wind turbine for our school**
- Anemometer
- Wind vane
- Digital device (for adding to digital portfolio)



Anemometer

Wind Vane

Digital resources:

- Discussion Images for Lesson 3
- Live wind map

Additional useful links:

- Video: how to make an anemometer
- Video: how to make a wind vane

Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Geography	Natural environments Environmental awareness and care Human environments	Weather, climate and atmosphere; Local natural environment Caring for the environment; Environmental awareness People at work; Transport and communications	Using maps and globes Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)
Science	Environmental awareness and care	Science and the environment; Caring for the environment; Environmental awareness	Investigating and experimenting; Measuring; Questioning; Observing; Predicting; Recording and communicating
Literacy	Oral Language Writing	Communicating	Communicating; Understanding; Exploring and using
SPHE	Myself and others Myself and the wider world	My friends and other people Relating to others Developing citizenship	Communication; Co-operation; Decision-making

Introduction
[10 min]

Resources:

- Discussion Image 1: How wind is formed

Introduction: What is wind?

Learners engage in a whole class discussion on wind:

- What is wind?
- Where does wind come from?
- How is wind formed?

Teacher explanation: Wind is the movement of air, caused by uneven temperatures. Air moves from a cold area to a warm area and this is wind. Warmer air is lighter and rises and the heavier cooler air rushes in to take its place. Learners should consider any places they have been that are windy (e.g. seaside/beach). Teachers should use Image 1 below to demonstrate how it is always windy along the shores of lakes and oceans because air over land heats up faster than air over water. The warmer air rises on the shore and cooler air rushes in from the sea/lake to take its place, causing wind!

Discussion Image 1: How wind is formed

Image 2 from Met Éireann shows the mean (average) annual wind speed for Ireland in metres per second (m/s). Teachers should use this map to demonstrate to the learners how the fastest wind speeds (7m/s and 6m/s are located around the coast with the slowest wind speeds (4m/s) found inland. This is linked to warmer air rising on land and cooler air coming in from the sea. Learners should also consider other factors that might influence slower wind speeds in the midlands (such as the location of mountains).

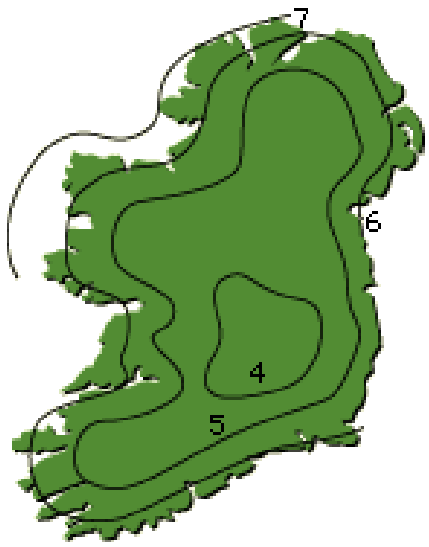
Introduction [Continued]

Resources:

- Discussion Image 2: Average wind speed in Ireland

Development [45 min]

Discussion Image 2: Average wind speed in Ireland



Mean annual wind speed
(units in m/s)

Investigating and measuring wind speed and direction on our school grounds

Please note that if the anemometer and wind vane need to be made then additional time will have to be allocated for this.

Learning how to use wind measuring instruments

Learners should use anemometers and wind vanes to measure wind speed and wind direction at different locations on the school grounds to determine the best place for a wind turbine for the school.

Teachers should introduce the children to the two wind measuring instruments they will be using today (anemometer and wind vane).

Measuring wind speed

An anemometer is the instrument used to measure wind speeds. It has 3 or 4 cups which rotate as the wind blows. The speed is determined by how many times the cups spin round in a given time.

Resources:

- Discussion Image 3: Beaufort Scale

Wind speed is measured on the Beaufort Scale. Most anemometers have the Beaufort Scale measurement on them. Image 3 shows the Beaufort Scale and how to interpret the different wind speed measurements. Learners should refer to the Beaufort Scale when interpreting their measurements from the anemometers.

Discussion Image 3: Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Measuring wind direction

Wind direction is measured using a wind vane. The narrow end (arrow) of the vane points into the wind and tells you the direction the wind is coming from. This is how wind is named (e.g. if the arrow points south, the wind is coming from the south and is then called a 'southerly wind'). Learners should use a compass to locate North and ensure the N on the wind vane is pointing in the correct direction.

Development [Continued]

Resources:

- Printable investigation sheet: **Measuring Wind around Our School: where is the best location for a wind turbine for our school**

Please note that an anemometer and wind vane can be made by each group if these resources are not available in the school (VIDEO: **how to make a wind vane** and VIDEO: **how to make an anemometer**). However, ideally the real instruments should be used where possible.

Investigating the best location for a wind turbine on the school grounds

The teacher should use this **investigation sheet**.

Learners examine a map/aerial photograph of the school grounds and surrounding area and select 3 locations where they will measure wind direction and speed for finding the best location for a wind turbine for their school. Learners discuss why they have chosen these three locations. These locations should be recorded on the map/aerial photograph. Using their anemometers and wind vanes, the learners investigate the wind speed and wind direction at each of the three locations. These investigations should be carried out in a fair and consistent manner (i.e. hold the instruments high in one position at that location for 1 minute and record the results). Learners then record their data in a table, present their results on a graph and then analyse their findings. Conclude with a whole class discussion comparing the results from each location and linking back to the map/aerial photo, drawing any insights from compass directions, surrounding buildings or trees that may influence the wind speed measurements.

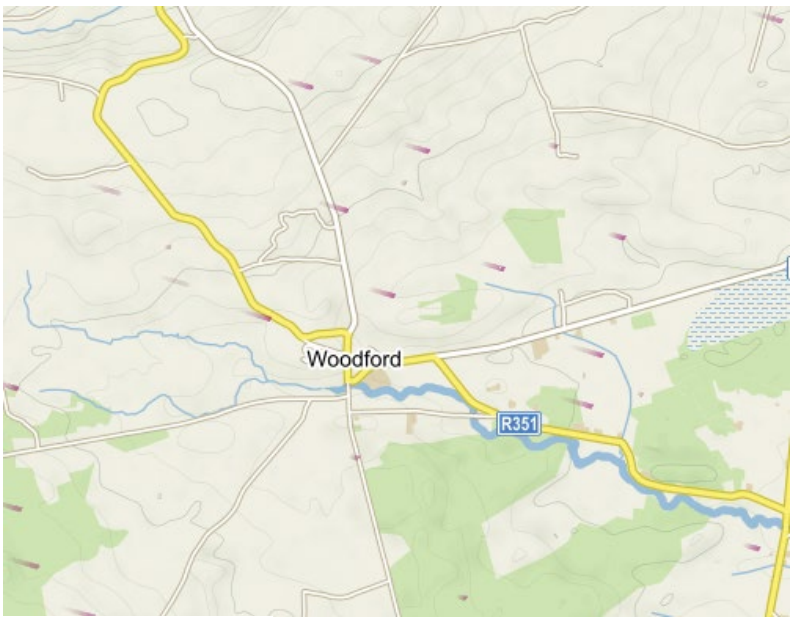
Key Questions

- Which is the windiest/calmest location? How do you know?
- What direction was the wind blowing from?
- What direction do you think the wind turbine should face in this location? Why?
- What location do you think would be the most suitable location for a wind turbine? Why?
- How do you think a wind turbine in this location might impact children/parents/teachers?

Development [Continued]

The learners' measurements could be compared with the forecast on **https://www.windy.com**. Zoom down to your locality to compare (see image below for example).

Below is a screenshot from **Windy.com** zoomed into Woodford, Co. Galway. The purple arrows show westerly winds (winds blowing from west to east). Measurements of wind speed and direction can also be read from the website.



Closure [5 min]

Learners reflect on they key information they have learned

- What is wind?
- How is it formed?
- Why is it important to measure wind speed and wind direction?
- What instruments measure wind speed and wind direction?

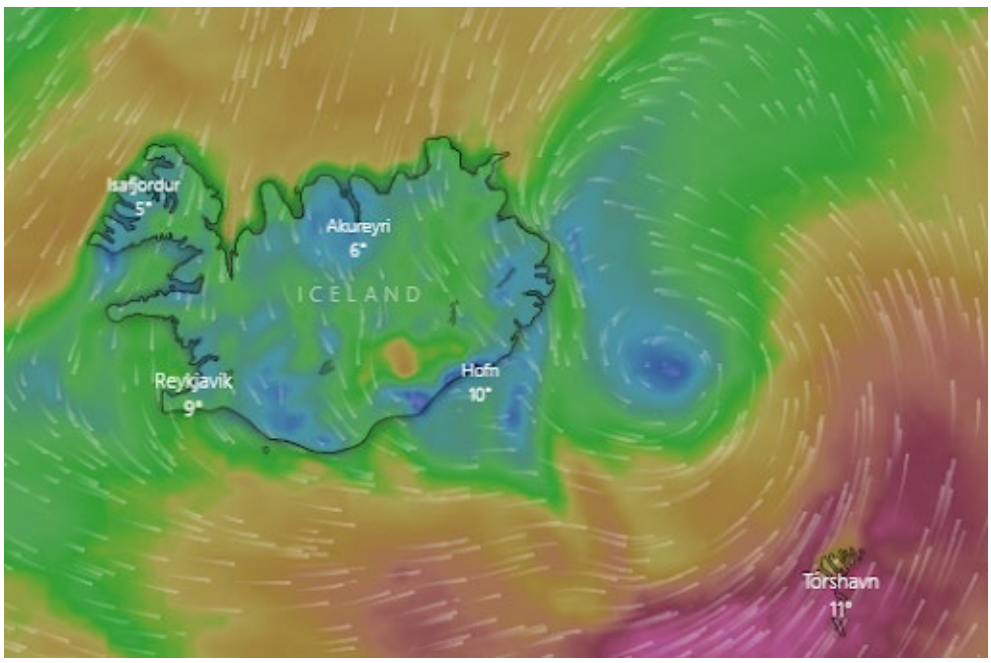
Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
Geography	Natural environments	Weather, climate and atmosphere; Local natural environment	Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)
History	Story	Stories from the lives of people in the past	Using evidence Continuity Cause and effect
Literacy	Writing	Exploring and using Understanding	Communicating; Understanding; Exploring and using

Geography: Weather, Climate and Atmosphere

Learners should explore how wind speeds are linked to atmospheric pressure by identifying places around the world that are currently experiencing high wind speeds (areas of low pressure) on **Windy.com**

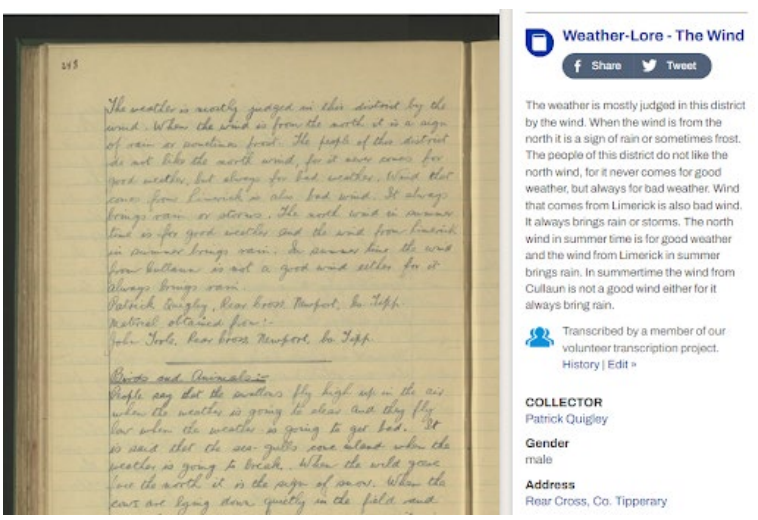
For example, this area east of Iceland is experiencing strong winds (it is an area of low pressure) meaning hot air is rising and cooler winds are blowing inwards to take its place (hence the air is circulating in an anticlockwise inward direction).



Images from Irish weather forecasts such as the screenshot from RTÉ Weather below could be used to show learners how low pressure (L) is represented and what type of weather is predicted with this. Learners should be able to identify that this L means low pressure with warm air rising and cool air coming in to take its place (i.e. strong winds).

History: Story - Stories from the lives of people in the past

Learners could examine accounts of weather lore and weather events linked to wind in their local area/county from the Irish folklore project Dúchas.ie. The below example is from Rear Cross, Co. Tipperary. The original handwriting and a typed version of each account are available.



Weather-Lore - The Wind

Share Tweet

The weather is mostly judged in this district by the wind. When the wind is from the north it is a sign of rain or sometimes frost. The people of this district do not like the north wind, for it never comes for good weather, but always for bad weather. Wind that comes from Limerick is also bad wind. It always brings rain or storms. The north wind in summer time is for good weather and the wind from Limerick in summer brings rain. In summertime the wind from Cullaun is not a good wind either for it always bring rain.

Transcribed by a member of our volunteer transcription project.
History | Edit »

COLLECTOR
Patrick Quigley

Gender
male

Address
Rear Cross, Co. Tipperary

This example reads:
"The weather is mostly judged in this district by the wind. When the wind is from the north it is a sign of rain or sometimes frost. The people of this district do not like the north wind, for it never comes for good weather, but always for bad weather. Wind that comes from Limerick is also bad wind. It always brings rain or storms."

Having read the above account, learners could be asked why winds from Limerick and the north would be considered bad? Where would these winds be coming from (origin)? Why would northern winds sometimes bring frost (i.e. coming from the Arctic)?

Learners could also explore the historical event 'The Night of the Big Wind' by searching this on the Dúchas website and also engaging in the video documentary about the greatest storm to ever hit Ireland. **Night of the Big Wind / Oíche na Gaoithe Móire**

History: Story - Stories from the lives of people in the past

Learners could explore the life of Francis Beaufort from Navan, Co. Meath who invented the Beaufort Scale and understand why and how this was created. **Link to Francis Beaufort**

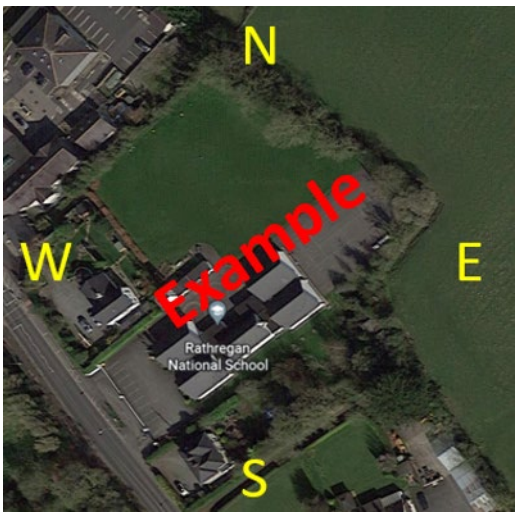
Gaeilge/English: Poetry

Learners could explore poems about the wind such as 'October Wind' by Lenore Hetrick, 'The Wind' by Christina Rosetti or 'An Ghaoth Aduaidh': **An Ghaoth Aduaidh** The video link here further explains this Irish poem for children linking wind direction to the kind of weather winds bring: **Na Gaotha**

Learners could also write their own poetry inspired by wind and/or other sources of energy.

Measuring Wind around Our School: where is the best location for a wind turbine for our school?

Teacher note: Insert map/aerial photograph screenshot of the area around your school here (e.g. taken from Google Earth or Scoilnet Maps). Mark in the cardinal points (NSEW). See example here:



1. Identify 3 locations on the map/aerial photo that would be good to locate a wind turbine for your school. Mark these on the map/photograph above.
2. Use your wind vane to measure the wind direction. Use a compass to ensure your wind vane is pointing in the right direction (i.e. N = North). Hold the wind vane up high for 1 minute at each location and record the wind direction in the table for each location.

3. Use the anemometer to measure the wind direction in each location. Hold the anemometer up high for 1 minute at each location and record the wind speed (using Beaufort Scale) in the table for each location.

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
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11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Location	Wind Direction	Wind Speed (Beaufort Scale)

Reflecting on the findings:

1. Which is the windiest/calmest location? How do you know?
2. What location do you think would be the most suitable location for a wind turbine? Why?
3. What direction do you think the wind turbine should face in this location? Why?
4. How do you think a wind turbine in this location might impact children/parents/teachers?

Lesson 4: Examining How Wind Turbines Work

Learning Outcomes:

Learners will be enabled to

1. Explain how a wind turbine works and generates energy
2. Critically evaluate the accuracy of the LEGO wind turbine model.

Learners will build:

- LEGO Wind Turbine model

Purpose:

Learners will examine how wind turbines function.

Learners will build the LEGO wind turbine and explore how it works.

Core Values:

Teamwork | Fun | Discovery

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- SUPERPOWERED Explore Set
- SUPERPOWERED Mat
- Digital device (for adding to digital portfolio)

Digital resources:

- Discussion Images for Lesson 4
- *FIRST* LEGO League Explore Engineering Workbook - Video of Wind Turbine
- Wind Turbines - How they work videos
  - Wind Turbine detailed video
  - How Wind Turbines Work TEDed
- Wind Turbine Video Tours
  - 360-Degree video tour: Wind turbine inside and out
  - Tour of Wind Turbine, narrated by Engineer

Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Geography	Natural environments Environmental awareness and care Human environments	Weather, climate and atmosphere; Local natural environment Caring for the environment; Environmental awareness People at work; Transport and communications	Using maps and globes Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)
Science	Energy and forces Environmental awareness and care	Forces Science and the environment; Caring for the environment; Environmental awareness	Investigating and experimenting; Measuring; Questioning; Observing
Literacy	Oral Language Writing	Communicating	Communicating; Understanding; Exploring and using
SPHE	Myself and others Myself and the wider world	My friends and other people Relating to others Developing citizenship	Communication; Co-operation; Decision-making

Introduction
[10 min]

Resources:

- Image 1: Wind Turbine

Introduction: Revisit Wind Energy

Learners will already have examined what wind energy is, and the advantages/disadvantages of wind energy during Lesson 2. They will also have a deep understanding of how wind is formed and how and why we measure wind (Lesson 3).

Refer to the digital product/poster created by the group who investigated wind energy (Lesson 2).

Display Image 1. Allow each pair to discuss/draw how they think a wind turbine functions. This can be used as a method of formative assessment.

Discussion Image 1: Wind Turbine

Development
[20 min]

Resources:

- How do wind turbines work?
- How does a wind turbine work?

Could your class visit a wind turbine in the local area?

How does a wind turbine function? [15 min]

Learners watch the following video of how a wind turbine functions. This first video gives a general overview.

How do wind turbines work? - Rebecca J. Barthelmie and Sara C. Pryor

If time allows, this second video provides greater detail on how a wind turbine generates electricity:

How does a wind turbine work?

Learners should make notes of anything interesting they learned while watching the videos. Having watched the videos and discussed the learning with the whole class, learners should then work in pairs to draw and explain how wind turbines work by making an annotated drawing.

Connections should be made to Lesson 3 and how the wind turbine also has anemometers and wind vanes on it so it knows where the wind is coming from and how fast it is travelling.

Development [Continued]

Resources:

- 360-Degree video tour: Wind turbine inside and out

360 degree video tour [5 min]

Learners explore a functioning wind turbine using the 360-degree tour

360-Degree video tour: Wind turbine inside and out

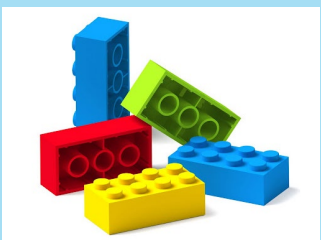
Learners (or the teacher) can click and drag within this video clip in order to change their view. As the video progresses the viewpoint moves from the base of the turbine, into the body of the turbine, on top of the turbine, and finally viewed from above.

Alternatively learners can engage with the tour of a wind turbine narrated by an engineer.

Build [10-15 min]

Resources:

- SUPERPOWERED Explore Set
- SUPERPOWERED Mat
- Engineering Notebook p. 10



Wind Turbine [10-15 minutes]

Purpose of build:
This build is intended to enable learners to extend and consolidate their understanding of wind turbines and how they generate electricity. It is important to note that as it is a model, it may be necessary to highlight to learners that a 'real' turbine is powered by wind, whereas this model has a hand crank which can be turned to imitate the movement of a 'real' wind turbine.

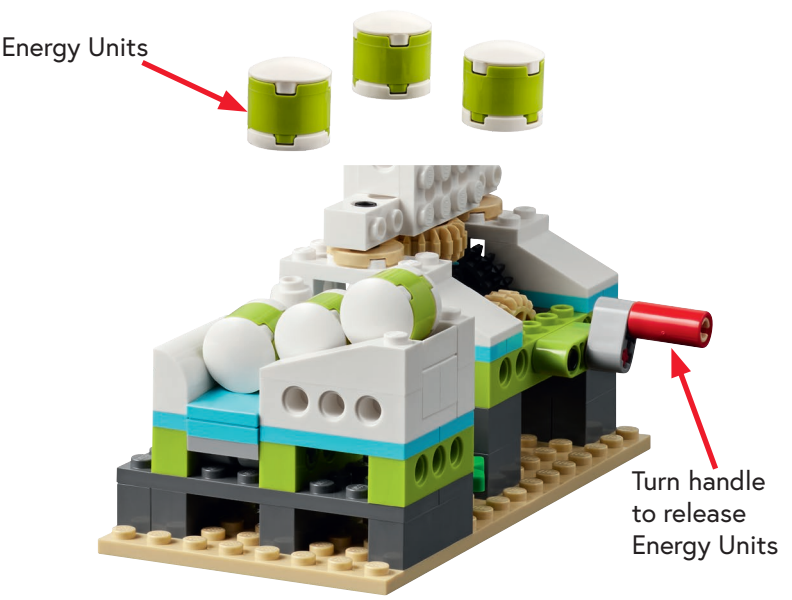
Build [Continued]

Resources:

- Image 2: LEGO Wind Turbine

Discussion Image 2: LEGO Wind Turbine

Learners follow the instructions in Book 1 in the Explore Set to build the wind turbine.



This model includes three 'energy units' which are cylinders resembling batteries. These are loaded into the model before use. As wind energy turns the wind turbine it 'generates' energy. This generated energy is represented by the 'energy units' which are released by the wind turbine.

Closure (Document/ Share/Tidy up) [10-15 mins]

Resources:

- How does a wind turbine work?

- Digital portfolio
- Digital device

Return to Section A p. 37 to read more about the process of using a digital portfolio to document the engineering design process.

Invite learners to discuss in groups how the model demonstrates the process shown in the earlier videos:

How does a wind turbine work?

1. **Document:**
   Each team documents and reflects upon the Wind Turbine model they built - adding photos, videos, notes to their digital portfolios. Consider how they built it, how it works, how they might change or adapt or improve it.

2. **Share:**
   a. What they did in the lesson
   b. Explain how the wind turbine and their prototype renewable energy source worked
   c. Compare how the LEGO model works by comparison to a real wind turbine

3. **Teams Tidy Up:**
   a. The wind turbine should stay assembled and be returned to a designated storage space.
   b. All other parts should be disassembled and stored safely, preferably in a labelled box per team.

Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
Science	Energy and forces Environmental awareness and care	Forces Science and the environment; Caring for the environment; Environmental awareness	Investigating and experimenting; Measuring; Questioning; Observing
History	Local studies Continuity and change over time Life, society, work and culture in the past	Buildings, sites or ruins in my locality Food and farming Life in the 19th Century	Using evidence Continuity Cause and effect
Geography	Human environment Natural environment	Local natural environment Natural environmental features and people	Developing empathy; Questioning, hypothesising, investigating

Coding & Build [~15 min]

Prototyping a renewable energy source

1. List the energy sources in the local area.
2. Discuss the energy sources available in the local area, building on the learners' knowledge and understanding of energy sources (renewable and nonrenewable).
3. Challenge each group to create a renewable energy source for the local area using the prototyping pieces from the SUPERPOWERED Explore Set.
   a. Groups can be challenged to prototype an energy source which could realistically be developed in the local area, or develop a hypothetical source
4. Invite each group to share their design and explain how it works
   a. What renewable source of energy is being used?
   b. Why was this source chosen over others?
   c. How might this prototype benefit the local area?

Science: Design and make a wind turbine

Reference: Energy Handbook SUSTAIN (**www.sustain-europe.eu**)

In groups learners must design and make a wind turbine that moves freely in front of a fan and that lifts a weight of at least 50g.

1. Explore

Divide the learners into groups. Provide each group with a number of images of wind turbines. Learners explore the pictures with their groups. Sort and classify the images.

Sample questions

- What shapes are the blades of the turbines?
- What do you think affects the amount of power a turbine can generate?
- How many blades do most wind turbines have? What do you think would happen with more or fewer blades?
- What do you think makes one turbine work better than another?

2. Plan

In groups learners explore the range of materials that are available to them to make their wind turbines (e.g. paper plates, skewer sticks, cardboard, lollipop sticks). Using the information they have from the exploring phase above each group draws a detailed diagram of their wind turbine design. Encourage the children to think about some of the following variables before deciding on their final designs:

- Size of blades
- Number of blades
- Thickness of blade
- Shape of blade

3. Make

Each group then makes their wind turbines carefully following their designs. As they make their designs each group should be encouraged to test their turbines to ensure that the blades rotate when placed near the large fan/hairdryer. Please note that some learners may find some design faults when testing their turbines, so it is important to afford them time to revise and retest their designs based on their observations.

4. Evaluate

Each group then presents their design to the whole class, explains how it works, and makes links as to how their designs model how a wind turbine works.

Sample questions

- How is your design similar to how a wind turbine works?
- Which wind turbine do you think is the most effective? Why do you think this?

• Why do you think this turbine performed better than other

types?

• Did you adhere to your original plan?

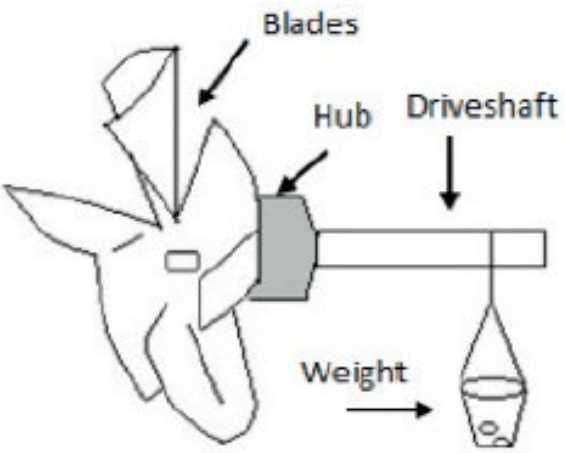
• What do you like most about your wind turbine?

• If you were to make another wind turbine is there anything you would do differently?

• If you had to locate your turbine on school grounds where would you put it? How could we test the suitability of a site?

5. Investigate

Learners investigate the strength of their turbines. They could do this by attaching a basket (paper cup) with a small weight to the shaft. They then place the turbine in front of the fan/hairdryer and investigate whether their turbine can lift the weight.



Sample Questions

• Which wind turbine lifted the most weight?

• Why do you think this turbine performed better than other types?

• If you were to revise your turbine what would you do differently? Why?

Geography: Human environment and Natural environment

Scenario: An energy company (Elex Energy) is interested in building a wind farm in your local area. Some of the community support this development while others oppose it.

Key Questions

- Do you think that a wind turbine in the local area is a good idea? Why/why not?
- Why do you think some people might not be happy about this?

In groups, learners brainstorm people who might be affected by the decision to build a wind turbine in an area. For example families, farmers, the government, the wind farm company, etc. The learners are then informed that they are going to participate in a 'community' debate and that they are going to represent different people in the community.

Each group is assigned a 'role'. Role cards can be found **here**

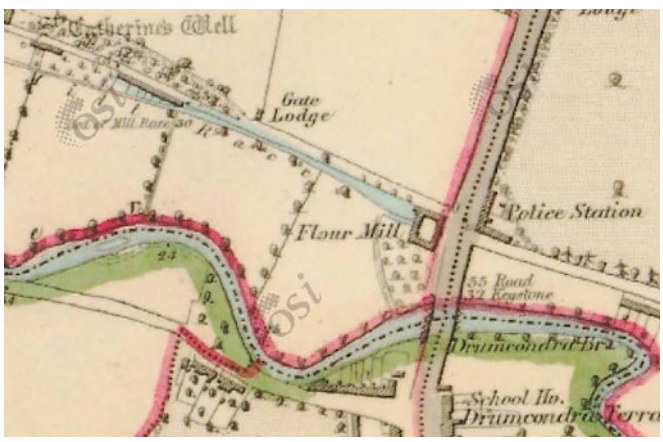
To prepare for the debate each group must discuss their roles; find information to support their argument and work collaboratively to create a poster representing their opinions / findings. They then make a presentation at the 'community meeting'.

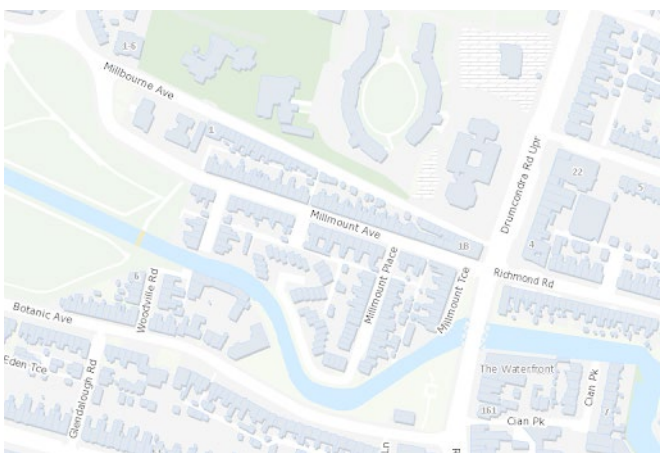
Distribute the **role play cards**. Samples of the different roles can be found below. Learners discuss the information on the cards and then carry out some additional research and discussion to support their arguments. They must design a presentation/poster that summarises their arguments. They must also write a persuasive statement that would encourage the rest of the community to listen to their points of view at the community meeting.

Teachers should prompt the learners by asking questions and ensuring they are really thinking about and identifying with their given roles. For example, the Exel Energy group should consider ways they can create a positive image of themselves supporting local organisations. How could this be done? Could the company sponsor a local sports club or community event?

History: Local studies: Buildings, sites or ruins in my locality; and My locality through the ages

Learners can investigate and explore sites in the locality linked to historical mills (e.g. flour mills, flax mills, corn mills). A variety of current and historical maps of every locality in Ireland can be examined on websites such as OSI **Geohive** and **Scoilnet Maps** The example below is a screenshot from OSI Geohive (1842) map of Drumcondra, Co. Dublin and a current day map (2022). Learners could investigate if the mill is still in evidence there today, if the building has been repurposed or whether any local place names still carry references to that mill.





Discussion Images for Lesson 4

Discussion Image 1: Wind Turbine

Discussion Image 2: LEGO Wind Turbine Model

fll.learnit.ie/superpowered

Lesson 5: Energy Storage

Learning Outcomes:

Learners will be enabled to

1. Understand why energy needs to be stored
2. Identify different types of energy storage (e.g. oil/gas tanks, battery packs, water pumped storage)
3. Build the energy storage model, examine and explain how it works using correct terminology (potential energy, kinetic energy)
4. Identify different ways energy is stored and distributed.

Learners will build:

- SUPERPOWERED Energy Storage model
- SUPERPOWERED Carousel connected to the Energy Storage model

Purpose:

Learners will explore how energy is stored and distributed.

Core Values:

Teamwork | Fun | Discovery

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- SUPERPOWERED Explore Set
- Prototyping pieces
- SUPERPOWERED Mat
- Digital device

Digital resources:

- Discussion Images for Lesson 5
- Google Earth Project: Energy Storage in Ireland

Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Geography	Natural environments Environmental awareness and care Human environments	Local natural environment Caring for the environment; Environmental awareness People at work; Transport and communications	Using maps and globes Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)
Science	Environmental awareness and care Energy and forces	Caring for the environment; Environmental awareness Forces	Investigating and experimenting; Questioning; Observing
SPHE	Myself and others Myself and the wider world	My friends and other people Relating to others Developing citizenship	Communication; Co-operation; Decision-making

Introduction
[10 min]

Resources:

- **Discussion Images for Lesson 5**

Introduction to Energy Storage

Learners are introduced to the concept of energy storage through a series of key questions and discussion. Display **images** for learners:

- How is energy stored? Think about any of the electrical devices or toys you use, what do they have that enables them to be portable? (Learners should be able to identify batteries and locations for batteries on toys, laptops, tablets, phones, etc.)
- Where does the phone with a dead battery get the energy to recharge? How does the phone store energy for later use?
- What about other storage for sources of energy such as fuel for cars? Oil/gas for heating our home/ school?
- Where does the energy to charge the phone come from?

Introduction [Continued]

Learners identify sources of energy used in their home/ school (e.g. oil heating, electricity, gas). Learners consider how this energy is distributed and stored (e.g. powerlines, oil tank and pipes). Please note learners may refer back to the energy journey (Lesson 2) to assist them with this. If the school is heated by oil, learners should be shown where the oil tank is and asked:

- Why do you think we store oil here? How is the oil moved from the tank to the boiler (learners should identify pipes)?
- What happens when this oil runs out and the tank is empty?
- Where does the oil come from?

If the school is heated by gas, learners should be shown the gas boiler and the associated pipes.

Development [45 min]

Resources:

- Google Earth Project: Energy Storage in Ireland

Exploring Energy Storage around Ireland: Google Earth Interactive Map Project [15 mins]

Learners explore the interactive Google Earth Project on energy storage around Ireland to investigate different types of energy storage in Ireland (e.g. jet fuel storage at one of the airports, oil storage at the ports and our national emergency oil supply at Whiddy Island, Co. Cork). They should click the pins and explore the images and information associated with each pin to learn about energy storage and answer the questions.

Google Earth Project: Energy Storage in Ireland

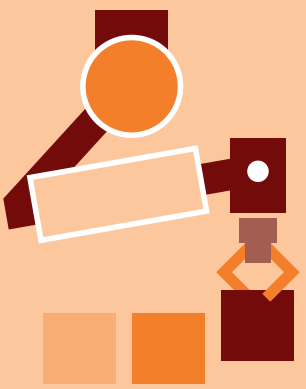
Learners should consider the advantages/disadvantages of each form of energy storage:

- Is the storage of fossil fuels (such as oil and gas) environmentally friendly?
- What happens to batteries (including the large grid batteries) when they reach end of life (5-15 years)?
- Are there any issues with pumped storage such as Turlough Hill?

Development [Continued]

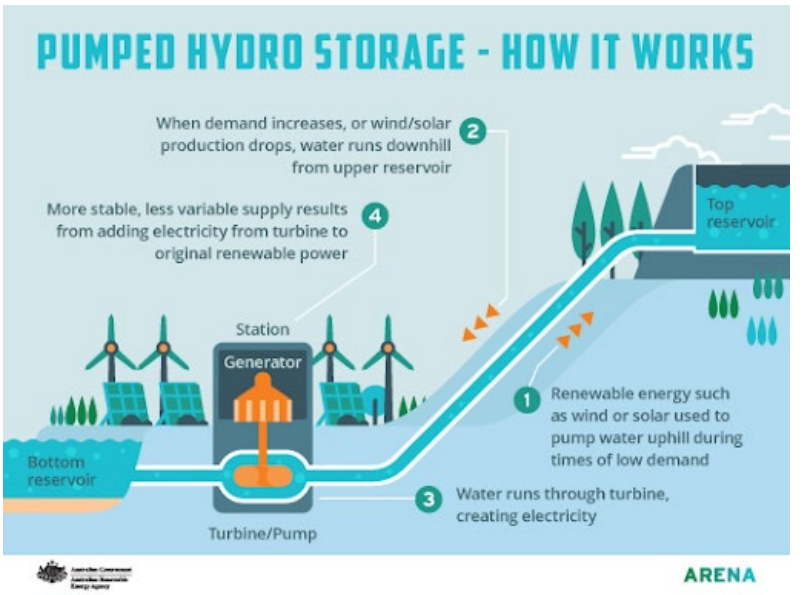
Resources:

- Image 2 for Discussion: How Pumped Hydro Storage Station Works



Teachers should show the learners the Turlough Hill pumped storage power station in Co. Wicklow (also linked on the Google Earth Project). Learners should observe and identify the reservoir, lake and pumping station. Teachers should use Image 2 below to explain that the water from the lake is pumped uphill to the reservoir during times of low demand (e.g. overnight) and then allowed to flow downstream back into the lake during times of high demand (e.g. during the day), through the turbines, to generate hydroelectricity. The water in the reservoir is essentially the energy storage (potential energy) so that when energy is needed it can be released downhill to the lake through the hydroelectric turbines (kinetic energy) to generate electricity. Connections should be made here to the Energy Storage Model (see build below).

Image 2 for Discussion: How Pumped Hydro Storage Station Works



Key questions:

- When do you think energy would be in low demand? Why?
- Why is the water not pumped downhill?
- How is a pumped storage energy station similar to a battery?

Build
[15 mins]

Resources:

- SUPERPOWERED Explore Set
- SUPERPOWERED Mat
- Engineering Notebook p. 12
- **Image 3 for Discussion: Energy Storage Model**

The following video explains how kinetic energy is used in 'pull-back toy cars' - **How does a Pull-Back Toy Car work?**

Build [15 mins]

Image 3 for Discussion: Energy Storage Model

Follow the instructions in Book 2 to make the Energy Storage Model.

Place the Energy Storage Model on the mat in the space by the gas tanks.

Load two energy units into the energy slot (A), which will raise the tyre arm (B).

Lift the release lever (C). The energy units will come back out of the slot.

Discuss how this model represents energy being stored ready for distribution when it is needed. Connections should be made here to Turlough Hill pumped storage station.

Note to teachers:

Kinetic energy is the energy processed by an object in motion like a car in motion or a football when kicked.

Potential energy is the stored energy an object has because of its position or state.

The Energy Storage Model provides a visual representation of potential and kinetic energy. When the tyre arm is raised, this is the potential energy. When the lever is lifted, the potential energy is changed into kinetic energy. This motion releases the energy units.

Build
[Continued]

Resources:

- SUPERPOWERED Explore Set
- SUPERPOWERED Mat
- **Image 4 for Discussion: Energy Storage Model and Carousel**

Carousel Build [15 mins]

Follow the instructions in Book 3 to make the Carousel.

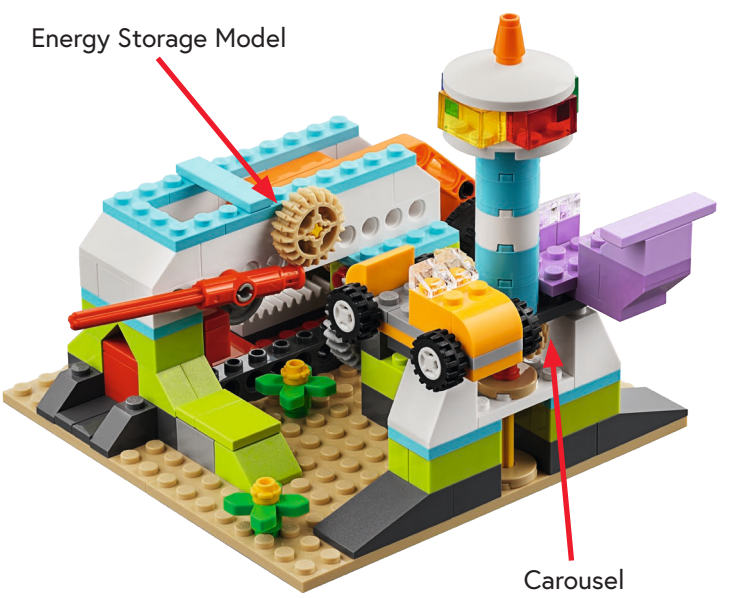
Connect the Carousel to the Energy Storage Model.

Load two energy units into the energy slot, which will raise the tyre arm.

When the release lever is pulled, the stored energy in the Energy Storage Model is released in order to power the carousel.

Discuss how this model represents how energy is stored and consumed.

Image 4 for Discussion: Energy Storage Model and Carousel



Closure (Document/ Share/Tidy up) [5 mins]

Resources:

- Digital portfolio
- Digital device

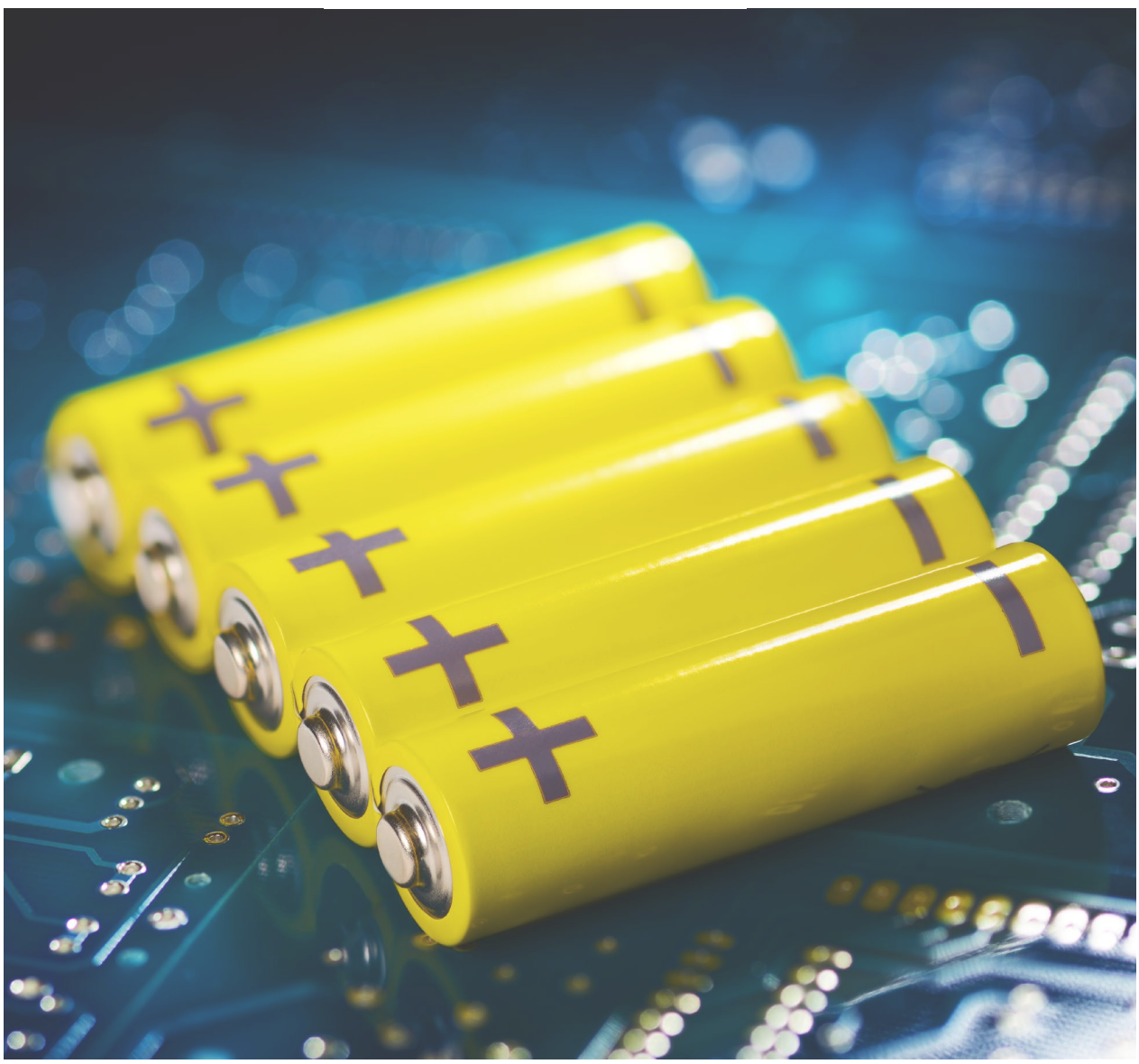
Document:
Each team documents and reflects upon the Energy Storage Model and Carousel they built - adding photos, videos, notes to their digital portfolios. Consider how they built it, how it works, how they might change or adapt or improve it.

Share:

1. What they did in the lesson?
2. Explain how energy is stored and distributed in their everyday lives.
3. Explain how the Energy Storage Model works; how energy units are used to power the Carousel.

Teams Tidy Up:

1. Leave the Energy Storage Model and Carousel assembled.
2. All other parts should be disassembled and stored safely, preferably in a labelled box per team.



Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
Geography	Environmental awareness and care Human environments	Caring for the environment; Environmental awareness People at work; Transport and communications	Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)
Science	Energy and forces Environmental awareness and care	Forces; Electricity Science and the environment; Caring for the environment; Environmental awareness	Investigating and experimenting; Measuring; Questioning; Observing

Geography - Transport and Communications

Learners could visit the local filling station and investigate any signs of fuel storage (note the storage tanks are located underground). The below image can be used to demonstrate fuel storage in the local filling station. Learners could also interview a fuel attendandant/shopkeeper at the filling station about their job and ask them to explain how the petrol/diesel is stored and what happens when the storage tanks run out (i.e. the tanks are refilled by delivery lorries).

Energy Connections (Science and Geography)

1. Learners refer to the SUPERPOWERED Mat. Identify ways energy is stored and distributed on the SUPERPOWERED Mat.
   a. Examples of energy storage on the SUPERPOWERED Mat are the gas tanks and charging station.
   b. Examples of energy distribution on the SUPERPOWERED Mat include power lines, fuel trucks and pipelines.
2. Using the prototyping pieces, learners should work in small groups to connect and distribute energy from different locations on the SUPERPOWERED Mat.

Science - Electricity

Learners can explore simple circuits with the use of batteries.

Divide the pupils into pairs. Each pair will need (i) a bulb (ii) 2 wires/crocodile clip wires (iii) 2 different size batteries (e.g. AA, AAA, D).

Allow learners to observe each battery taking note of key features: size of battery, voltage of battery, positive sign, negative sign, etc.

Learners predict what impact a different size battery will have on the brightness of the bulb in the circuit.

Teacher note: The battery voltage or electrical potential and not the size (amount of energy stored) directly affects the brightness of the bulb.

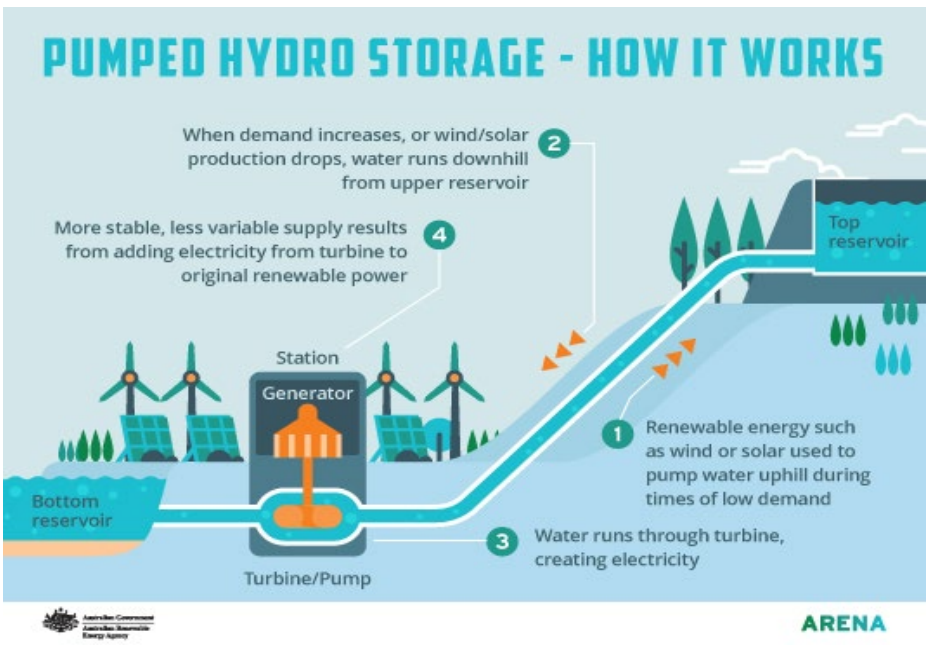
Learners should then set up a simple circuit. Learners observe the brightness of the bulb with one battery. The learners then replace the battery and observe the brightness of the bulb. Learners compare the brightness of bulbs and discuss findings with their peers.

Learners should find that if the batteries are the same voltage the bulbs should be the same brightness.

Discussion Images for Lesson 5

Discussion Image 1: Different forms of energy storage

Discussion Image 2: Pumped hydro storage



Discussion Image 3: Energy Storage Model

Discussion Image 4: Energy Storage Model and Carousel

Lesson 6: Power On

Learning Outcomes:

Learners will be enabled to

1. Build and code the LEGO robot (Cooling Fan/Merry-Go-Round).
2. Develop greater understanding of the code through adapting and testing.

Learners will build:

- LEGO SPIKE Essential
  - Lesson 1 - Merry-Go-Round
  - The Spinning Ferris Wheel
- LEGO WeDo 2.0
  - Cooling Fan
  - Moving Satellite

Purpose:

Learners will be introduced to the LEGO Education Set (SPIKE Essential or WeDo 2.0).

Learners will be introduced to a simple block-based coding language.

Learners will build and code a motorised LEGO robot.

Core Values:

Teamwork | Innovation | Fun | Discovery

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- LEGO Education Set (SPIKE Essential or WeDo 2.0)
- SUPERPOWERED Mat
- Digital device (for adding to digital portfolio)

Per learner:

- Engineering Notebook p. 16

Digital resources:

- Discussion Images for Lesson 6

Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Literacy	Oral Language	Communicating	Communicating; Understanding; Exploring and using
Visual arts	Construction; Drawing	Making constructions, Making drawings	An awareness of line; An awareness of form; An awareness of space
Science	Energy and forces, Materials	Forces; Properties and characteristics of materials	Design and make
SPHE	Myself and others	My friends and other people , Relating to others	Communication; Co-operation; Decision-making

Introduction
[10 min]

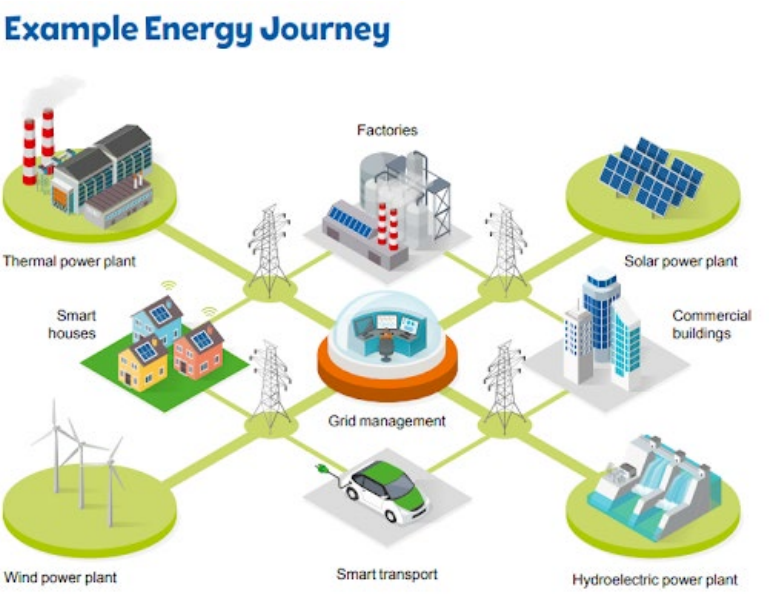
Resources:

- Discussion Images for Lesson 6

Discussion

Revisit the Energy Journey image and discuss with learners how we have examined the generation and storage of energy. We are now moving to look at how energy is consumed or used. Learners should identify where energy is consumed in Image 1.

Discussion Image 1: Example Energy Journey



The Energy Storage Model built in the previous lesson is limited in that it has to be continually refuelled with energy units. Over the course of this lesson learners will work in teams to build two LEGO models which consume power stored within the LEGO Education hubs.

Pose the question to learners:

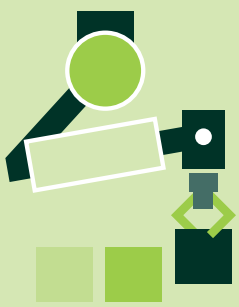
- How does the LEGO hub store energy?
- Where does this energy come from?
- How is energy transferred to the LEGO hub?

As required, explain to learners that the LEGO hub functions similarly to a battery pack. The WeDo 2.0 hub is powered by batteries, whereas the SPIKE Essential hub is rechargeable using a power cable plugged into an electricity source.

Development (Build)
[40 min]

Resources:

- LEGO Education Set (SPIKE Essential or WeDo 2.0)
- Engineering Notebook, p. 16
- Digital device
- **WeDo Cooling Fan**



Purpose of the Build:

To introduce learners to the LEGO® Education SPIKE Essential or WeDo 2.0 software and block-based coding.

To introduce the 'motor' block and explore what happens when the power of the motor is changed.

To build an additional robot which uses electrical energy in the fairground (Merry-go-Round).

Essential Build: [20 min]

1. In teams, learners engage with the LEGO Education classroom project:
   a. **SPIKE Essential**
      - Lesson 1 - Merry-go-Round

   b. **WeDo 2.0**
      - Cooling Fan

2. Learners follow detailed instructions to build and code the Merry-go-Round or Cooling Fan.

3. Encourage learners to complete challenge tasks:
   a. **SPIKE Essential**
      i. Make the robot turn clockwise
      ii. Make the robot turn anti-clockwise
      iii. Make the robot move quicker/slower
      iv. Code the robot to be more like a 'real' Merry-go-Round: start slow, speed up, change direction, etc.

Development (Build) [Continued]

b. WeDo 2.0

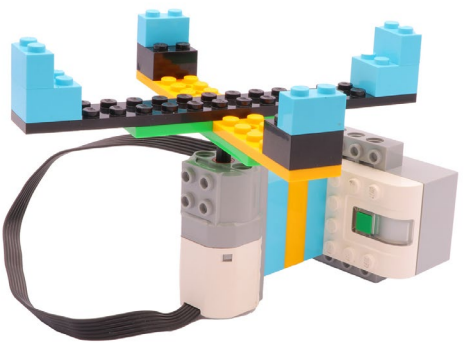
i. Modify the build to turn the Cooling Fan into a basic Merry-go-Round (i.e. lie the robot flat and add chairs to the blades)

ii. Make the robot turn clockwise

iii. Make the robot turn anti-clockwise

iv. Make the robot move quicker/slower

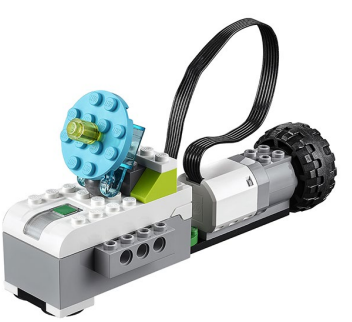
v. Code the robot to be more like a 'real' Merry-go-Round: start slow, speed up, change direction, etc.



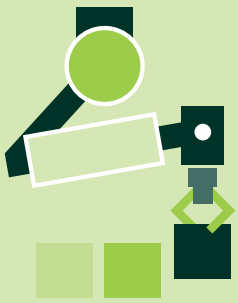
4. Document and deconstruct the Merry-go-Round.

Development Build: [20 min]

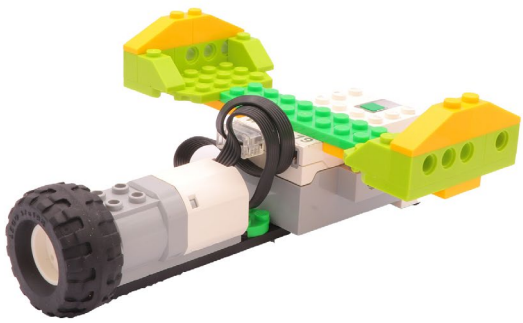
1. In teams, learners engage with the LEGO Education classroom project:
   a. **SPIKE Essential** - The Spinning Ferris Wheel
   b. **WeDo 2.0** - Moving Satellite
2. Learners follow detailed instructions to build and code the extension builds.

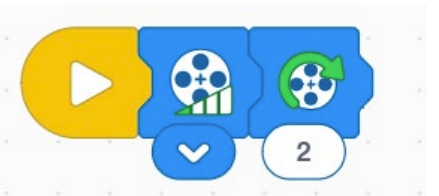
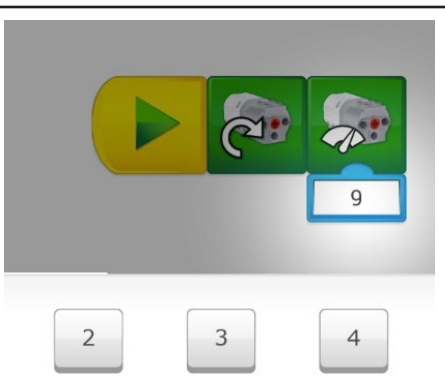
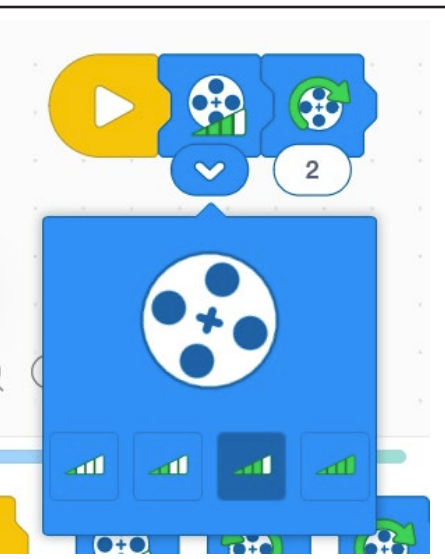
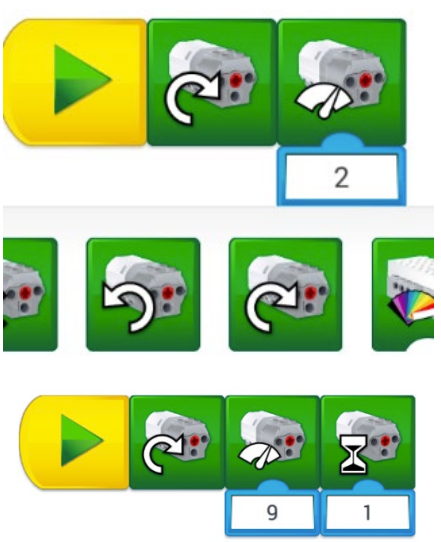


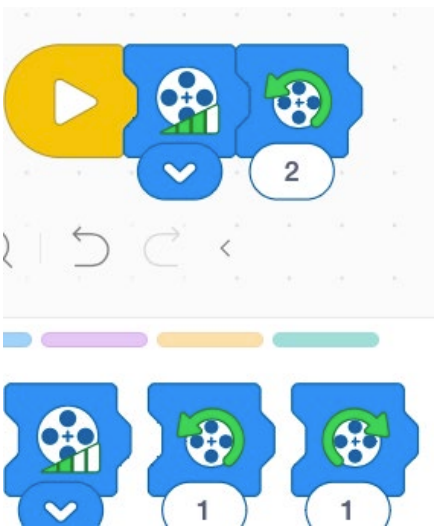
Development (Build) [Continued]



3. Encourage learners to complete challenge tasks:
   a. **SPIKE Essential**
      i. Make the robot turn clockwise
      ii. Make the robot turn anti-clockwise
      iii. Make the robot move quicker/slower
      iv. Code the robot to be realistic.
   b. **WeDo 2.0**
      i. Modify the build to turn the Moving Satellite into a fairground ride (i.e. lie the robot flat and add chairs to the blades)
      ii. Make the robot turn clockwise
      iii. Make the robot turn anti-clockwise
      iv. Make the robot move quicker/slower
      v. Code the robot to be realistic.



<table>
<tr><td>LEGO Education WeDo 2.0 Classroom Project: Cooling Fan</td><td>LEGO Education SPIKE Essential - Lesson 1 - Merry-go-Round</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Once the code is executed (started), this robot will turn on the motor at a power of two (2), which will cause the fan to begin moving.</td><td>Once the code is executed (started), the motor power is set, followed by setting the motor to turn clockwise twice (2).</td></tr>
<tr><td colspan="2">This simple algorithm (code) can be tinkered with in order to make the robot move more quickly/slowly, to change the direction of movement (clockwise/anticlockwise), and to change how long/short the motor stays on for (duration).</td></tr>
<tr><td colspan="2">Change speed</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">Change direction and duration</td></tr>
<tr><td> 

The number under the hourglass is the number of seconds the motor will run.</td><td> 

The number under the rotation (2) sets the number of rotations, in this case the duration.</td></tr>
</table>

Coding & Build Guidance for Teachers [Continued]

Guiding Questions:

- Can you change the direction the robot turns?
- I wonder what might happen if you change the number under the motor block?
- Can you see any blocks that might make the robot stay running for longer?
- What is the fastest you can set the robot to turn?

Closure (Document/ Share/Tidy up) [10-15 min]

Document:

Each team documents and reflects upon the robots they built - adding photos, videos, notes to their digital portfolios. Consider how they built it, how it works, how they might change or adapt or improve it.

Share:

1. What they built: Merry-go-Round or Cooling Fan and Ferris Wheel or Moving Satellite
2. How their robots are able to move (power source and code)
3. Show the coding skills they learned
   a. Explain how they changed the program
   b. Explain a problem they faced or overcame
4. Demonstrate their solutions

Teams tidy up:

Everything built in this lesson should be disassembled and returned to the LEGO Education Set.

Resources:

- Digital portfolio
- Digital device

Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
Science	Energy and forces; Materials	Forces; Properties and characteristics of materials	Design and make
Visual Arts	Construction	Making constructions	An awareness of space
Drama	Drama to explore feelings, knowledge and ideas, leading to understanding	Exploring and making drama Co-operating and communicating in making drama	Belief, role and character, action, time, tension
Literacy	Writing	Exploring and using	Communicating; Understanding; Exploring and using

Coding & Build: (~20 min per build)

SPIKE Essential

The following two builds will further develop the building and coding skills of learners. Each build can be thematically linked to the 'Fairground' theme.

Twirling Teacups

Underwater Quest

Drama:

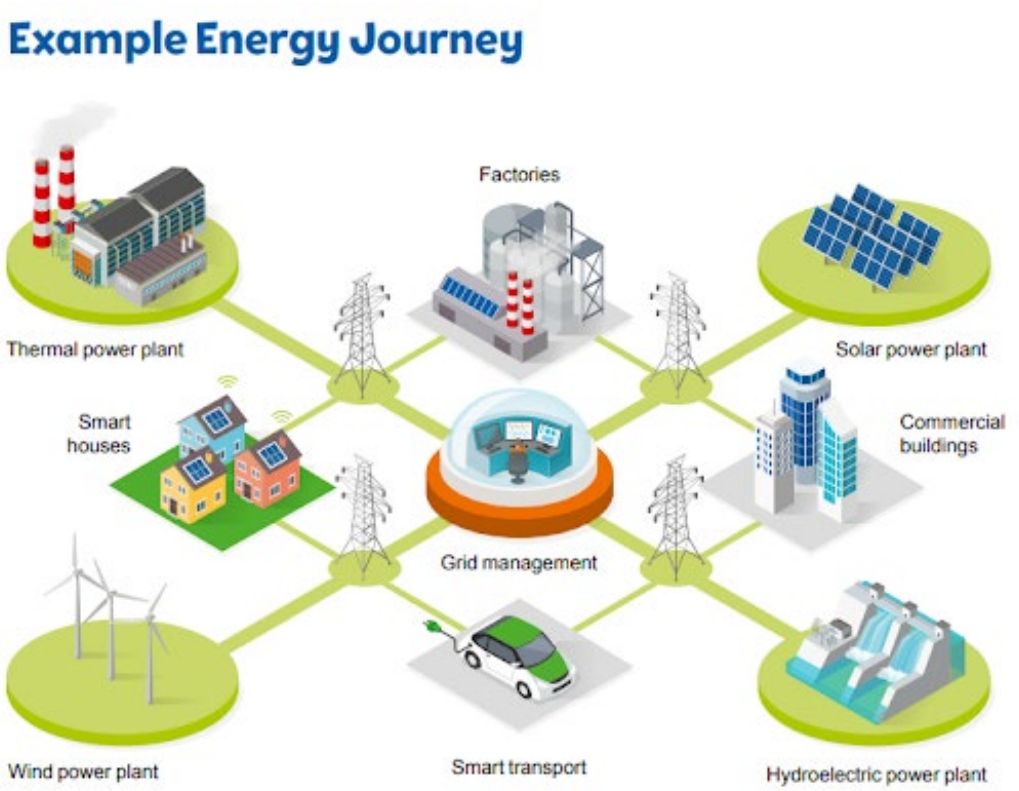
In pairs or small groups, learners create still images or tableaus of their reactions before, during and after their ride on the Merry-go-Round.

English/Gaeilge: Diary Writing

Task learners to imagine they have spent the day at the fairground. What would their diary entry look like? How would they describe their rides on the Merry-go-Round they built? What else did they see and do?

Discussion Images for Lesson 6

Discussion Image 1: Example Energy journey



fll.learnit.ie/superpowered

Lesson 7: Motorise Model (Safety and Sensors)

Learning Outcomes:

Learners will be enabled to

1. Develop an appreciation for, and understanding of, sensors in everyday life.
2. Build and code a LEGO robot which uses sensors.

Learners will build:

- LEGO SPIKE Essential
  - Lesson 2 - Animal Alarm
- LEGO WeDo 2.0
  - Spy Robot
- Both kits: Motorise the LEGO SUPERPOWERED Carousel

Purpose:

Learners will be introduced to sensors and their associated coding blocks.

Learners will build and code a LEGO robot which uses/responds to a sensor.

Learners will begin to consider how sensors could enhance the safety of their LEGO builds.

Core Values:

Teamwork | Inclusion | Innovation | Fun

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

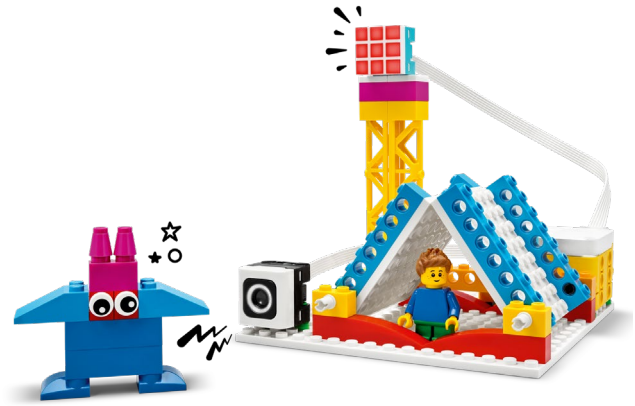
Resources

Per team:

- LEGO Education SPIKE Essential/WeDo 2.0 set
- SUPERPOWERED Mat
- SUPERPOWERED models: Wind Turbine, Energy Storage Model, Carousel
- Digital device (for adding to digital portfolio)

Digital resources:

- Discussion Images for Lesson 7



Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Literacy	Oral Language	Communicating	Communicating; Understanding; Exploring and using
Visual Arts	Construction; Drawing	Making constructions; Making drawings	An awareness of line; An awareness of form; An awareness of space
Mathematics	Shape and space	2-D shapes; 3-D shapes	Applying and problem-solving; Communicating and expressing
Science	Energy and forces; Environmental awareness and care	Forces Science and the environment	Investigating; Observing; Design and make
SPHE	Myself and others	My friends and other people; Relating to others	Communication; Co-operation; Decision-making

Introduction
[10 min]

Resources:

- **Discussion Images: Safety and Sensors**

If necessary, pre-teach these related vocabulary words: alarm, cause, colour sensor, effect, react. If using SPIKE Essential - creature.

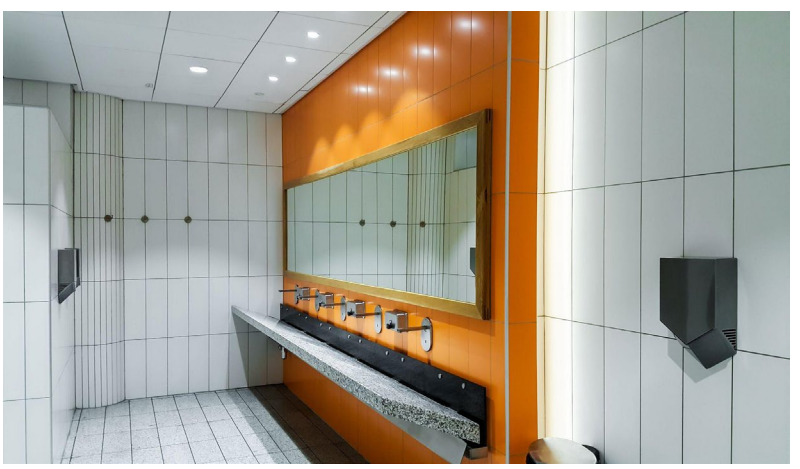
Safety and Sensors

Learners are introduced to the concept of safety and sensors through a series of questions and discussion:

- When you visit a shop, how does the automatic door work? How does it only open when someone is near the door?

- Where else might sensors be found in our daily lives? In school? At home? In our local area?
- Are there any sensors in use in the image of a public toilet below?

Discussion Image 1: Public Toilet



- How do these sensors work? Why is it beneficial to have automatic taps?
- Are sensors used in any other ways? (such as automatic flushing toilets, automatic taps/hand sanitiser dispensers, fire alarms in classrooms/ homes, burglar alarms - how do these work?)
- Have you been in a car that made a noise as it reversed? How did the car know there was something behind it? Why would sensors be useful for this task?

- Could the same principle be used to make other things safe?

Learners could view this three (3) minute video on roller coaster safety and identify the use of sensors to prevent one carriage from crashing into another **Roller Coaster Testing**.

Cause & Effect Discussion:

To prepare learners to understand how sensors work, facilitate a quick discussion about cause and effect.

Talk with your students about what happens when an alarm (e.g. fire alarm) goes off.

Ask questions, like: What would happen if you heard an alarm going off? What would you think is happening?

Development (Build) [40 min]

Resources:

- LEGO Education Set (SPIKE Essential or WeDo 2.0)
- Engineering Notebook, p. 18 & 19
- Digital device
- **WeDo 2.0 Spy Robot**
- **SPIKE Essential Animal Alarm**

Purpose of the Builds:

To introduce the sensor and sensor code block.

Explore how the sensor and sensor code block function.

Tinker with, and build upon the sensor code to make the LEGO robot safer.

To motorise the Carousel using electrical energy stored in the LEGO hub.

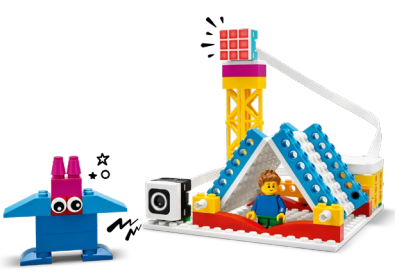
Key Questions:

- Could we build something that would let fairground workers know that someone was in the operating area of a fairground ride?
- Could we build something that would alert a worker if someone or something got too close to the blades of a Wind Turbine?
- What ways could the worker be alerted? Could we cater for all situations, e.g. if someone had sight difficulties (poor sight / colour blindness) or hearing difficulties (or perhaps they are wearing ear protectors because it is a noisy environment)?

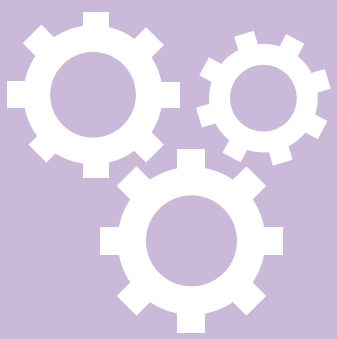
Sensor Build: (20 min)

1. In teams, learners engage with the LEGO Education classroom project:
   a. **SPIKE Essential**
      - Lesson 2 - Animal Alarm

   b. **WeDo 2.0**
      - Spy Robot



Development (Build) [Continued]



2. Learners follow detailed instructions to build and code the Animal Alarm OR Spy Robot.. Encourage learners to complete challenge tasks:
   a. **SPIKE Essential**
      i. Change the colours displayed by the colour light matrix
      ii. Create a 'pixel' image on the colour light matrix (e.g. smile for safe, frown for alarm) [add image of this please]
      iii. Add sound so that when the alarm is activated a sound is also played
      iv. Record and add a learner-recorded sound
      v. Write an algorithm that plays a noise and flashes a light when the alarm is activated
      vi. Discuss why it is beneficial to have the alarm provide both visual and audio alerts.
   b. **WeDo 2.0**
      i. Change the sound played when the alarm is activated
      ii. Record and add a learner-recorded sound
      iii. Code the robot to flash a coloured light on the hub when the alarm is activated
      iv. Change the colour displayed by the hub
      v. Write an algorithm that plays a noise and flashes a light when the alarm is activated
      vi. Discuss why it is beneficial to have the alarm provide both visual and audio alerts.
3. Discuss how these sensors and outputs could be used to enhance the safety of the Carousel robot. Remind learners of the sensors used in the rollercoaster video. Could their build use a similar process?
4. Document & deconstruct the Animal Alarm/Spy Robot.

Motorise & Enhance Carousel: (20 min)

In teams, learners engage with the building instructions in **Book 3** of the SUPERPOWERED Explore Set to build the motor and hub base for the Carousel robot.

Learners follow detailed instructions to build and code the motorised base in order to motorise the Carousel.

Encourage learners to adapt and improve the code so that the Carousel is safer. Ideas include:

Alarm when a person is entering or exiting the ride

Sound/Light when the ride is in motion

Coding & Build Guidance for Teachers

Resources:

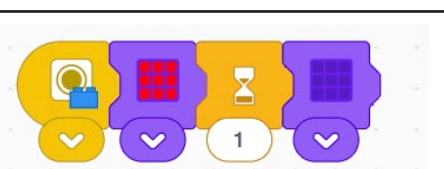
- **Narrated video for code**

Teacher Tip:

If using the LEGO WeDo 2.0 Set - remember that the sound comes from the digital device, not from the hub. Learners may need to turn up the volume on the device.

The overall build and code are very similar, however the different sets use different sensors:

- The LEGO WeDo 2.0 Set uses a **motion sensor**.
  - The motion sensor detects changes in distance from an object within its range in three different ways:
    - Object moving closer
    - Object moving farther away
    - Object changing position
  - e.g. a robot can be programmed to react after something moves within range of its sensor
- The SPIKE Essential Set uses a **colour sensor**.
  - The Colour sensor can be programmed to detect a specific colour and then react to this.
  - e.g. a robot can be programmed to react after a specific colour is detected within range of its sensor

LEGO Education WeDo 2.0 Classroom Project: **Spy Robot**	LEGO Education SPIKE Essential - **Lesson 2 - Animal Alarm**
	
Once the code is executed (started), this robot will wait until the sensor senses motion. It will then start playing an audio file (sound 1).	Once the colour sensor recognises the target colour (blue), the colour light matrix will display a 3x3 grid of red lights. After 1 second has passed, the colour light matrix will not display any lights.

This simple algorithm (code) can be tinkered with in order to make the 'alarm' more effective by including both lights and sound. The additional code blocks for lights in WeDo 2.0 and sound in SPIKE Essential are shown below.

WeDo 2.0	SPIKE Essential
	

Guiding Questions:

- Can you change the sound the robot makes?
- I wonder what might happen if you change the number under the music block?
- Can you see any blocks that might make the robot turn on a light?
- Can you change the colour of the light?
- Can you make the robot play a sound and flash a light one after the other?
- I wonder if you could change the order of sound and light?

Closure (Document/ Share/Tidy up) [10 min]:

Resources:

- Digital portfolio
- Digital device

Document:

Each team documents and reflects upon their builds - adding to their digital portfolios etc.

Share:

1. What they built
2. Show the coding skills they learned
   a. Explain how they changed the program
   b. How were sensors used? How did they improve the safety or efficiency of the robot?
3. Describe their improvements to the Carousel robot
4. Demonstrate their solutions

Teams tidy up:

1. The Carousel robot and motor and hub base should stay assembled.
2. All other pieces from the LEGO Education Set should be disassembled and returned.

Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
SPHE	Myself	Safety and protection	Communication; Co-operation; Decision making
Science	Living things	Human life	Investigating; Observing; Predicting

SPHE: Fire Safety around our School

Learners should examine features of fire safety in their school (such as assembly points, fire alarms, fire hose, fire blankets, instructions and maps on classroom doors). Learners should discuss the role of sensors in fire safety and how fire alarms are triggered by smoke sensors. The class could carry out a routine fire drill as part of this learning activity.

Science - 5 Senses Outdoor Scavenger Hunt

These activities could be conducted outdoors so that learners can explore how our senses can help us to learn about the natural environment.

Egg box activity

Each pair is given an egg box with each hollow labelled with a different adjective, e.g. soft, dry, hard. Learners work in pairs to identify objects that match the adjective in the egg box. Discuss the objects the learners collected and which senses were used to detect the characteristic of each object.

Sound map

Each learner is given an A4 piece of paper. The learner marks X on the sheet to represent where they are standing. When the learner hears a sound they must mark it on their sound map using a symbol to illustrate the sound heard (e.g. bird's beak for bird sound). Allow learners to discuss sounds heard.

Blindfold Activity

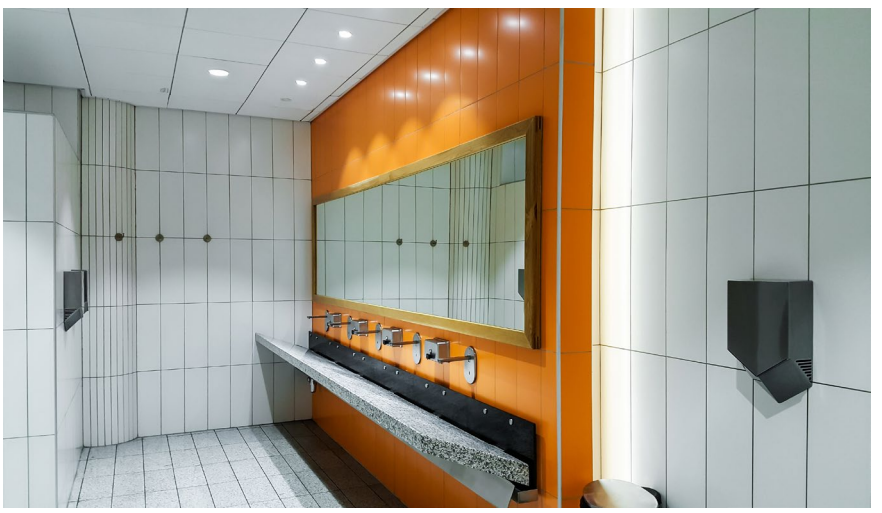
Divide the learners into pairs. One learner is blindfolded (Learner A). The other learner (Learner B), who is not blindfolded, takes their partner to a tree. Learner A must observe the tree, e.g. what does the bark feel like? How wide is the tree etc. The learners then return to their original starting point. Remove the blindfold from Learner A. Learner A must try to identify their tree using the characteristics they observed. Repeat the activity for Learner B.

Making Perfume

Provide each pair with a cup and mixer (e.g. small stick). Learners must collect different items and mix them together to create a perfume of smells. Learners can add water and observe the impact this has on the smell of the perfume. Share perfumes with other groups and see if they can identify the ingredients based on the smell only.

Discussion Images for Lesson 7

Discussion Image 1: Safety and Sensors



Lesson 8: Electric Car (Energy Consumption)

Learning Outcomes:

Learners will be enabled to

1. Examine an example of their energy consumption (e.g. how they travel, different forms of transportation, etc.).
2. Build and code a motorised LEGO vehicle.
3. Apply their coding and building skills to modify/change the existing vehicle into an electric car.

Learners will build:

- LEGO SPIKE Essential
  - Lesson 3 - Snowmobile
- LEGO WeDo 2.0
  - Milo the Science Rover
- Both kits: Adapt and enhance their LEGO vehicle with sensors

Purpose:

Learners will build and code a motorised LEGO vehicle and then adapt it into an 'Electric Car' in order to explore an example of energy consumption.

Core Values:

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- LEGO Education Set (SPIKE Essential or WeDo 2.0)
- SUPERPOWERED Mat
- Digital device (for adding to digital portfolio)
- Prototyping pieces (from SUPERPOWERED Set)

Digital resources:

- Images of consumer cars; electric and fossil fuel
- **Discussion Images for Lesson 8**

Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Literacy	Oral Language	Communicating	Communicating; Understanding; Exploring and using
Visual Arts	Construction; Drawing	Making constructions; Making drawings	An awareness of line; An awareness of form; An awareness of space
Mathematics	Shape and space	2-D shapes; 3-D shapes	Applying and problem-solving; Communicating and expressing
Science	Energy and forces; Materials	Forces, Properties and characteristics of materials	Design and make
SPHE	Myself and others	My friends and other people; Relating to others; Design and make	Communication; Co-operation; Decision-making
Geography	Environmental awareness and care Human environments	Caring for the environment; Environmental awareness People at work; Transport and communications	Geographical investigation skills (Questioning, Observing, Predicting, Investigating and experimenting, Estimating and measuring, Analysing, Recording and communicating, Evaluating)

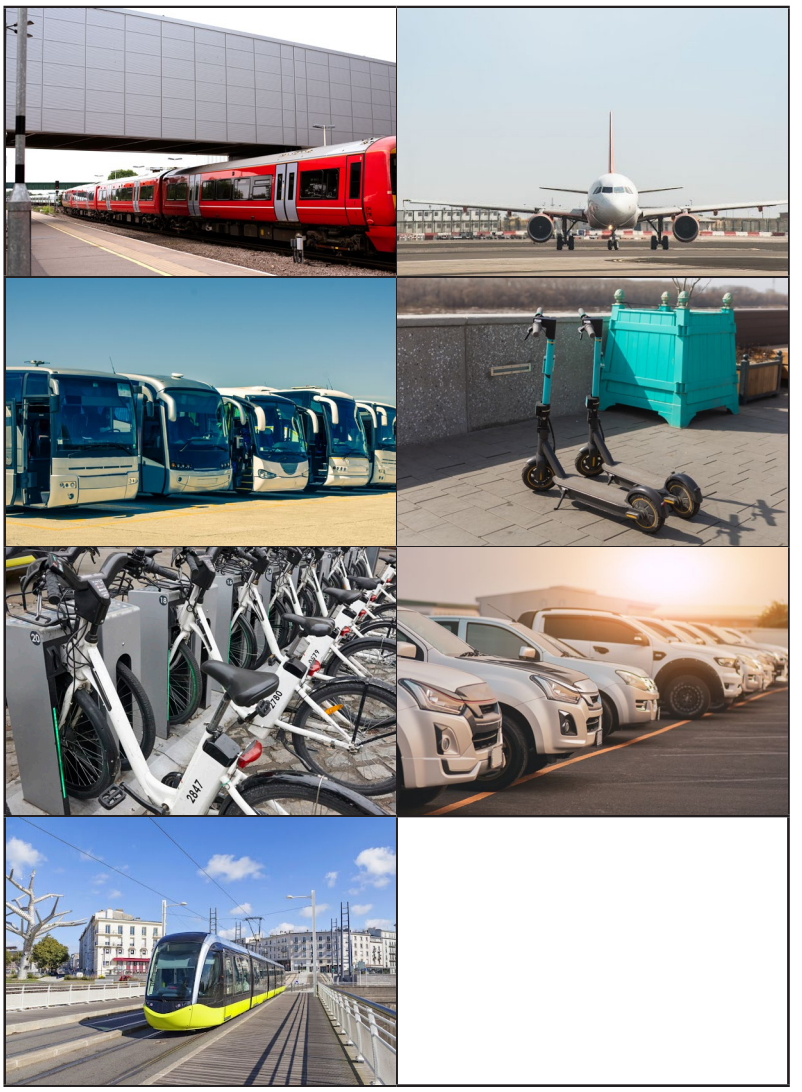
Introduction
[10-15 min]

Resources:

- Images of modes of transport
- Images of charging points for electric cars

Key Questions:

Begin the lesson by asking learners how they travel from one place to another? From home to school? From home to any after school activities? What about longer journeys? How would you travel to another town or city or country? If you've been in another place/country, are the types of transport similar?



Building on their knowledge and understanding of energy sources (renewable and nonrenewable) discuss how these transportation methods are powered. Is the same type of energy used for each? What kinds of transport modes have they seen/used before? (consider electric LUAS, other electric/non-electric trains, hybrid buses, etc.)

Introduction [Continued]

Has anyone seen or used an electric charging point? Where are these located locally? How do these work?

Teacher explains to the learners that in this lesson they are going to build and code their own electric car robots using LEGO elements. They will then apply their knowledge of sensors to make their electric car robots safer.

Development (Build) [35 min]

Purpose of the Build:

- To apply their developing understanding of engineering and coding in building and adapting a LEGO vehicle.
- To reinforce learner understanding and experience of using and coding sensors.

Build a Motorised LEGO Vehicle: (20 min)

1. In teams, learners engage with the LEGO Education classroom project:
   a. SPIKE Essential - Lesson 3 - Snowmobile
   b. WeDo 2.0 - Milo the Science Rover

Development (Build) [Continued]

Resources:

- LEGO Education Set (SPIKE Essential or WeDo 2.0)
- Prototyping pieces
- Engineering Notebook, p. 20 & 21
- Digital device
- **SPIKE Snowmolile**
- **WeDo 2.0 Milo**
- **Images of consumer cars (electric and fossil fuel)**

2. Learners follow detailed instructions to build and code the Snowmobile or Milo the Science Rover .

3. Encourage learners to modify the code in order to complete challenge tasks:
   a. Make the vehicle move backwards
   b. Make a turn (see Important Points to Note)
   c. Code the vehicle to drive to different brick icons on the SUPERPOWERED Mat
   d. Other adaptations of their choosing (Engineering Notebook p. 20, or a copybook can be used for planning code changes)
4. Sensors and Safety - in groups, ask learners to add a sensor to the LEGO vehicle and complete the following tasks:
   a. Code their vehicle to stop if there is an obstacle
   b. Could learners add sound/visuals to make their vehicle safer?

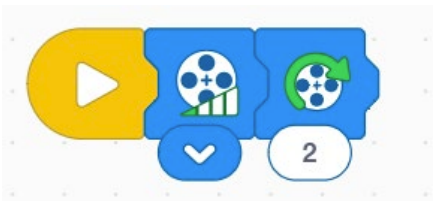
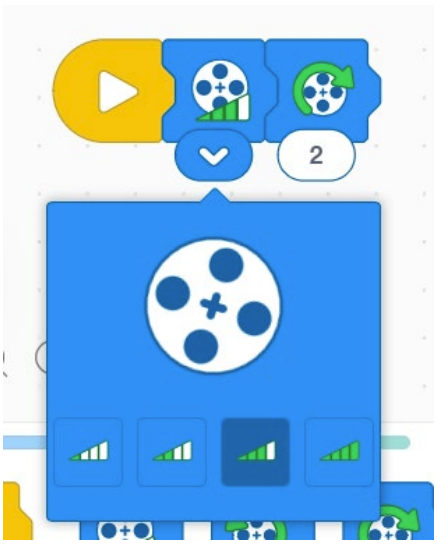
Electric Car: (15 min)

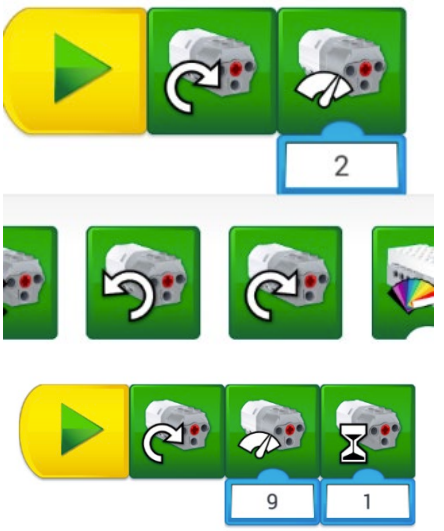
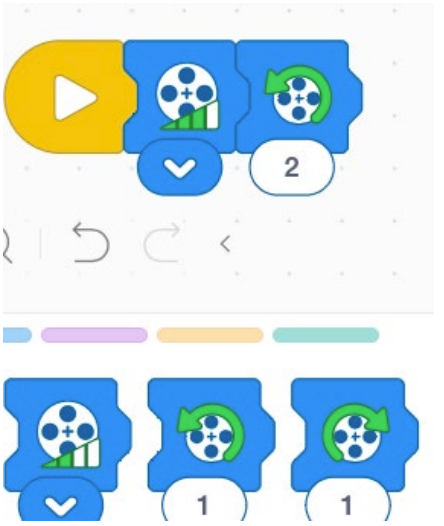
1. Share images of consumer electric cars and traditional fossil fuel consumer cars with the class in order to support a discussion about similarities and differences between them.
2. In teams, learners discuss and plan how they could adapt their LEGO vehicle (Snowmobile or Milo the Science Rover) so that it represents an electric car.
3. In teams, learners design and build a model using the prototyping pieces to represent an electric car charging station and how it connects to an energy source.
4. Create a program (code/algorithm) to drive the electric car from one of the brick icons on the SUPERPOWERED Mat to the charging station.

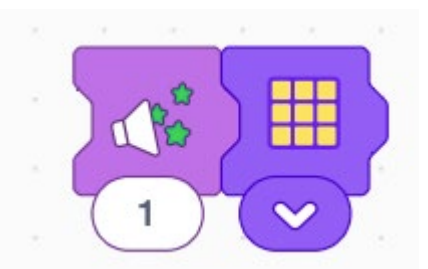
Coding & Build Guidance for Teachers

Resources:

- **Narrated video for code**

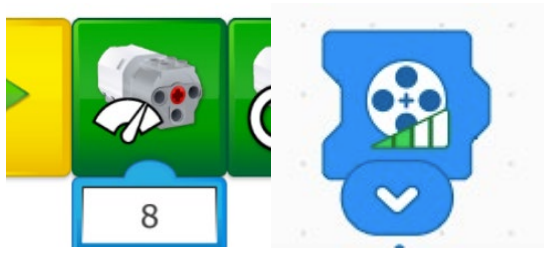
LEGO Education WeDo 2.0 Classroom Project: **Milo the Science Rover**	LEGO Education SPIKE Essential - **Lesson 3 - Snowmobile**
	
This program begins by setting the engine power at '8'. It then sets the rotation of the motor, clockwise, to move forward. The motor will run for a duration of '2' seconds before stopping.	This program begins by setting the motor power. It then sets the rotation of the motor, clockwise, to move forward. The motor will make two full rotations. Links could be made to each rotation equalling 360 degrees.
This simple algorithm (code) can be tinkered with in order to make the model move more quickly/slowly, to change the direction of movement (clockwise/anticlockwise), and to change how long/short the motor stays on for (duration).	
Change speed	
 The motor power can be increased or decreased	

Change direction and duration	
 The number under the hourglass is the number of seconds the motor will run.	 The number under the rotation (2) sets the number of rotations, in this case the duration.

The algorithm could be further adapted to add use of sensors and sound and/or lights. See the Coding & Build guidance in Lesson 8 and/or the SPIKE/WeDo app for further support and examples.	
	

Guiding Questions:

- Can you tinker with the code in order to make the vehicle run for longer?
- Can you change the code to make the vehicle move faster?
- I wonder what might happen if you change the number under the motor or duration blocks?
- Can you see any blocks that might make the vehicle change direction? (change the rotation from clockwise to anticlockwise)
- I wonder if you could make the vehicle play a sound and/or flash a light to warn that it is about to move?
- I wonder if you could change the order of sound and light?



The number under this block sets the power of the motor. Encourage learners to test what happens when this number is changed. Does the robot move faster/slower?

Learners could build upon the code learnt in previous builds:

- The motion sensor or colour sensor could be used to start or stop the robot.
- A sound could be played or a light could flash when the code begins or ends. This idea could link to the reversing warning noise that is a feature on most newer models of cars.

LEGO WeDo 2.0 - Make a turn

Milo the Science Rover is not mechanically capable of turning due to its design. The purpose of this challenge task is to encourage learners to consider the design of a robotic model and any limitations it may face.

Closure (Document/ Share/Tidy up) [10-15 min]:

Resources:

- Digital portfolio
- Digital device

Document:

Each team documents and reflects upon their builds - adding to their digital portfolios etc.

Share:

1. What they did in the lesson
2. Show the coding skills they learned
   a. Explain how they changed the program
3. Describe how they adapted the LEGO vehicle to represent an electric car
4. Demonstrate their solutions
5. If they had more time, what other changes might they build/code?

Teams tidy up:

Everything built in this lesson should be disassembled and returned to the LEGO Education Set.

Suggested Learning Activities			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Science	Energy and forces; Materials	Forces; Properties and characteristics of materials	Design and make
Visual Arts	Construction	Making constructions	An awareness of space
Music	Composing Improvising and creating	Talking about and recording compositions	A sense of: pulse, duration, tempo, pitch, dynamics, structure, texture, timbre, style
History	Continuity and Change over time	Transport	Time and chronology; Cause and Effect; Using Evidence

Coding & Build [~20 min per build]

SPIKE Essential

The following two builds will further develop the building and coding skills of learners. Each build can be thematically linked to the theme of transport and electric vehicles.

Happy Traveller lessons:

Big Bus

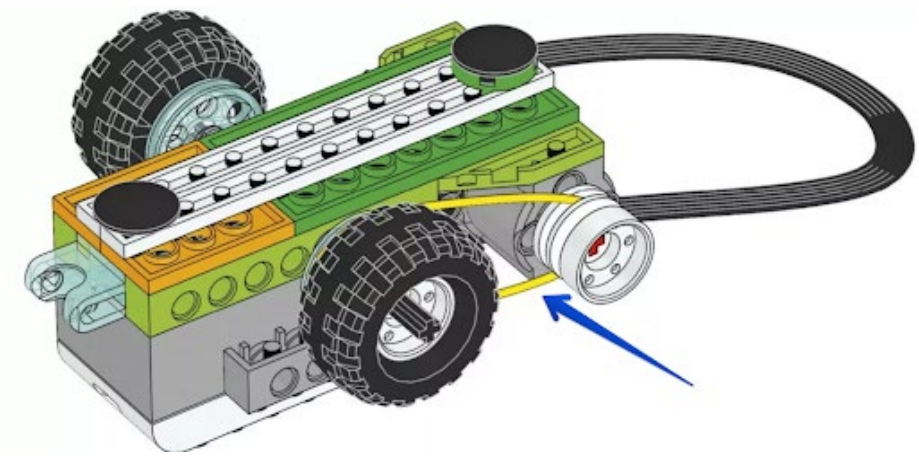
Taxi taxi

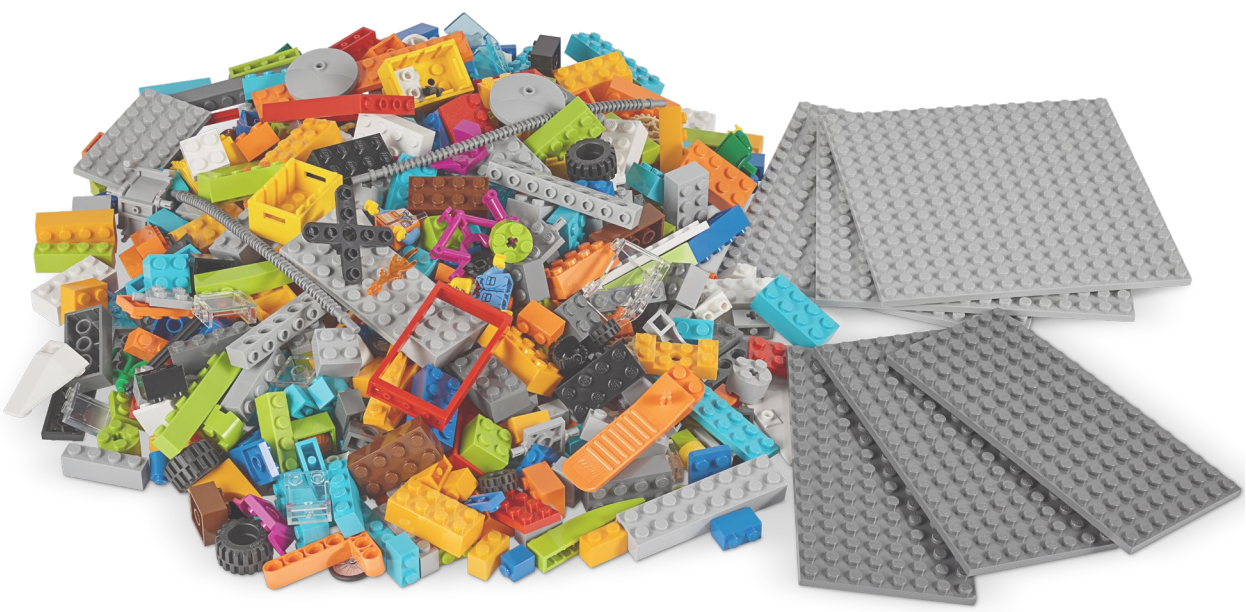
Science: Investigating with Milo/Snowmobile

Learners work in groups to program the 'fastest' vehicle. Each group will be given an investigation question:

- What impact does adding additional wheels have on the time it takes Milo/ Snowmobile to travel 2 metres? Predict how long you think it will take? Record your findings.
- What impact does adding larger wheels have on the time it takes Milo/ Snowmobile to travel 2 metres? Predict how much faster/slower? Record your findings.
- If I change the pulley system on the vehicle's wheel, what impact will it have on the speed of the vehicle? (see images below: Milo's wheel and pulley system on the left, and an example of changing the pulley system on the right)

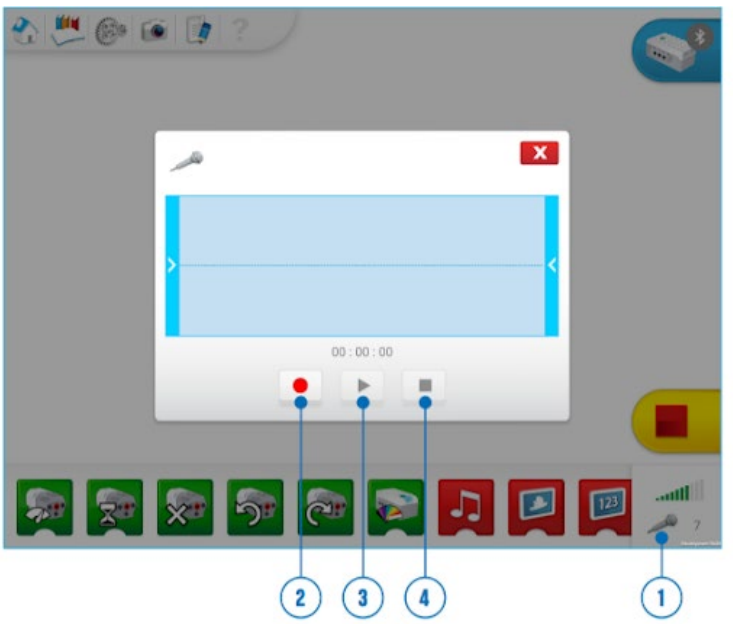
In groups, learners use the results from the above investigations to redesign a 'faster' vehicle.



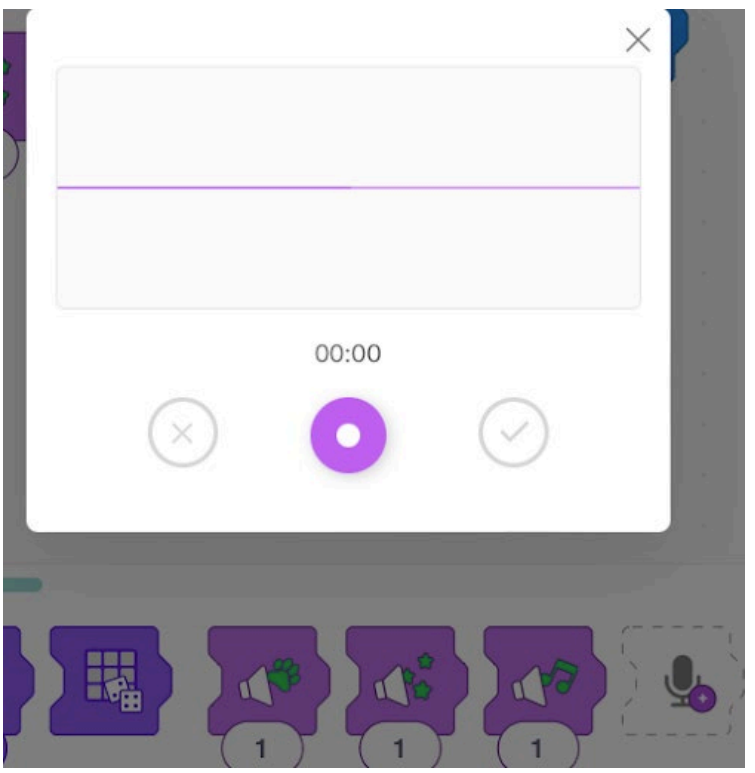


Music: Composing, Performing

- As it is an **EU law** that electric vehicles must make a noise while operating (**https://ec.europa.eu/growth/news/electric-and-hybrid-cars-new-rules-noise-emitting-protect-vulnerable-road-users-2019-07-03_en**), groups can compose a short piece of music that their electric car would make while moving.
- The following short video explains and sets up the learning activity:
  How Music Composers Are Replacing The Sound Of Engines In Cars
- Compose and perform a short melody which could be recorded and played by the Snowmobile/Milo the Science Rover as part of its program.
- Custom sounds or music can be recorded in each app using the blocks below:

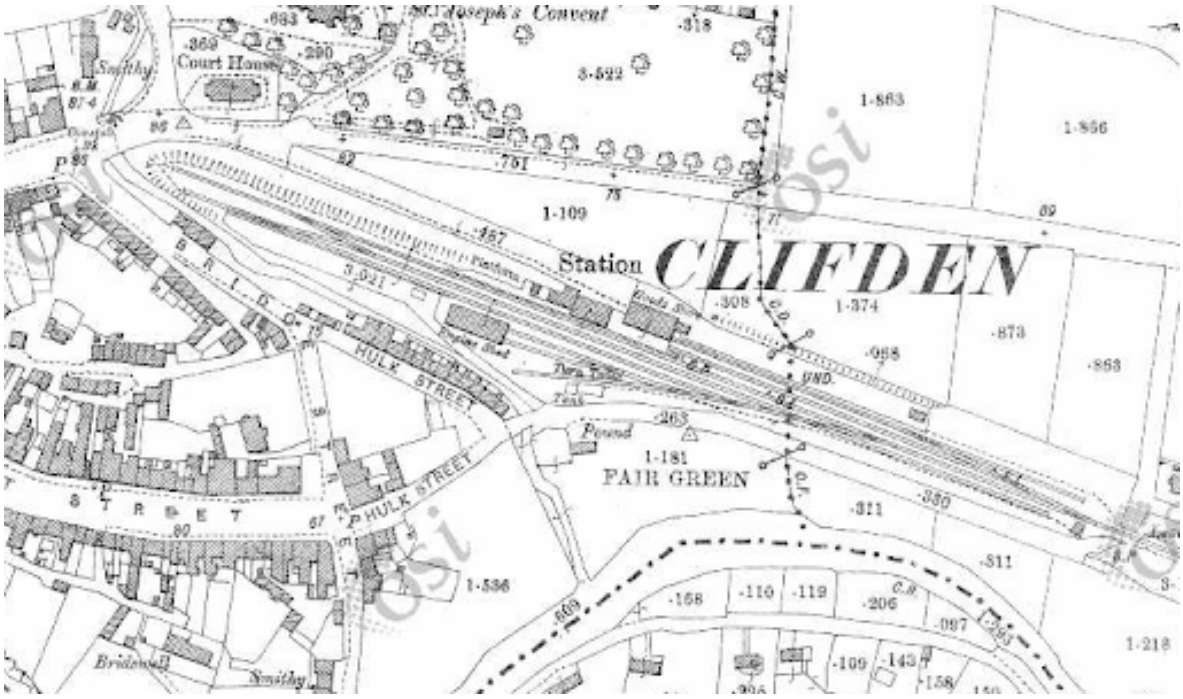


1. Press the Mic icon to access the window.
2. Press the Record icon to begin recording.
3. Press the Play icon to play back the recording.
4. Press the Stop icon to stop the recording.



History: Transport in the Past & in the Future

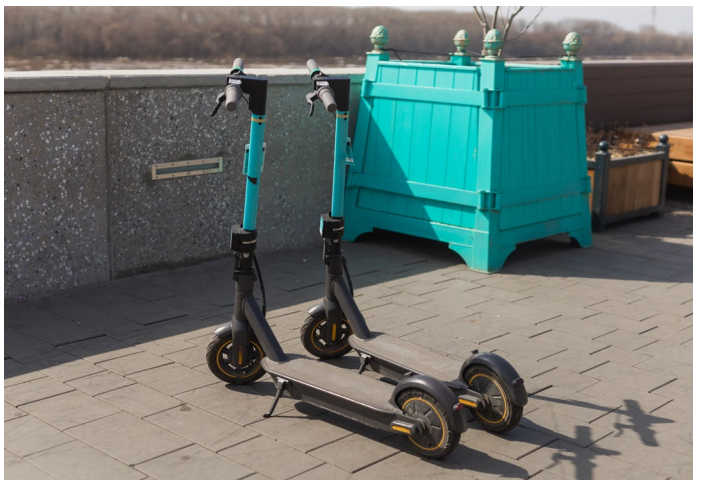
Learners could review old maps of the local area through Scoilnet or Geohive and identify evidence of different transport modes in the past and present (e.g. tramways, old rail lines, canals). The image below is a sample screenshot from Geohive 1913 map of Clifden, Co. Galway. Learners could investigate any evidence of the old railway today (such as Railway Avenue place name, old station building etc.).



Learners could investigate an historical form of transport such as the canal and inland waterways system (barges used for transporting sugar beet, coal and turf) and how these stopped when the railway system (which was faster and cheaper) was built.

Learners could investigate other forms of transportation around the world that are "superpowered" and could become more widely used in the future (e.g. Bullet train / Hyperloop **https://www.youtube.com/watch?v=L51xfyMeLqw**) or other ways in which transport is changing (e.g. transport that uses "sensors" - Tesla / driverless buses etc.).

Discussion Images for Lesson 8



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Lesson 9 & 10: Team Model

Team Model Requirements:

- Include motorised parts and sensors (at least one)
- Use LEGO coding (SPIKE/WeDo 2.0 app)
- Should fit on a table, be sturdy and be easily transportable (to be brought to showcase)

This *Teacher Guide for Ireland* supports greater flexibility and creativity for learners by adapting the build requirements on p. 23 of the SUPERPOWERED Engineering Notebook:

- There is **no** requirement to use the SUPERPOWERED Mat, or to include all three Explore models.
- If Explore models are used it is encouraged that they be adapted to suit the Energy Journey being improved by the learners.

Learning Outcomes:

Learners will be enabled to

1. Discuss knowledge and understanding of the SUPERPOWERED theme (to design a better energy journey for their community).
2. Work collaboratively to build and code a Team Model that shows a better way to source and/or store and/or use energy
3. Collaboratively design and label a Team Model.
4. Communicate the purpose of their Team Model, specifically: how it demonstrates a solution to a problem in the energy journey.

Learners will build:

- Each team will build a LEGO model of their own design which includes motorised parts and sensors (at least one).

Purpose:

In teams, learners will create a Team Model that shows 'Better ways to source, store, and use energy'. Their Team Model can address a specific part of the energy journey, or all of it.

Core Values:

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Curriculum Content

Subject	Strands	Strand units/ elements	Skills and concepts
Mathematics	Shape and space; Measures	2-D shapes; 3-D shapes; Time	Applying and problem-solving; Communicating and expressing
Science	Energy and forces; Materials	Forces; Properties and characteristics of materials	Design and make; Observation; Investigating and experimenting; Recording and communicating
Literacy	Oral Language; Writing	Communicating	Communicating; Understanding; Exploring and using
Visual Arts	Construction; Drawing	Making constructions; Making drawings	An awareness of line; An awareness of form; An awareness of space
SPHE	Myself and others; Myself and the wider world	My friends and other people; Relating to others; Developing citizenship	Communication; Co-operation; Decision-making

Resources

Per team:

- Materials for planning design (paper/digital tool e.g. Jamboard/ Book Creator)
- LEGO Education Set (SPIKE Essential or WeDo 2.0)
- SUPERPOWERED Explore Set (Wind Turbine, Energy Storage Model, Carousel)
- SUPERPOWERED Mat
- Prototyping pieces (from SUPERPOWERED Set)
- Digital device (for adding to digital portfolio)

Per Learner:

- Engineering Notebook p. 22 - 23

Digital resources:

Digital voting/response tool to support planning and brainstorming (e.g. Mentimeter, Sli.do)

- **Team Build Checklist**

Optional:

- The team model can use extra LEGO bricks, minifigures, baseplates and other LEGO elements in addition to the LEGO Education Set and SUPERPOWERED Set.

Introduction
[10 min]

Resources:

- Images of an Energy Journey
- Digital device (Mentimeter/Sli.do)

Introduction

1. Teacher introduces the lesson by reminding learners of the journey of energy from source to place of consumption such as a school/home as examined in Lesson 1.
2. Invite learners to think about their new knowledge and understanding of the journey of energy by working with a partner using a think-pair-share approach, or with their team in a snowballing approach. Learners can be asked to refer to their completed digital portfolios for further information.
3. Using an appropriate digital response gathering tool (e.g. **Mentimeter**) or blank A3 paper, invite learners to record what they know about the journey of energy from source to storage and distribution to consumption.

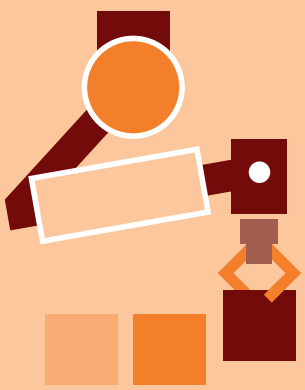
Key Questions:

- In what ways do we use energy in our daily lives? (at home, at school, etc.)
- How does our energy use differ at different times? (day vs night, week vs weekend, summer vs winter, etc.)
- Where does this energy come from? How is it generated or sourced?
- Can you explain how this energy gets stored and distributed to us?
- In what ways might we improve our energy consumption? (use less/use more efficiently/use more renewable sources)

Development (Build)
[80 min]

Resources:

- Engineering Notebook
- LEGO Education Set
- SUPERPOWERED Set
- Additional LEGO pieces
- Digital device
- A4 paper or relevant copybook for planning



1. Teacher explains to learners that they are now going to use all that they have learnt through the SUPERPOWERED lessons in order to *create a Team Model which shows 'better ways to source, store, and use energy'.*
2. **Explore:** In teams, learners;
   a. Brainstorm ideas on how to improve the journey of energy to their local area using a LEGO model.
   b. Learners can choose to focus on one part or all parts of the energy journey; Sources of Energy or Storage of Energy or Distribution of Energy or Consumption of Energy.

The following are scenarios which learners could consider in order to show *'better ways to source, store, and use energy'*:

- Renewable energy sources for the school's local area (wind/hydroelectric/solar)
- Safer or more efficient solutions to how energy is stored (electric charging points, change of use for filling stations, etc.)
- Better or more attractive ways of distributing energy (e.g. underground cables vs overhead pylons)
- Ways in which energy is used at home/at school/at local businesses/etc. How can this be done more sustainably?
- Ways energy is used in transportation (car/bus/train/plane etc.)

Teachers should refer back to some of the learning activities completed in previous lessons to support learners during the Explore stage. For example:

- School energy audit (lesson 1)
- Posters created of renewable and nonrenewable sources of energy (lesson 2). Webquest used in this lesson may also be useful for the Explore stage.
- Google Earth Interactive Map Project: How energy is stored around Ireland (lesson 5).
- Example Energy Journey (lesson 6) could be used to promote discussion and research.

The teacher will remind learners that additional LEGO elements could be brought in and used in building their team model (see Important Points to Note).

Development (Build) [Continued]

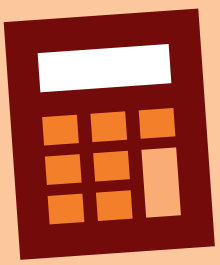
c. Allow teams time to discuss how they might create a Team Model which shows 'better ways to source, store, and use energy'.

3. **Plan:** Each team must draw a detailed plan of their design . Ask the learners to consider:
   a. What parts do you need?
   b. Could you adapt a part of one of the models you've encountered in previous lessons? (e.g. Snowmobile or Milo the Science Rover)
   c. Could one of the Explore models be adapted or included (Wind Turbine/Energy Storage Model/ Carousel)?
   d. Think about and record the coding skills you will use. Use the coding skills you have developed through previous builds (look at photos of code documented in your digital portfolios).
   e. How will your model use motorised parts and sensors?
   f. Planning could be done using a digital device, using pen and paper, or by using p. 22 & 23 of the Engineering Notebook.

Key Question:
How could you improve an Energy Journey? e.g. more sustainable; more efficient; safer; renewable sources.

[Suggested break between lessons]

4. **Make:** In teams, learners build their design using the prototyping pieces and any other LEGO elements available. Learners ensure that their team model meets the Team Model requirements:
   a. Include motorised parts and sensors (at least one)
   b. Use LEGO coding (SPIKE/WeDo 2.0 app)
   c. Should fit on a table, be sturdy and be easily transportable (for future showcase event to share and communicate ideas)
   d. Teams are encouraged to take inspiration from the builds encountered so far in order to develop an original motorised part in their model.



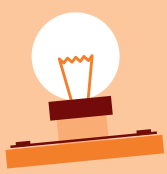
Development (Build) [Continued]

5. **Evaluate:** Encourage the learners to reflect on their build with their team: How does their team model show 'better ways to source, store, and use energy'.
   a. Have you improved the creation/sourcing of energy?
   b. Have you improved the storage and distribution of energy?
   c. Have you improved on the consumption of energy?
   d. What impact could this prototype have on energy journeys in your local area?
   e. What part of your model is motorised, and how have you coded this?
   f. What sensors have you used, and how do they improve your model?
   g. What other things would you like to add?
   h. What are the strengths and the weaknesses of your design? (particularly structural - is the model sturdy enough to be moved)

Closure (Document/ Share/Tidy up) [20 min]

Resources:

- Digital device
- Digital portfolio
- Team Build Checklist



Document:
Each team documents and reflects upon their builds - adding to their digital portfolios etc.

Share:

1. Teams share their completed Team Models with the class
2. Teams demonstrate what part of the Energy Journey their build enhances
3. Teams explain the program and how sensors and motors are used as part of their build.

Closure (Document/ Share/Tidy up) [Continued]

The following **checklist of questions** can support assessment while teams share their models and run their code:

- Is power running continually?
- Does it start/stop - is there a pattern?
- Is there a motorised part?
- What does it represent?
- Does it work as intended?
- Are sensors used?
- For what purpose?
- Does it work as intended?
- Does it make a sound?
- Is this sound linked to motion or as a safety feature?
- Could self-recorded sound be used?
- Are there any flashing lights?
- What do these lights symbolise or represent?
- Could ideas from other teams be adapted to improve your team's model?

Teams Tidy Up:

1. The Team Model will remain assembled from this point forward until the event and should be placed in the designated storage space.
2. Any unused pieces should be returned to the correct box and stored - this includes LEGO Education Set, prototyping pieces, and any LEGO elements supplied by learners.

Coding & Build Guidance for Teachers

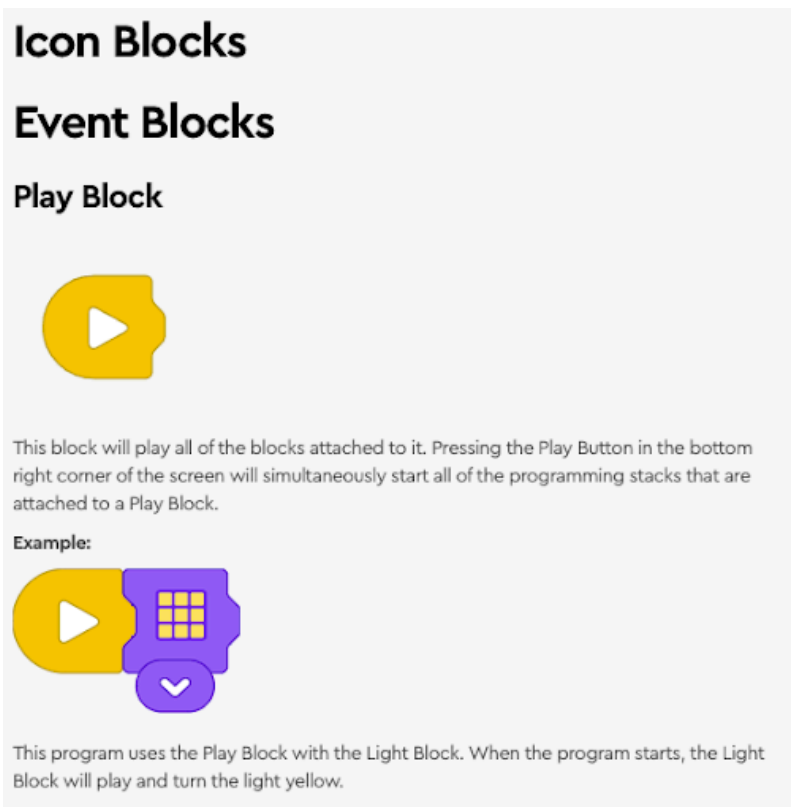
There is no specific code or build in this lesson.

The programs encountered to date should be adapted and innovated upon. Further assistance and guidance can be found below.

The LEGO WeDo 2.0 app includes a **program library** and **build library** which demonstrates ways in which learners could build and code their model in order to achieve different outcomes.

This can be accessed by clicking on the 'lightbulb' icon in the top left of the app.

The SPIKE Essential app **Help Section** (bottom left corner of the app) includes a helpful detailed explanation for each of the Icon Blocks used to create code.



Icon Blocks

Event Blocks

Play Block

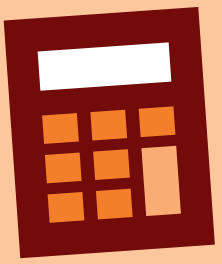
This block will play all of the blocks attached to it. Pressing the Play Button in the bottom right corner of the screen will simultaneously start all of the programming stacks that are attached to a Play Block.

Example:

This program uses the Play Block with the Light Block. When the program starts, the Light Block will play and turn the light yellow.

Teacher questioning and scaffolding will assist teams in creating innovative models. The more learners are questioned, the more they will be encouraged to think about the what/how/why of their prototypes/ models that represent their ideas. The following Guiding Questions could be adapted to support your class.

Coding & Build Guidance for Teachers



Guiding Questions:

- What part of your model could you motorise?
- What would you like it to do? How can you motorise it to do this?
- What sensors could you use? How might these sensors be used?
- Could we test and improve this?
- How does your model improve the journey of energy?
- Could you add any safety features to your model?
- I wonder if you could make use of skills you've encountered in other builds? Could your digital portfolio have ideas you could build on?
- Could your model make use of light and/or sound?
- Could you tinker with your code in order to make it work faster/slower?
- Could your model play an original sound? How could you record your own original sounds?
- I wonder if you could change the order of sound and light?
- Have you spoken to other teams to see how their model and code works?
- Could you learn from any of the other teams?

Important Points to Note:

If learners are allowed to bring in LEGO elements, it is advised that either:

- Any LEGO elements contributed will become part of the class materials and not returned.
- A clear record is kept of what a learner contributed so that it can be returned following completion of the project.

The teams will apply coding concepts throughout these lessons to create their programs.

As all teams will include learners of differing abilities, these lessons should be **differentiated** as required.

Closure (Document/ Share/Tidy up) [10-15 min]

Resources:

- Digital device
- Digital portfolio

Document:
Each team documents and reflects upon their builds - adding to their digital portfolios etc.

Share:

1. What they did in the lesson
2. Show the coding skills they learned
3. Demonstrate their solutions
4. Explain any problems they faced, and seek solutions from other learners.

Teams tidy up:

Once Team Models have been assembled, any other LEGO elements should be returned to the LEGO Education Set.

Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
Literacy	Writing	Exploring and using	Understanding Communicating; Understanding; Exploring and using
Drama	Drama to explore feelings, knowledge and ideas leading to understanding	Exploring and making drama Cooperating and communicating in making drama	Belief, role and character, action, time, tension
Visual Arts	Drawing	Making drawings	An awareness of line, shape, space, form, colour and tone, texture, pattern and rhythm

Literacy: Writing/Exploring and Using - Procedural Writing

Aided by media captured during these lessons (images, video, etc.), learners write instructions on how to build their Team Model.

Literacy: Oral Language/Exploring and Using - Podcasting

In teams, learners record a short podcast based upon their experience creating their Team Model. The podcast can be created using an appropriate digital tool (**anchor.fm**, **Vocaroo**, etc). Suggested content: what Energy Journey was chosen, how their model innovates on the journey chosen, what part of their model is motorised, how a sensor is used, how these were coded, the individual input of each team member, etc.

Drama: Drama to explore feelings, knowledge and ideas, leading to understanding/Exploring and making drama - 'The journey of energy to a destination'

In teams, learners create three scenes/tableaus which represent three 'stops' along the journey of energy within their Team Model.

Visual Arts: Drawing/Making Drawings, Paint and colour/Painting - Design a logo

Learners design a logo for their Team Model. Learners can first explore logos for energy supply companies in order to seek inspiration.

Team Build Checklist

1. Is power running continually?
    a. Does it start/stop - is there a pattern?
2. Is there a motorised part?
    a. What does it represent?
    b. Does it work as intended?
3. Are sensors used?
    a. For what purpose?
    b. Does it work as intended?
4. Does it make a sound?
    a. Is this sound linked to motion or as a safety feature?
    b. Could self-recorded sound be used
5. Are there any flashing lights?
    a. What do these lights symbolise or represent?
6. Could ideas from other teams be adapted to improve your team's model?

Lesson 11 & 12: Team Poster

Team Poster Requirements:

Divided into three sections which describe the team's journey throughout the lessons:

1. Explore - focused on their newfound knowledge and understandings of Energy Journeys
2. Create and Test - focused upon their builds and coding
   a. Previous builds
   b. Team Model
   c. How they tested and improved their build and code
3. Share - focused on how their model shows a better way to source and/or store and/or use energy in their local community.

Learning Outcomes:

Learners will be enabled to

1. Discuss knowledge and understanding of the SUPERPOWERED theme
2. Work collaboratively to plan and design a Team Poster which describes their team's journey throughout the lesson and supports their Team Model.
3. Communicate the purpose of their Team Model - how it demonstrates a solution to a problem in the energy journey.

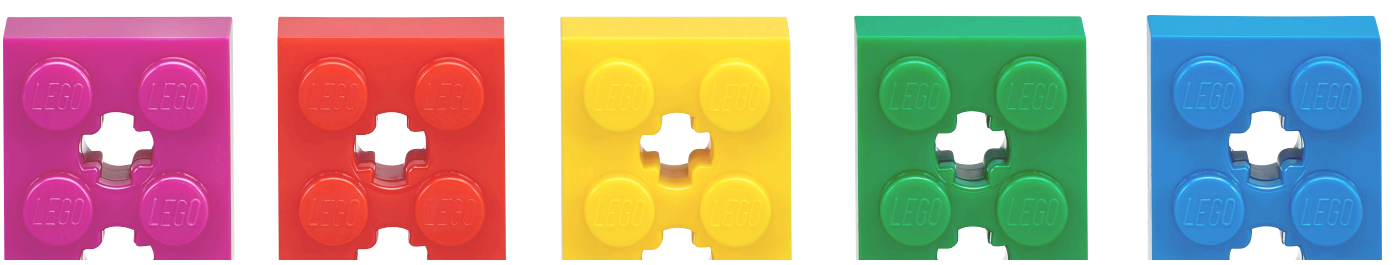
Purpose:

In teams, learners will plan, design and create their Team Poster to support their Team Model.

Core Values:

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14



Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Literacy	Oral Language Writing	Communicating	Communicating; Understanding; Exploring and using
Visual Arts	Construction; Drawing	Making constructions; Making drawings	An awareness of form; An awareness of space

Resources

Per team:

- Poster paper OR digital poster software (e.g. Canva, Slides, **piktochart**)
- Photos of team journey/Team Model/coding.
- Diagram of Team Model
- Poster board to present poster
- Markers/crayons/colouring pencils
- Engineering Notebook
- Reflections from each lesson
- Digital device (for reviewing and adding to digital portfolio)
- Engineering Notebook p. 24 & 25

Digital resources:

- Digital Poster software (e.g. Canva, Slides, **piktochart**)
- Digital voting/response tool to support planning and brainstorming (e.g. Mentimeter, Sli.do)
- **Examples of Team Posters PDF**

Introduction
[10 min]

Resources:

- Digital device
- Poster paper/ digital poster software
- Digital portfolio

1. Explain to learners that in this lesson they are going to design and create a Team Poster which illustrates the Energy Journey the Team Model represents, as well as the design process they followed in building their Team Model.
2. In teams, learners brainstorm what to include in their Team Poster. Engineering Notebook p. 24 & 25 can be used to scaffold this activity.
3. Learners should be encouraged to use the reflections/journal entries and photos that they documented in their digital portfolio throughout previous lessons.

Development (Create)
[40 min]

Resources:

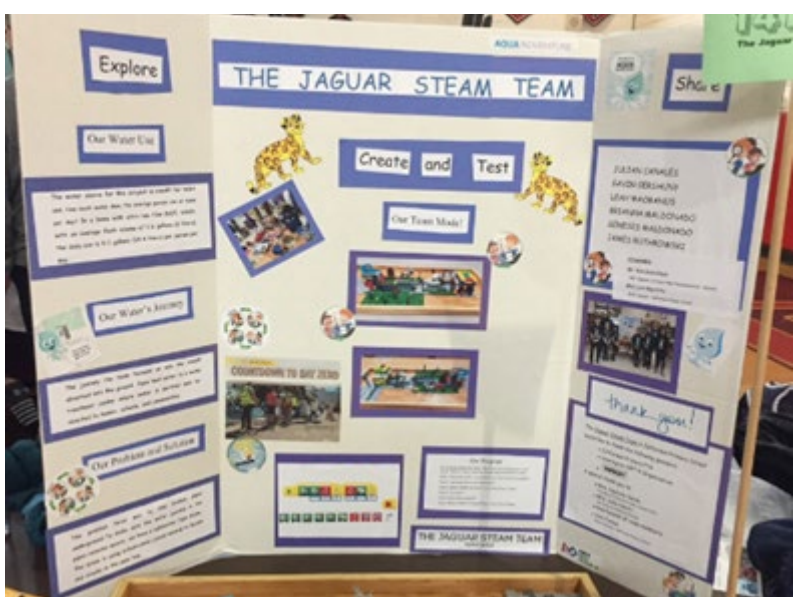
- Digital device
- Poster paper/ digital poster software
- Digital portfolio
- Diagram of Team Model
- Poster board
- Engineering Notebook
- Marker/crayons/ colour

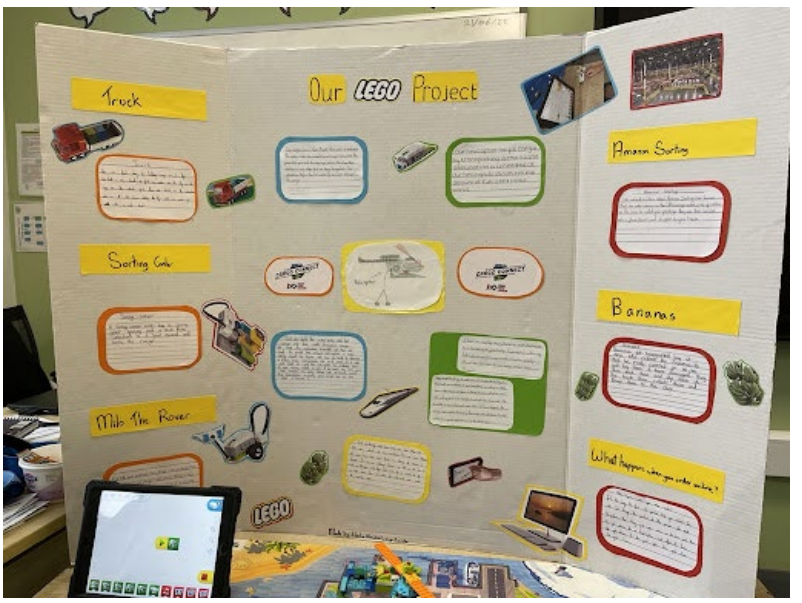
1. Clarify the **Team Poster Requirements** to learners. Divide the poster board into **three sections** which describe the team's journey throughout the lessons:
   a. Explore - focused on their newfound knowledge and understandings of Energy Journeys
   b. Create and Test - focused upon their builds and coding
      i. Previous builds
      ii. Team Model
      iii. How they tested and improved their build and code
   c. Share - focused on how their model shows a better way to create and/or store and/or use energy in their local community.

2. OPTIONAL: Use the '**previous Team Poster examples' resource** to support learners in brainstorming and structuring their Team Poster ideas.

Development (Create)
[40 min]

3. In teams, learners draft their ideas for their Team Poster. These can be added to the Engineering Notebook, p. 25. Learners should consider using the following headings:
    - **Team Name:** Each poster should include the team name.
    - **Explore:** It should tell the story of the team's build – pictures or words. Here the learners could explain the entire journey of energy in their team model.
    - **Our Problem and Solution:** Learners explain how they improved the journey of energy. Did they do any research to help them find a solution, e.g. search the internet, talk to an engineer, talk to a parent/ guardian? They could include these findings.
    - **Our Model:** Include a detailed drawing of the Team Model. If the team had a number of designs these can all be included here.
    - **Our Coding Program:** What program did the team use for their model? Can you add this here?
    - **Core Values:** Provide examples of how your team has used the Core Values throughout the lessons.
    - Encourage the use of keywords, photos, and diagrams related to their lessons in this project to date.





Sample posters from previous *FIRST* LEGO League Explore events.

Closure (Document/ Share/Tidy up) [10-15 min]

Share:

1. What they did
2. Demonstrate their poster design
3. Explain their team journey

Teams Tidy Up:

1. Learners store their posters in a safe place
2. Tidy away all art supplies

Resources:

- Digital poster/ paper poster

Suggested Learning Activities			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Literacy	Writing	Exploring and using	Understanding Communicating; Understanding; Exploring and using
Drama	Drama to explore feelings, knowledge and ideas leading to understanding	Exploring and making drama Cooperating and communicating in making drama	Belief, role and character, action, time, tension
Visual Arts	Drawing	Making drawings	An awareness of line, shape, space, form, colour and tone, texture, pattern and rhythm

Literacy: Writing/Exploring and Using - Procedural Writing

Aided by media captured during these lessons (images, video, etc.), learners write instructions on how to build their Team Model.

Literacy: Oral Language/Exploring and Using - Podcasting

In teams, learners record a short podcast based upon their experience creating their Team Model. The podcast can be created using an appropriate digital tool (**anchor.fm**, **Vocaroo**, etc). Suggested content: what energy journey was chosen, how their model innovates on the journey chosen, what part of their model is motorised, how a sensor is used, how these were coded, the individual input of each team member, etc.

Drama: Drama to explore feelings, knowledge and ideas, leading to understanding/Exploring and making drama - 'The journey of energy to a destination'

In teams, learners create three scenes/tableaus which represent three 'stops' along the journey of energy within their Team Model.

Visual Arts: Drawing/Making Drawings, Paint and colour/Painting - Design a logo

Learners design a logo for their Team Model. Learners can first explore logos for energy supply companies in order to seek inspiration.

Lesson 13: Let's Share

Final Celebration Event

The capstone to the *FIRST* LEGO League Explore project is a Final Celebration Event where teams can present their models and posters to other learners. Regional events will be taking place, with full details available on **https://fll.learnit.ie/**

Schools and teachers may also opt for a Final Celebration Event within their own school where members of the school community are invited to learn about the solutions proposed by each team.

However the class decides to share their projects and solutions, it is important that all learners get a chance to both present their work, and examine the work of other teams. This is to enable deeper reflection and learning.

Further helpful information is available on p.30 of the **Team Meeting Guide**.

Learning Outcomes:

Learners will be enabled to

1. Communicate the purpose of their Team Model and Poster at a Final Celebration Event - how it demonstrates a solution to a problem in the Energy Journey.
2. Discuss their knowledge and understanding of the SUPERPOWERED theme.

Purpose:

In teams, learners will plan for how they will share their Team Model and Team Poster at the final event.

Core Values:

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Resources

Per team:

- Team Model
- Digital device (tablet, laptop)
- Team Poster
- Engineering Notebook pages 26 & 27

Digital resources:

- Reviewing Sheet and Questions for Final Celebration Event

Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Literacy	Oral Language Writing	Communicating	Communicating; Understanding; Exploring and using
Visual Arts	Construction; Drawing	Making constructions; Making drawings	An awareness of form; An awareness of space
Science	Environmental awareness and care	Environmental awareness	Working scientifically; Analysing; Designing and making
Geography	Environmental awareness and care	Caring for the environment	A sense of place; Geographical investigation skills

Introduction [10 min]

1. Explain the Final Celebration Event where the learners will showcase their LEGO builds and posters.
2. The key purpose of these events is for learners to share their projects and learn from others. There is an equal focus on sharing the what/why/how of their project, as there is on learning from the projects of others.

Development [20 min]

In teams, learners decide who will present each section of the poster.

1. Learners review their Team Model and ensure that their code works. Learners decide who will present the Team Model.
2. In teams, learners discuss what they have learned throughout the SUPERPOWERED lessons. Learners should be prepared to share what they have learned at the Final Celebration Event.
3. Pair teams up so that each team can practise their presentations with other learners.
4. Sample reviewing sheet and reviewing questions can be used to support the learners during this lesson.

The *FIRST* LEGO League Explore team have prepared review questions and self-assessment checklists to assist teams in preparing for their Final Celebration Event. These can be accessed below:

Reviewing Sheet and Questions for Final Celebration Event

The prompt questions on p. 27 of the Engineering Notebook could be used to further scaffold teams in their preparations.

Closure (Document/ Share/Tidy up) [10 min]

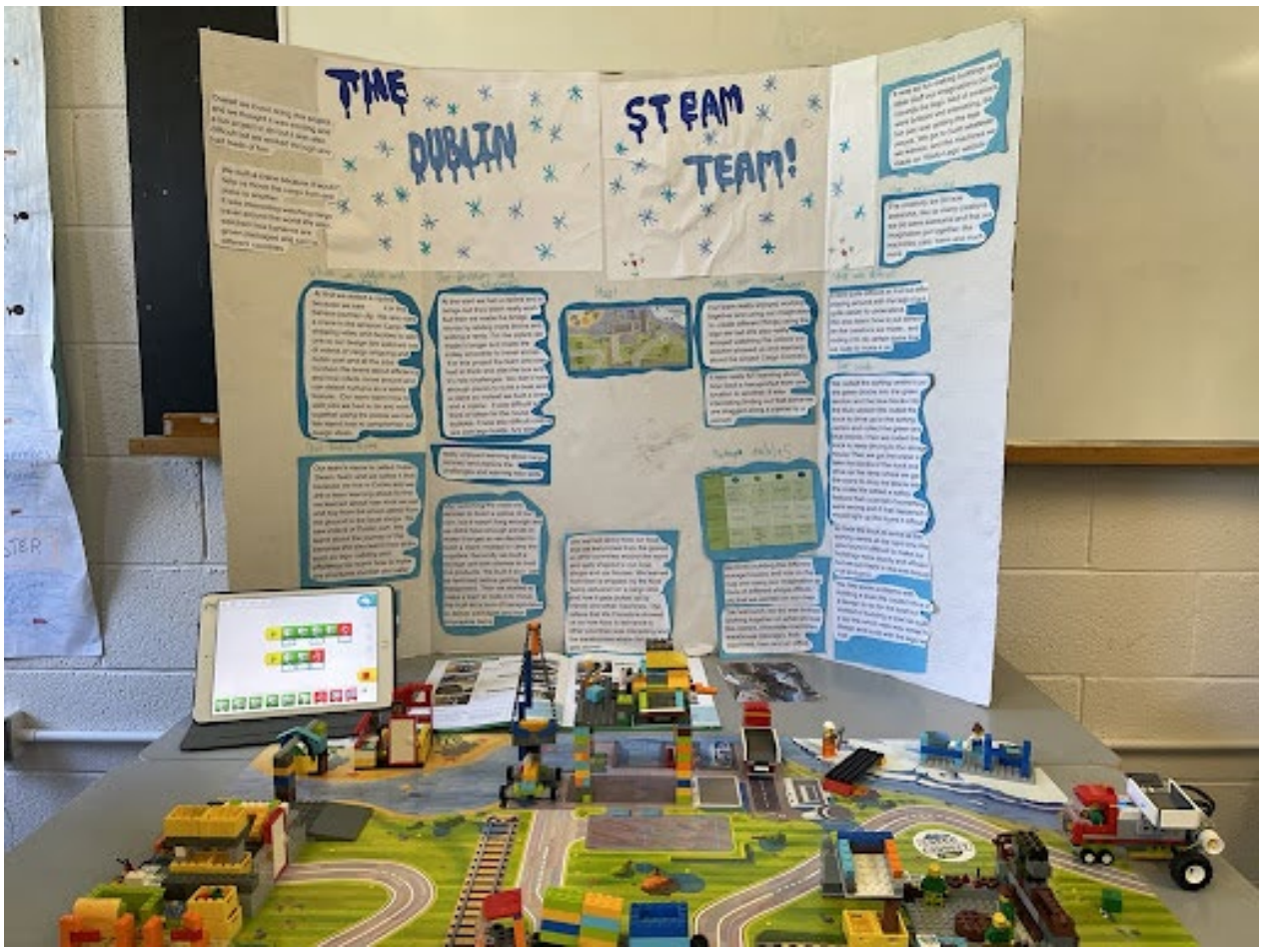
Share:

Reflection and assessment (self and peer) of presentations

Teams Tidy Up:

Ensure Team Models and Team Posters are stored and ready to be transported to the event.

Ensure all devices are fully charged.



Suggested Learning Activities

Subject	Strands	Strand units/ elements	Skills and concepts
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Literacy: Oral Language/Exploring and Using - Podcasting

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Drama: Drama to explore feelings, knowledge and ideas, leading to understanding/Exploring and making drama - 'The journey of energy to a destination'

In teams, learners create three scenes/tableaus which represent three 'stops' along the journey of energy within their Team Model.

Visual Arts: Drawing/Making Drawings, Paint and colour/Painting - Design a logo

Learners design a logo for their Team Model. Learners can first explore logos for energy supply companies in order to seek inspiration.

Lesson 14: Let's Reflect

Learning Outcomes:

Learners will be enabled to

1. Describe their team's journey throughout the SUPERPOWERED lessons.
2. Discuss their knowledge and understanding of the SUPERPOWERED theme.

Purpose:

Learners will reflect upon the SUPERPOWERED lessons, their Team Model and Poster, and their understanding of energy journeys.

Core Values:

Teamwork | Innovation | Fun | Impact

Progress:

1 2 3 4 5 6 7 8 9 10 11 12 13 14

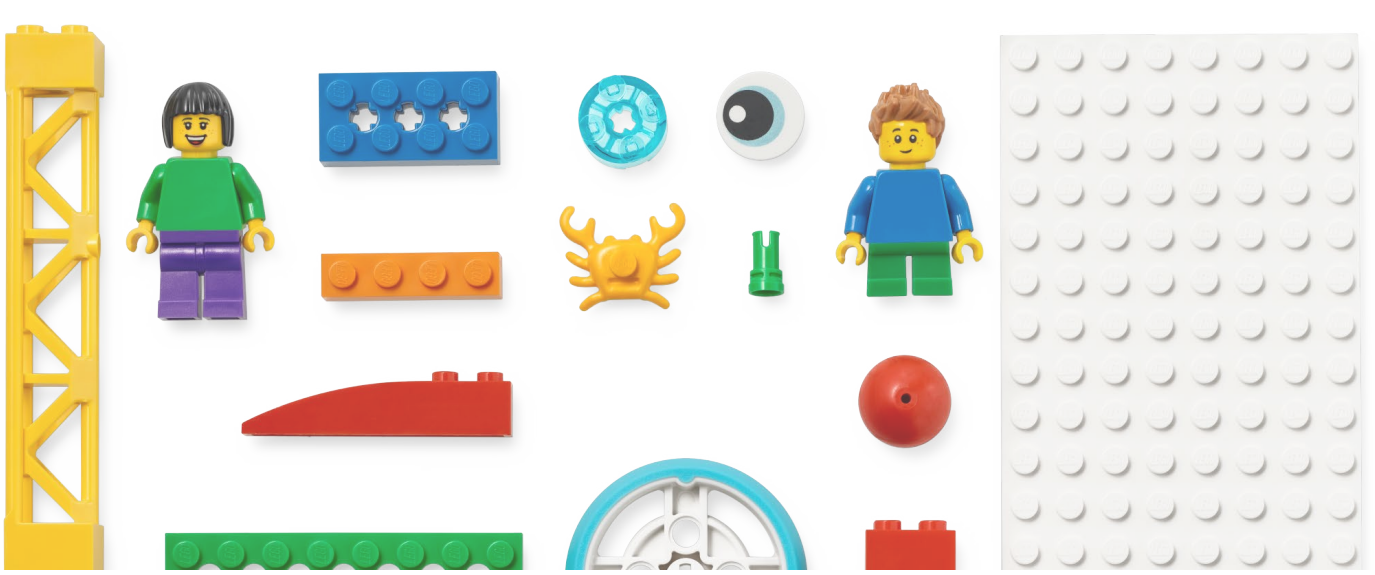
Resources

Per team:

- Team Model
- Digital device (tablet, laptop)
- Team Poster

Digital resources:

- Reflection Prompt Questions
- Discussion images for Lesson 14



Curriculum Content			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
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Science	Environmental awareness and care	Environmental awareness	Working scientifically; Analysing; Designing and making
Geography	Environmental awareness and care	Caring for the environment	A sense of place; Geographical investigation skills

Revisiting Energy Journeys [25 min]

Resources:

- Discussion Image 1: SUPERPOWERED Challenge
- Discussion Image 2: Concept Map

1. Revisit the introduction and purpose of SUPERPOWERED with learners:

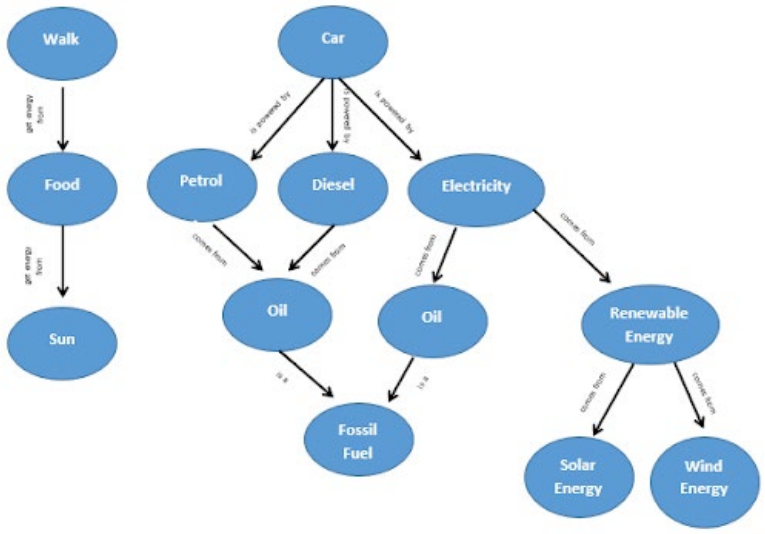
   The purpose of this project is that the learners will engage in 14 lessons through which they will learn how energy is sourced and distributed to homes, schools and businesses. They will identify issues and opportunities for improvement of this process and design solutions to create a better energy journey for their community with regard to energy sources, energy distribution and energy usage. Through building and coding with LEGO Education Sets, learners will demonstrate their ideas, knowledge and understanding.

   Discussion Image 1: SUPERPOWERED Challenge

2. In groups, learners create a concept map of the energy used and where it comes from. See sample concept map below. Concept maps should have key words, arrows to indicate the direction of the relationship and connecting words above each arrow to describe the relationship. This will be useful to consolidate learning on energy sources and uses.

   Discussion Image 2: Concept Map

Revisiting Energy Journeys [Continued]



3. Now that we have built Team Models, created Team Posters, and shared our solutions at a Final Celebration Event, it is time to reflect on all that we have achieved and learned along the way.

Meta Reflection [25 min]

Resources:

- Digital devices
- **Prompt questions to display on IWB**

The following prompt questions should be considered by learners following engagement with SUPERPOWERED.

These might be discussed orally, in small groups or teams, or independently using a device/paper.

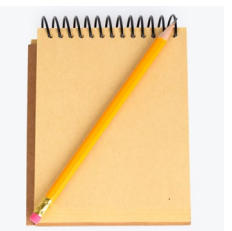
1. What are three things you learnt?
2. What is one thing that you learnt about yourself through completing SUPERPOWERED?
3. What part of SUPERPOWERED stands out for you? (your favourite lesson, build, code?)
4. What will you do differently now as a result of SUPERPOWERED?
5. What changes could you or your family make to live more sustainably?
6. Can you think of an example of when you demonstrated the *FIRST* Core Value of: Teamwork, Inclusion, Innovation, Fun, Discovery, Impact?
7. What would you like to do with your LEGO Education Set next?
8. What other problems could we explore through the Engineering Design Process?

Following discussion, learners could be tasked with one of the following activities to further their reflection. The finished products could then be shared with the school community.

Meta Reflection [Continued]

Record a short video diary of their experiences of SUPERPOWERED

Make an audio recording or podcast



Write a short diary entry and type or photograph this for inclusion in their digital portfolio.

Audit Equipment

Any final photos or videos of the Team Model should be taken as the final part of this project is to disassemble and audit the LEGO Education equipment.

All LEGO Education equipment should be disassembled and returned to its correct place.

All elements from the SPIKE Essential or WeDo 2.0 boxes should be returned and audited using the audit sheet on page 39.

If any elements have been lost, replacements can be ordered from:

https://www.lego.com/en-ie/pick-and-build/pick-a-brick

All LEGO elements from the SUPERPOWERED Explore Set should be disassembled and returned to suitable containers (e.g. ziplock bags) for use by a future class. It is highly advised that the Explore models (e.g. Wind Turbine) be disassembled into separate bags for future use.

Any LEGO elements belonging to learners can be disassembled and returned to them at this point.

Resources:

- Audit sheets
- **WeDo 2.0 Element Overview**
- **SPIKE Essential Element Overview**
- **fll.learnit.ie/videos/sortingkit**

Suggested Learning Activities			
Subject	**Strands**	**Strand units/ elements**	**Skills and concepts**
Literacy	Writing	Exploring and using	Understanding Communicating; Understanding; Exploring and using
Drama	Drama to explore feelings, knowledge and ideas leading to understanding	Exploring and making drama Cooperating and communicating in making drama	Belief, role and character, action, time, tension
Visual Arts	Drawing	Making drawings	An awareness of line, shape, space, form, colour and tone, texture, pattern and rhythm

Literacy: Writing/Exploring and Using - Procedural Writing

Aided by media captured during these lessons (images, video, etc.), learners write instructions on how to build their Team Model.

Literacy: Oral Language/Exploring and Using - Podcasting

In teams, learners record a short podcast based upon their experience creating their Team Model. The podcast can be created using an appropriate digital tool (**anchor.fm**, **Vocaroo**, etc). Suggested content: what Energy Journey was chosen, how their model innovates on the journey chosen, what part of their model is motorised, how a sensor is used, how these were coded, the individual input of each team member, etc.

Drama: Drama to explore feelings, knowledge and ideas, leading to understanding/Exploring and making drama - 'The journey of energy to a destination'

In teams, learners create three scenes/tableaus which represent three 'stops' along the journey of energy within their Team Model.

Visual Arts: Drawing/Making Drawings, Paint and colour/Painting - Design a logo

Learners design a logo for their Team Model. Learners can first explore logos for energy supply companies in order to seek inspiration.

SUPERPOWERED Reflection Prompt Questions

1. What are three things you learnt?
2. What is one thing that you learnt about yourself through completing SUPERPOWERED?
3. What part of SUPERPOWERED stands out for you? (your favourite lesson, build, code?)
4. What will you do differently now as a result of SUPERPOWERED?
5. What changes could you or your family make to live more sustainably?
6. Can you think of an example of when you demonstrated the *FIRST*® Core Value of: Teamwork, Inclusion, Innovation, Fun, Discovery, Impact?
7. What would you like to do with your LEGO® Education Set next?
8. What other problems could we explore through the Engineering Design Process?

References

fll.learnit.ie/qr/superpowered/references

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