



Rapid Prototyping For Communities

SDG 11 - (targets 11.2, 11A)

Science, Engineering, Technology



4 QUALITY EDUCATION



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



11 SUSTAINABLE CITIES AND COMMUNITIES



Module includes

- **01 Introduction to Engineering:**
- **02 Waste Recycling**
- **03 3D Printing**
- **04 Innovation**



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Module Description

The Rapid Prototyping toolkit has been designed for community participants to gain an introductory awareness of how engineering and innovation can be applied to the Sustainable Development Goals. The skills learnt promote the targets of SDG11; Sustainable Cities and Communities.

Overarching Aims

There are four sessions in the Rapid Prototyping toolkit; Introduction to Engineering, 3D Printing, Innovation and Waste Recycling.

01 Introduction to Engineering:

Participants will...

- develop their understanding of Engineering general and the different fields of study
- develop their understanding of how engineering can be used to help solve the SDG's
- learn the concept behind and utilise the idea of the engineering design process
- work collaboratively with peers on an engineering related problem
- plan, design, sketch and Improve a design prototype

02 Waste Recycling:

Participants will...

- develop their understanding of the issues around human produced waste, recycling and the complexities of the recycling process
- learn how to effectively support recycling in their communities
- learn about how creative technology use can be applied to clean up global waste
- work collaboratively with peers on a recycling related problem
- plan, design, sketch and build a recycling system



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03 3D Printing:

Participants will...

- Develop their understanding of 3D Printing, how it works and what it can be used for
- Develop their understanding of how it relates to traditional manufacturing processes
- Learn the concept behind the practical aspects of 3D printing
Examine potential applications for 3D printing to tackle SDG related problems
- Ideate on potential problems and solutions arising from the use of 3D Printing

04 Innovation:

Participants will...

- develop their understanding of the concept of Innovation
- develop their understanding of the different types of Innovation
- learn how to ideate effectively
work collaboratively with peers on an ideation and innovation problems

Outline of lessons/time

There are four, 60-minute sessions in the toolkit, that can be run in a variety of formats;

- Two, full day sessions
- Four, half day sessions that are run over a week, a fortnight or a month.
- Online and bespoke delivery options can also be developed and delivered





Session 01

Engineering a Better World

SESSION TIME
60 MINUTES

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Lesson Title & Summary: Engineering a Better World

Engineering a Better World introduces learners to the concept of Engineering and how it can be used to help meet the SDG targets. It develops problem-solving skills through a design challenge, applying principles of Engineering.

The learner will.....

- develop their understanding of Engineering in general and the different fields of study
- develop their understanding of how engineering can be used to help meet the SDG's
- learn the concept behind and utilise the idea of the engineering design process
- work collaboratively with peers on an engineering related problem
- plan, design, sketch and improve a design prototype

Resources

- "Engineering a Better World" presentation
- CoDesRes SDG Cards
- Notebooks, Pen/Pencil
- 4 Index Cards
- 2 Pieces of Paper (A4)
- 4 Pieces of Newspaper
- 10 Craft/Lollipop Sticks
- Graph paper (roughly 91 sq. cm)
- Ruler
- 10 Pieces of Masking Tape (8 cm long)
- 4 Straws
- Hair Dryer (Permission required)

Session 01

STAGE 1

10 Minutes

Resources

**Presentation: Part 1
Engineering a Better World**

“Engineering a Better World” Presentation Part 1

1. Show the PowerPoint presentation for the class (or give a printed copy).
2. Use the question slides to engage and assess their prior knowledge
3. Review the concept of Engineering and the different types of Engineering that exist.

10 Minutes

Resources

- Notebooks
- Pen/Pencil
- Paper
- SDG Cards

STAGE 2

Ideation: What SDG’S do you think Engineering can help meet?

1. Divide learners into small groups (2-3).
2. Display the SDG cards on the screen or give each group a copy.
3. Ask groups to discuss which SDG’s Engineering can help meet. Encourage them to think about what engineering solutions may help tackle each SDG identified.
4. Nominate a spokesperson per group and summarise key ideas with the whole class.

10 Minutes

Resources

**Presentation: Part 2
Engineering a Better World**

STAGE 3

“Engineering a Better World” Presentation Part 2

1. Continue running through the PowerPoint presentation to introduce learners to the ways Engineering is helping to tackle the SDG’s.
2. Discuss the examples as they will prepare learners for Stage 4.

Session 01

STAGE 4

25 Minutes

Resources

- Pen / Pencil
- 4 Index Cards
- 2 Pieces of Construction Paper (A4)
- 4 Pieces of Newspaper
- 10 Craft / Lollipop Sticks
- Graph paper (roughly 91 sq. cm)
- Ruler
- 10 Pieces of Masking Tape (8 cm long)
- 4 Straws
- Hair Dryer

Activity: Desert Island Survival

1. Divide learners into groups of 4.
2. Explain the list of supplies and constraints.
3. Groups chose 2 random SDG cards from their pile.
4. Explain the challenge: build a hut no bigger than the graph paper sheet (91 sq. cm) that is at least 10cm high with a working door. It must withstand a wind storm (generated by the hair dryer on full power) of more than 10 seconds. If it doesn't collapse or blow away, they have succeeded.
5. Explain that the hut cannot be taped to the table or graph paper
6. Learners use the Engineering Design Process presented to plan their design. Once they have a plan and drawing, they can start building.
7. Set a 20-minute timer for groups to build.
8. After the time is up, conduct a test with the hair dryer on each design.

10 Minutes

STAGE 5

Resources

- Notebooks
- Pen/Pencil
- Paper
- SDG Cards

Reflective Practice

Give learners five minutes to reflect on the lesson in their notebooks, using the following prompts;

- Three things they feel they have learnt from the lesson and tasks
- Two things they found the most interesting and would like to learn more about
- One piece of feedback on the lesson and the tasks

You can use the information in their reflections to plan and modify the accompanying lessons, create projects or share with another teacher to implement cross curricular tasks

Please encourage your learners to reflect honestly on the lesson, including positive and negative opinions. If they give negative feedback, explain and make a suggestion that could improve the lesson.



Session 02

Waste Not Want Not

SESSION TIME
60 MINUTES

SDG 11 - (targets 11.2, 11A)

Science, Engineering, Technology,
Waste, Environment, Sustainability



4 QUALITY
EDUCATION



9 INDUSTRY, INNOVATION
AND INFRASTRUCTURE



12 RESPONSIBLE
CONSUMPTION
AND PRODUCTION



Lesson Title & Summary: Waste Not Want Not

In Waste Not, Want Not, learners will apply the Engineering Design Process to designing and testing a system for waste separation and management.

The learner will...

- develop their understanding of the issues around human produced waste, recycling and the complexities of the recycling process
- learn how to effectively support recycling in their communities
- learn about how creative technology use can be applied to clean up global waste
- work collaboratively with peers on a recycling related problem
- plan, design, sketch and build a recycling system

Resources

- Presentation : “Waste Not Want Not”
- Notebooks
- Pen/Pencil
- Paper
- A variety of clean, dry recyclables in a single, large recycling bin
- Four smaller bins (one for plastic, one for metal, one for glass, and one for paper)
- A long table
- A selection of craft materials including, but not limited to: bin bags, hand fans, small magnets, plastic tubs, netting, paper, plastic cups, straws, tape etc.

Session 02

STAGE 1

15 Minutes

Resources

Presentation: Part 1
Waste Not Want Not

“Waste Not Want Not ” Presentation

1. Display the PowerPoint presentation for the class or hand out a printed copy.
2. Use question slides to engage the class and assess their prior knowledge.
3. Introduce learners to the concept of recycling, the types of materials and classification of them.
4. Give the class a basic understanding of how Materials Recovery Facilities operate
5. Play the embedded videos for the learners to give further background on recycling and MRF's

40 Minutes

STAGE 2

Resources

- Notebooks
- Pen/Pencil
- Paper
- A variety of clean, dry recyclables in a single, large recycling bin
- Four smaller bins
- A long table
- A selection of materials including, but not limited to: bin bags, hand fans, small magnets, plastic tubs, netting, paper, plastic cups, straws, tape etc

Activity: Waste Design Challenge

1. Learners break into teams of 2 or 3.
2. Each team will brainstorm ways to sort each type or recyclable from the combined bin.
3. Review the Engineering design process.
4. Challenge: *use the brainstorm in Step 2 and the Engineering design process to design a way of separating the materials. Learners can help run the system (pouring, pulling, acting as machinery etc, but cannot handle the recyclables directly. The paper must remain dry.*
5. Each team decides on their best idea to separate the materials and shares their ideas with other teams.
6. As a whole class, vote for the best ideas presented. Take these ideas and combine them to try and build a recycling system.
7. The group then tests the system with everyone observing how it works, changes that can be made. What worked? What didn't work? Why?

5 Minutes

Resources

- Notebooks
- Pen/Pencil
- Paper

Reflective Practice

- Give learners five minutes to reflect on the lesson in their notebooks, using the following prompts;
- Three things they feel they have learnt from the lesson and tasks.
- Two things they found the most interesting and would like to learn more about.

One piece of feedback on the lesson and the tasks. You can use the information in their reflections to plan and modify the accompanying lessons, create projects or share with another teacher to implement cross-curricular tasks.

Please encourage your learners to reflect honestly on the lesson, including positive and negative opinions. If they give negative feedback, ask them to write the reason why they didn't like it.



Session 03

3D Printing

SESSION TIME
90 MINUTES

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Lesson Title & Summary: 3D Printing

Learners will discover the scope that 3D Printing can offer to the achievement of SDGs.

The learner will...

- develop their understanding of Engineering in general and the different fields of study
- develop their understanding of how engineering can be used to help solve the SDG's
- learn the concept behind and utilise the idea of the engineering design process
- work collaboratively with peers on an engineering-related problem
- plan, design, sketch and Improve a design prototype

Resources

- CoDesRes 3D Printing Presentation : "3D Printing: A Tool for the Future"
- CoDesRes SDG Cards
- Notebooks
- Pen/Pencil
- Post it Notes/ Paper

20 Minutes

Resources

**Presentation: Part 1
3D Printing**

“3D Printing: A Tool for the Future”

1. Display the PowerPoint presentation for the class or hand out a printed copy.
2. Use the question slides to engage the class and assess their prior knowledge.
3. Introduce learners to the concept of 3D Printing, how it relates to traditional manufacturing and the different types of printing it can do

10 Minutes

Resources

- Notebooks
- Pen/Pencil
- Paper

STAGE 2

Ideation: What can you use 3D printing for in your everyday life?

1. Learners break into groups of 2 or 3 to discuss potential uses for 3D printing in their everyday life.

Prompts include:

- *What could you use it for in the kitchen, shed...?*
- *What small problems do you face everyday at home?*
- *What would you make for yourself?*
- *What would you make for your parents, family, friends etc?*

2. Share ideas as a whole class and create a collaborative list on the board.

STAGE 3

Session 03

20 Minutes

Resources

Presentation: 3D Printing: A Tool for the Future

“3D Printing: A Tool for the Future” Presentation Part 2

1. Display the PowerPoint presentation for the class.
2. Look at the process steps involved in 3D printing, the materials that can be used and some examples of 3D printing applications.

STAGE 4

30 Minutes

Resources

Presentation: 3D Printing: A Tool for the Future

Ideation: Printing to tackle SDGS?

1. Learners break into groups of 2 or 3.
2. Print and cut out 1 SDG Card sheet per group.
3. Groups choose 2 random SDG cards from their pile.
4. Ask groups to use the 2 cards they have chosen as areas to apply 3D printing technology to, to improve global issues. Make a list.
5. Share lists as a whole class.

10 Minutes

Resources

- Notebooks
- Pen / Pencil
- Paper

STAGE 5

Reflective Practice

- Give learners five minutes to reflect on the lesson in their notebooks, using the following prompts
- Three things they feel they have learnt from the lesson and tasks.
- Two things they found the most interesting and would like to learn more about. One piece of feedback on the lesson and the tasks.

You can use the information in their reflections to plan and modify the accompanying lessons, create projects or share with another teacher to implement cross-curricular tasks

Please encourage your learners to reflect honestly on the Lesson, including both positive and negative opinions. If they give negative feedback, ask them to write the opinions.



Session 04

Introduction To Innovation

SESSION TIME
90 MINUTES

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9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Lesson Title & Summary: Introduction to Innovation

Introduction to Innovation aims to show the value of all ideas and remove the idea of failure in innovation.

The learner will...

- develop their understanding of the concept of Innovation
- develop their understanding of the different types of Innovation
- learn how to ideate effectively
- work collaboratively with peers on an ideation and innovation problems

Resources

- CoDesRes Engineering Presentation : "Innovation: An Introduction"
- Notebooks
- Pen / Pencil

5 Minutes

Resources

Presentation: Part 1
Introduction to Innovation

“Innovation: An Introduction” Presentation Part 1.1

1. Display the PowerPoint presentation for the class or hand out a printed copy.
2. Use question slides to engage the class and assess their prior knowledge.
3. Introduce learners to the concept of Innovation, Innovation Methods & review the Engineering design process.

25 Minutes

Resources

- Notebooks
- Pen / Pencil
- Paper

STAGE 2

Activity 1: Worst Idea Ever

1. Learners break into groups of 2 or 3.
2. Ask groups to think up the worst ideas for companies, products or services they can imagine (*i.e. chocolate teapot, underwater hair dryer*). Encourage crazy ideas, the more out there the better.
3. After 10 minutes, ask groups to swap their lists of ideas with another team.
4. Create a collaborative list on the board of all the worst ideas.
5. Ask groups to now turn the bad ideas into good ideas. Again, being creative, inventive and think outside the box. Emphasize using the actual bad idea for a beneficial use.

Discourage inversions (*i.e. glasses that make your vision worse (bad) = glasses that make your vision better (good)*). Instead, ask them to find an actual use for glasses that make your vision worse.

6. Add the good ideas to the collaborative list on the board. Encourage discussion and debate of each idea.

Session 04

5 Minutes

Resources

Presentation: “Innovation: An Introduction”

50 Minutes

Resources

- Notebooks
- Pen / Pencil
- Paper

5 Minutes

Resources

- Notebooks
- Pen / Pencil
- Paper

STAGE 3

“Innovation: An Introduction” Presentation Part 2

1. Display the PowerPoint presentation for the class or a printed copy.
2. Continue with Part 2 of the presentation (Traits of an Innovator).
3. Use question slides to engage the class and assess their prior knowledge.
4. Discuss the importance of each trait of an innovator and how they can be improved or learned.
5. Discuss Cross Industry innovation, discussing the advantages of the examples given.

STAGE 4

Activity 2: Cross Industry Innovation

1. Learners break into groups of 2-4.
2. Show the list of company logos.
3. Ask groups to combine 2 companies attributes to solve an environmental problem. Encourage crazy ideas, the more out there the better. (*i.e. Ikea & McDonalds*: McDonalds boxes that you can assemble into useful objects).
4. Ask the groups to verbally share their ideas with each other.
5. Repeat Steps 2-3, two more times.
6. Summarise the best combination from each group.

STAGE 5

Reflective Practice

- Give learners five minutes to reflect on the lesson in their notebooks, using the following prompts;
- Three things they feel they have learnt from the lesson and tasks.
- Two things they found the most interesting and would like to learn more about.
- One piece of feedback on the lesson and the tasks.

You can use the information in their reflections to plan and modify the accompanying lessons, create projects or share with another teacher to implement cross-curricular tasks

Please encourage your learners to reflect honestly on the lesson, including positive and negative opinions. If they give negative feedback, ask them to explain why and add an improvement.