

SDG12 Future of Innovation and Enterprise

MM5: Introduction to Engineering for Good



Micro-Module 5: Introduction to Engineering for Good

Exploration and Experimentation

Lesson 1: Engineering a Better World 1

Subjects: Applied
Technology, Climate
Action and Sustainable
Development, Digital
Literacy, Technology

Lesson Title and Summary: Engineering a Better World 1

Engineering a Better World 1 introduces learners to the concept of Engineering, the different fields of the industry and how it can be used to help meet the Sustainable Development Goals.

Vocabulary:

Engineering, Prototype, Innovation

In this lesson, the learner will...

- develop their understanding of engineering
- develop their understanding of how engineering can be used to help solve the SDG's

Materials:

- Mix & Match Cards: Fields of Engineering
- SDG Image - see media box
- Teachers' Guide
- Notebooks, Pen/Pencil



MM4: Introduction to Engineering for Good

L1: Engineering a Better World 1



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



11 SUSTAINABLE CITIES AND COMMUNITIES



13 CLIMATE ACTION



Activity Instructions

Activity 1: Fields of Engineering (20 min)

1. Elicit a general response of what engineering is.
2. Ask learners to form groups of 2-3.
3. Give each group a set of Mix & Match cards and ask them to connect each field of engineering to its' description.
4. Go through the answers, using the Teachers' Guide to support the discussion.

Activity 2: Ideation: What SDGs do you think engineering can help meet? (30 min)

1. Put the SDG image on screen or print off copies:
2. In the same groups, learners will brainstorm different ways that they think engineering can help meet specific SDGs. Suggest each group selects 4-5 SDGs or assign each group enough so that all 17 goals are being discussed. Model examples with one SDG before they begin. See Teachers' Guide.
3. Summarise key ideas with the whole class. This can be done on poster paper and hung up in the classroom to refer to in the next lesson.

Reflective Exercise: 3-2-1 (10 mins)

- Three things they feel they have learnt from the tasks
- Two things they found most interesting and would like to explore more
- One opinion they have about the tasks

Use Post-its or a mentimeter survey - www.mentimeter.com - to gather reflections

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Extension / Reduction Activities

Reduction: For a shorter class, reduce the timings of Activities 1 & 2.

Extension: For a longer class, ask groups to select one idea from the summary in Activity 3 to build out in more detail.

Media (materials, online video links, extra resources, case studies etc)

Activity 2: SDG Image <https://www.un.org/development/desa/en/news/sustainable/sustainable-development-goals.html>

What is engineering? [4:17min] <https://youtu.be/bipTWWHya8A?si=Dnxwe1r5xdkxNnCc>

How to meet the Sustainable Development Goals together [5:04min] <https://youtu.be/wXASRXbjR08>

Open Source Ventilator project, a collective global engineering for good project during Covid led by an Irish engineer Colin Keogh

<https://sciencegallery.org/stories/colin-keogh-and-the-open-source-ventilator-project>

The Rapid Foundation <https://www.therapidfoundation.com/>

Engineers without Borders <https://ewb-ireland.org/>

Engineers for a Sustainable World <https://www.eswglobal.org/>

Local Tips / Expertise / Additional Work and Assessments

Invite local engineers to speak to the class about projects they work on, and their connection to the SDGs.

Organise a virtual talk with an engineer working on particular SDG-related problems. Contact Engineers without Borders or Engineers for a Sustainable world - links in the media box

Organise an interview with The Rapid Foundation to find out more about Open Source Engineering and Engineering for good projects in Ireland - see media box



What is engineering?

Engineering is a broad field that involves the application of science and mathematical methods to design, create, and improve technologies, systems, structures, and processes to meet specific needs. Engineers use their knowledge and skills to innovate and solve practical problems across various industries.

Mix & Match Cards- Fields of Engineering (Answer Key)

Civil: Responsible for the planning, construction & maintenance of fixed structures as they relate to earth, water or civilisation: buildings, infrastructure, transportation systems

Structural: Design the 'bones and joints' that create the form and shape of human-made entities. Understand and calculate the stability, strength, rigidity and earthquake-susceptibility.

Biomedical: Applying traditional engineering methods and techniques to solve problems in biology and medicine, and advance healthcare.

Mechanical: Design, analyse, manufacture, and maintain systems that run on machines. One of the oldest and broadest fields of engineering.

Energy Systems: Working on solutions to the world's energy problems, focusing on the interdependence between electricity systems, building energy systems, transport system, food supply chain and industrial production system.

Electrical: Concerned with the energy uses of electricity and focuses on the generation, transmission and final use of the electricity that powers our world.

Chemical & Bioprocess: Transformations (e.g. the transformation of crude oil into petrochemicals) and how such transformations can be realised on a large scale through research, design, construction and operation.

Electronic: Concerned with the design of circuits and systems (both hardware and programming/software) that underpin the on-going revolution in mobile communications, internet and digital media



Fields of Engineering Support Notes

Civil engineering

- High demand for Civil Engineers in Ireland
- €27 billion capital plan by Irish government (transport, flood defences, schools and hospitals)
- Civil is becoming more interdisciplinary, e.g. combining with electronics – sensors into structures, sensing is a structure becoming weaker and how to manage that.
- Wind turbines can account for 40 – 60% of the energy load produced in Ireland, but building wind farms off shore have their problems, Civil are looking to ensure structures can be built and how to do this for example on sand.

Structural engineering

- Structural engineers in Ireland typically have a background in civil or structural engineering.
- Ireland has experienced significant economic and infrastructural development in recent years. This growth has led to an increased demand for structural engineers, particularly in the construction sector.
- There is an increasing emphasis on sustainability and environmental considerations in structural engineering practices. Engineers in Ireland are likely to consider energy efficiency, environmentally friendly materials, and overall sustainability in their designs.

Biomedical engineering

- 13 of the world's top 15 biomedical device companies have operations in Ireland
- 250 med tech companies in Ireland exporting €12.6 billion worth of product annually
- Highest number of people per capita working in the industry in Europe.
- Biomedical engineering integrates knowledge and techniques from engineering, biology, chemistry, physics, and computer science. This interdisciplinary approach is essential for addressing complex challenges in healthcare.
- Biomedical engineering is a rapidly evolving field, and advancements in technology and medicine continue to drive innovation in areas that benefit patient care and overall public health.



Fields of Engineering Support Notes

Mechanical engineering

- 95% employment rate- strong manufacturing sector in Ireland.
- Examples of mechanical engineering in the real-world:
 - Microneedles mounted on a patch (array of needles half a millimetre high) that can be place on the skin – deliver certain drugs into the body.
 - Rapid foundation – Colin Keogh & Shane Keaveney provide 3D printed supports like arm casts and splints in Uganda and India.
 - 3D implantable devices for people with coronary artery disease / diabetes two of the worlds most prevalent chronic diseases in the developed world.

Energy Systems engineering

- The Annual Review on Renewable Energy and Jobs of 2014 report from the International Renewable Energy Agency (IRENA) showed a total of 6.5 million jobs around the world supported by the renewable energy sectors.
- Students in UCD Energy Masters are at the cutting edge of energy innovation. They are exposed to academics who are championing energy research projects and industry collaboration at a global level.

Electrical engineering

- Ireland is the internet & games capital of Europe; 3 of the world's top gaming companies are here
- Ireland is a top 5 world exporter of software
- 8/10 world's top technology companies are based in Ireland
- €1.5 billion being invested in sustainable energy technologies / services in Ireland annually.
- Use creative ways to generate and handle electricity and information.
- They have developed the technologies we use to listen to music and communicate with one another, including smartphones and the Internet.

MM5 L1TG WHAT IS ENGINEERING?

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Fields of Engineering Support Notes

Chemical & Bioprocess engineering

- Vibrant national pharmaceutical industry; 9 of the world's top 10 pharma companies are based in Ireland.
- 12 of the world's top selling medicines are manufactured in Ireland.
- Chemical and Bioprocess Engineering is a branch of engineering that applies principles from chemical engineering to biological systems and processes. It involves the design, optimization, and operation of processes that use chemical or biological transformations to produce various products.

Electronic engineering

- It encompasses a wide range of technologies, from small-scale integrated circuits to large-scale power systems.
- Ireland has become a hub for research and development in information and communication technologies. Research institutions and industry collaborations focus on advancing electronic engineering solutions for future technologies.
- Electrical and electronic engineers are also developing new ways to solve the world's energy problems by harnessing renewable energy sources like wind and ocean energy.

Ideation: What SDGs do you think engineering can help meet?

2 ZERO HUNGER



Engineers are building new robotic farm machinery to help increase crop fields for increased food supply.

3 GOOD HEALTH AND WELL-BEING



Engineers are creating high tech prosthetic limbs to help people regain their mobility and independence.

6 CLEAN WATER AND SANITATION



Engineers are developing new ways to turn seawater into fresh drinking water (Desalination Plants).

7 AFFORDABLE AND CLEAN ENERGY



Engineers are improving solar power to help supply more green renewable energy even in countries with little sunshine.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Engineers have designed processes to allow recycled plastic bottles to be turned into clothes and shoes.

14 LIFE BELOW WATER



Engineers are 3D printing new coral structures to help natural coral recover from damaged caused by global warming.

MM5: L1WS MIX & MATCH CARDS

12 RESPONSIBLE
CONSUMPTION
AND PRODUCTION



Civil
engineering

Structural
engineering

Biomedical
engineering

Mechanical
engineering

Energy Systems
engineering

Electrical
engineering

Chemical &
Bioprocess
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Electronic
engineering



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