

**FIRST
LEGO
LEAGUE**

EXPLORE

ENGINEERING NOTEBOOK





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The **LEGO** Foundation[♥]



Welcome!



I'm Jacob!

I'm Ruby!



Come along with us as
we guide you through the
SUPERPOWEREDSM challenge.

Who is on your team?

Team Members:

1.

4.

2.

5.

3.

6.



I'm Max!
Come on.
Let's go!



Team Journey

Explore the challenge



Learn about Core Values



Explore, create, test, and share as you go through the sessions

Create team model



Design team poster



Celebrate at an event



SUPERPOWEREDSM 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.



Let's identify the problems and design solutions.
What energy choices will you make?

Energy Journey



Energy Source
(captures energy)

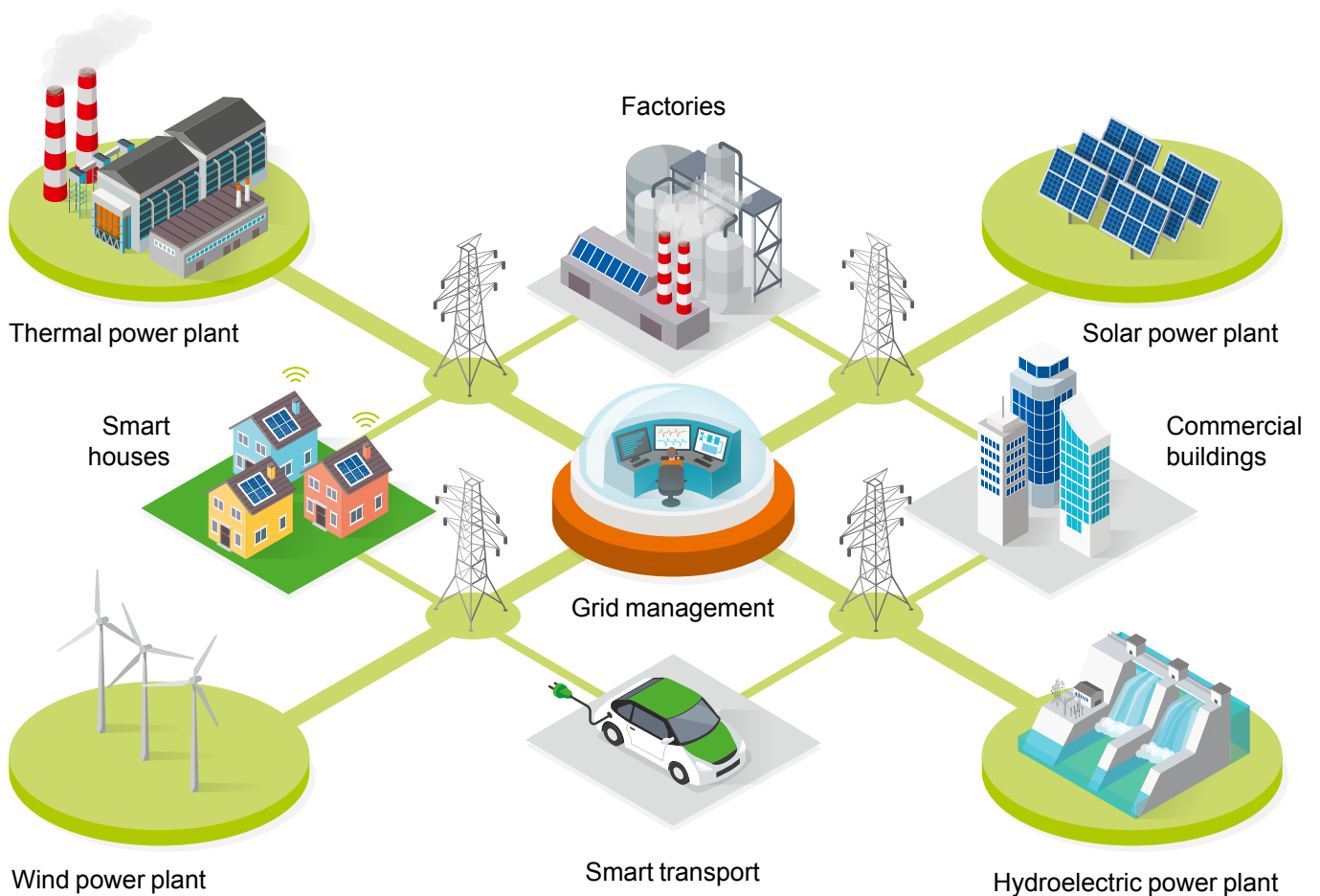


Energy Storage and Distribution



Energy Consumption
(uses energy)

Example Energy Journey



Core Values

DISCOVERY

We explore new skills and ideas.

INCLUSION

We respect each other and embrace our differences.

INNOVATION

We use creativity and persistence to solve problems.

TEAMWORK

We are stronger when we work together.

IMPACT

We apply what we learn to improve our world.

FUN

We enjoy and celebrate what we do!

Show me how you use the Core Values throughout your experience!



Draw or write an example of your team using each Core Value when directed in the sessions!



You will develop new skills as you work together.



Session 1

Activity 1 Tasks (15-20 minutes)

- ☐ Explore the energy theme.
- ☐ Talk about how you get and use energy.
- ☐ Think about how you use energy daily.
- ☐ Draw a picture of one way you use energy in your home every day.
- ☐ Think about what different energy jobs people have.
- ☐ Draw a person doing an energy job.

How I use energy:

Person doing an energy job:

How does a **solar panel installer** use teamwork on the job?

What does a **wind energy engineer** do?

How does a **substation technician** help with energy distribution?

See pages [30-31](#) for more details on jobs!



Energy Journeys

Your team needs:



Show me
what you have
discovered!



How does
energy get to
where we need
it?



Activity 2 Tasks (15-20 minutes)

- ☐ Explore what an energy journey is. Look over [page 6](#) for ideas.
- ☐ Look at the mat and describe what you see related to energy. Identify an energy journey.
- ☐ Explore these four energy categories – source, distribution, storage, and consumption.
- ☐ Label examples of each category on the mat image below.

Challenge

- ☐ Create a build that shows energy consumption using the prototyping pieces.
- ☐ Share your design and explain how it works.

Where do you
get energy?



Session 2

Activity 1 Tasks (15-20 minutes)

- ☐ Follow the building instructions in Book 1 to make the wind turbine from the Explore set.
- ☐ Place the wind turbine on the mat in the sandy area.
- ☐ Load energy units into the white hopper (A).
- ☐ Turn the hand crank (B) to generate an energy unit.
- ☐ Discuss how the wind turbine generates energy.
- ☐ Explain how the energy units generated could be used.

Your team needs:



Energy Units

Wind Turbine



White Hopper (A)

Hand Crank (B)



Scan the QR code to see a video of the wind turbine!



Energy Sources

Your team needs:



An energy source is:

Activity 2 Tasks (15-20 minutes)

- ☐ Explain what an energy source is in the box provided on the side.
- ☐ Look at the mat and identify an energy source.
- ☐ List the energy sources that you have in your community in the box below.

Challenge

- ☐ Create another renewable energy source using the prototyping pieces.
- ☐ Share your design and explain how it works.

What skills do you need to be a **hydroelectric specialist**? See [page 30!](#)



Energy sources in my community:

Session 3

Activity 1 Tasks (15-20 minutes)

- ☐ Follow the building 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 storage slot (A), which will raise the tire 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.

Your team needs:



Scan the QR code to see a video of the energy storage model!



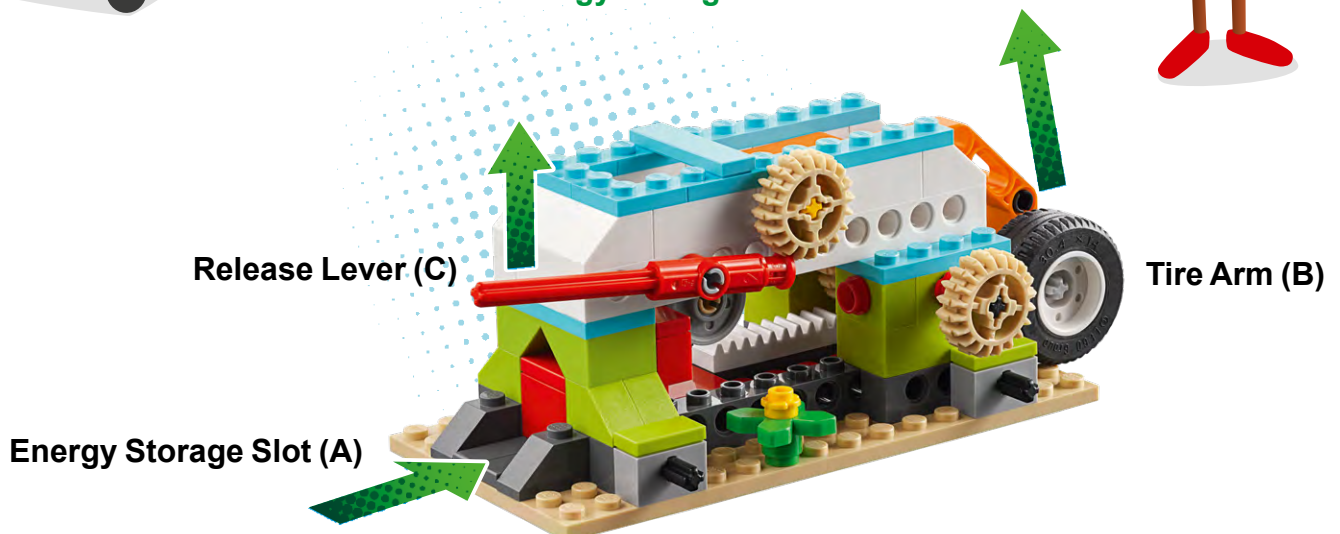
How does this show potential and kinetic energy?



How does the model store and release energy?



Energy Storage Model



Energy Connections

Your team needs:



Examples in my community:

Activity 2 Tasks (15-20 minutes)

- ☐ Circle examples of how energy is distributed and stored on the mat image below.
- ☐ Identify ways energy is stored and distributed in your community.

Challenge

- ☐ Build additional ways to connect and distribute energy to different locations on the mat using the prototyping pieces.
- ☐ Share the energy journey represented in your build.

Why is it important that an **electrician** ensures their work is reliable and correct?
See [page 31](#).



Session 4

Activity 1 Tasks (15-20 minutes)

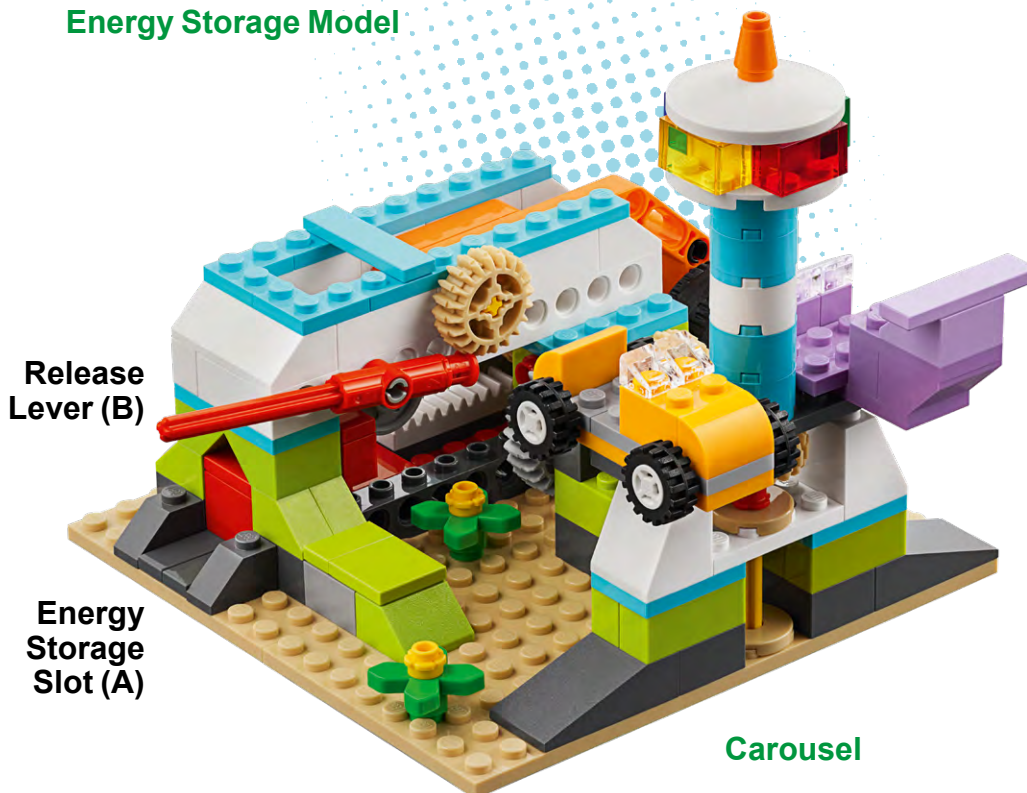
- ☐ Follow the building instructions in Book 3 to make the carousel.
- ☐ Connect the carousel to the energy storage model.
- ☐ Load energy units into the energy storage slot (A).
- ☐ Release the stored energy by lifting the release lever (B) to power the carousel.
- ☐ Discuss how these models represent how energy is stored and consumed.

Your team needs:



Scan the QR code to see a video of the carousel!

Energy Storage Model



How does this show how energy is stored and then used by changing it into motion?



Energy Consumption

Your team needs:



Examples in my community:

Activity 2 Tasks (15-20 minutes)

- ☐ Circle examples of energy consumption on the mat image below.
- ☐ Identify examples of energy consumption in your community.

Challenge

- ☐ Build examples of energy consumption using the prototyping pieces.
- ☐ Place your builds on the mat. You could use the LEGO® brick icons as building locations.
- ☐ Share your builds and explain how what you built uses energy.

How could a **sustainability team** help reduce energy consumed in a factory?
See [page 31](#).



Session 5

Activity 1 Tasks (15-20 minutes)

- ☐ Open the SPIKE™ Essential or WeDo 2.0 app. Complete your lesson.
- ☐ Make the model go in a different direction. Write down your ideas for how to change the program below.
- ☐ Modify the program based on your ideas.
- ☐ Run your new program. See what happens.

Challenge

- ☐ Make the motor turn in both directions and code it to go faster and slower.

Your team needs:



Choose your lesson:



FIRST® LEGO® League
Explore Unit:
Lesson 1



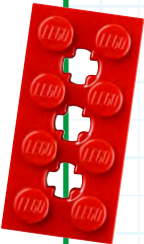
Classroom Projects:
Cooling Fan

Show me how you
include everyone's
awesome ideas!



MY IDEAS

Write your ideas!



Energy Capture

Your team needs:



What happens to the wind energy that is captured by the turbine?

Modify the code to show different wind speeds.

Activity 2 Tasks (15-20 minutes)

- ☐ Use the LEGO® model you built earlier in this session.
- ☐ Change the model so that it looks like a wind turbine.
- ☐ Redesign the model to capture maximum wind energy.
- ☐ Change the code so that the model captures maximum wind energy.

Challenge

- ☐ Change the model so that the wind turbine can move direction depending on the wind location.

MY IDEAS

Draw your ideas!



Session 6

Activity 1 Tasks (15-20 minutes)

- ☐ Open the SPIKE™ Essential or WeDo 2.0 app. Complete your lesson.
- ☐ Code the model to play a different sound or flash a light. Write down your ideas for how to change the program below.
- ☐ Change the existing program based on your ideas. Test it out!

Challenge

- ☐ Code the robot to play a different sound or show a different light. Code the model's motor to be triggered using a sensor.

Your team needs:



Choose your lesson:



FIRST® LEGO® League
Explore Unit:

Lesson 2



Classroom Projects:
Spy Robot

Show me your
awesome coding
skills!



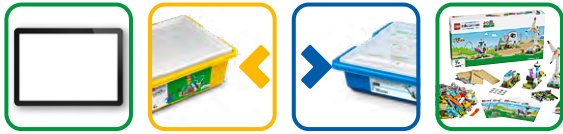
MY IDEAS

Write your ideas!



Motorize Model

Your team needs:

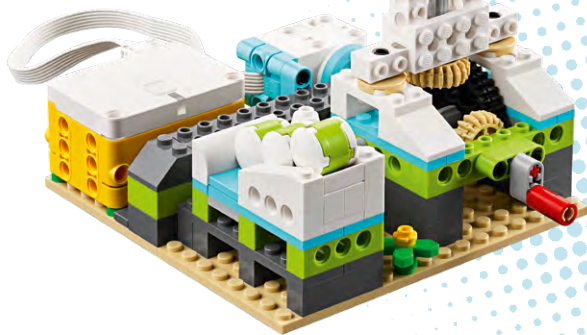


Motorized Explore Model Options



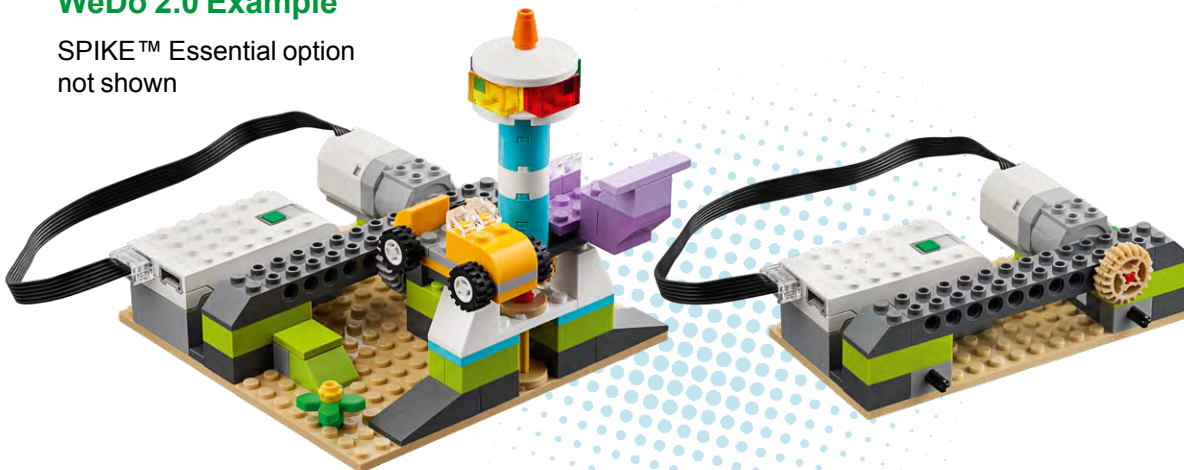
SPIKE™ Essential Example

WeDo 2.0 option not shown



WeDo 2.0 Example

SPIKE™ Essential option not shown



Activity 2 Tasks (15-20 minutes)

- ☐ Follow the building instructions in Book 3 to build the motor and hub base.
- ☐ Choose which model to motorize (wind turbine or carousel).
- ☐ Connect the model to the motor and hub base.
- ☐ Open the SPIKE™ Essential or WeDo 2.0 app.
- ☐ Re-create the program provided in Book 3. Try it out!

Challenge

- ☐ Signal with light and sound when energy is detected (being used or produced).



Scan the QR code to see a video of the motorized models!

Give examples of how your team has used teamwork.



Session 7

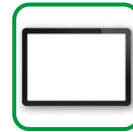
Activity 1 Tasks (15-20 minutes)

- ☐ Open the SPIKE™ Essential or WeDo 2.0 app. Complete your lesson.
- ☐ Code the robot to move backward. Write down your ideas for how to change the program below.
- ☐ Change the existing program based on your ideas. Give it a test!

Challenge

- ☐ Make your vehicle move on the mat. Modify the build so that the vehicle has four wheels.

Your team needs:



Choose your lesson:



FIRST® LEGO® League
Explore Unit:

Lesson 3



Classroom Projects:
**Milo the Science
Rover**

Show me your
innovative solution!



MY IDEAS

Write your ideas!



Electric Car

Your team needs:



How will you program your car to drive around the mat?

Redesign your model to look like an electric car.

Code your electric car to drive to the car charging station.

MY IDEAS

Draw your ideas!

Activity 2 Tasks (15-20 minutes)

- ☐ Use the LEGO® model you built earlier in this session.
- ☐ Modify the model so that it represents an electric car.
- ☐ Motorize your electric car. Create a program to go from one LEGO brick icon on the mat to another brick icon.

Challenge

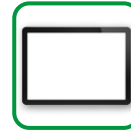
- ☐ Build an electric car charging station using the prototyping pieces. Create a program to drive your car from one of the brick icons to the charging station.

Sessions 8 & 9

Session Tasks (80-100 minutes)

- ☐ Think about how you can make a better energy journey for your community.
- ☐ Brainstorm your solutions.
- ☐ Explore the list of required parts on the next page.
- ☐ Draw your team model design and label the required parts.
- ☐ Create your team model together. Use the mat and build the different parts of your energy journey.

Your team needs:



Your energy choices can make a difference!

Build a team model to show a better energy journey for your community.

Draw your team model on the mat.



Team Model

Show me how your team model represents a better energy journey for your community.



Requirements

Be sure to include an example of energy source, storage, distribution, and consumption.

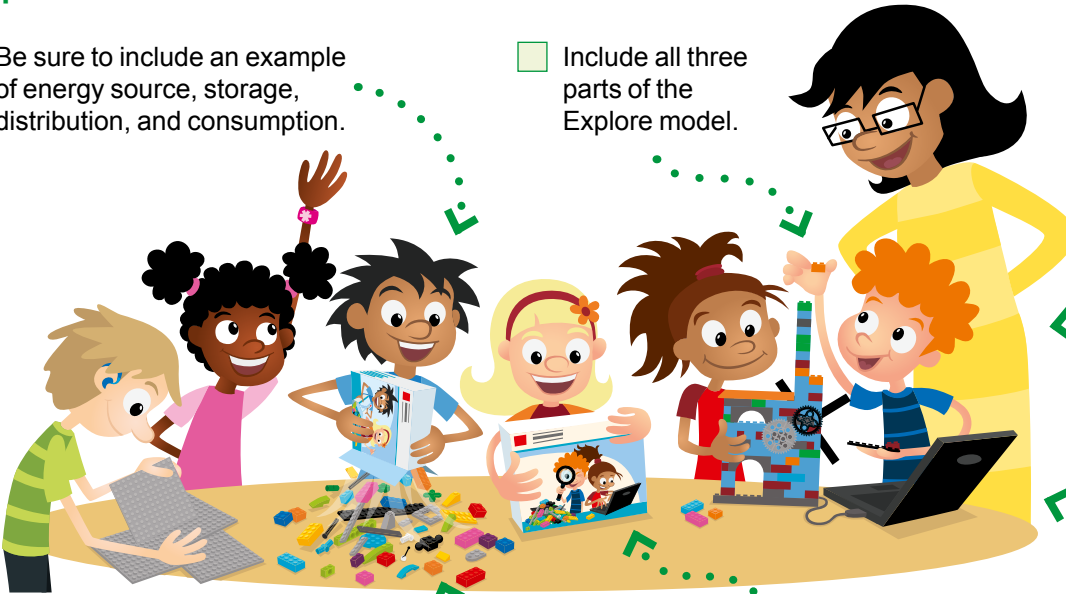
Include all three parts of the Explore model.

Motorize one part of the Explore model.

Use LEGO coding.

Be made of only LEGO® elements.

Use the SUPERPOWEREDSM mat.



Label the required parts of your team model.



Sessions 10 & 11

Session Tasks (80-100 minutes)

- ☐ Find your poster board and art supplies.
- ☐ Brainstorm what to put on your poster.
- ☐ Use the next page as a draft for your ideas.
- ☐ Work together to create your team poster. Teamwork!
- ☐ You can use words, drawings, and photos on your poster.

Your team needs:



Congrats on all you have learned. Now, make a team poster to share about it!

Describe your team journey throughout the sessions.



Team Poster

Show me how
creative you
can be!



Here's your chance to capture ideas for your team poster.

Sample Topics: *Explore, Create, Test, Share, Core Values, Team Journey*

Session 12

Tasks (40 minutes)

- ☐ Gather your completed team model and team poster.
- ☐ Talk about what your team would like to share at your event!
- ☐ Complete the next page to prepare for your event.
- ☐ Look over the reviewing sheet with your coach.
- ☐ Practice your presentation.
- ☐ Communicate what you have learned with others.



Sample Festival Setup



Prepare for Event

Let's celebrate how well we all worked together! It is much more fun when everyone on the team is included.



Consider what you will share at the event.

- Can you describe your team model?
- How did you use your mat to create your model?
- Explain the problems you solved about your community's energy journey.

- What did you learn about the challenge?
- How did you use Core Values?

- What part of your team model is motorized?
- How did you code your motorized part?

- What did you include in your team poster?
- How does the poster show your team journey?



Use this page to draw your designs and ideas!





Career Connections



Wind Energy Engineer

A wind energy engineer designs wind turbines and wind farms and then creates and tests them in the field.

Links to Session 1



Solar Panel Installer

A solar panel installer installs solar panels according to directions and safety requirements.

Links to Session 1



Substation Technician

A substation technician operates and maintains electrical substations that distribute energy from sources to consumers.

Links to Session 1



Exploration

(Recommend completing after Session 4)

Look at the careers on these pages. Choose a job role, research it, and answer the questions.

- Explain the job. What are some of this job's daily tasks?
- What education or training is required?
- What is this job's yearly salary?
- What companies could people in this job work for?

Fields of Study

- Renewable energy
- Energy end use and efficiency
- Energy storage and grid modernization
- Energy policy and economics
- Energy environmental impacts
- Fossil and nuclear energy



Hydroelectric Specialist

A hydroelectric specialist installs, maintains, and operates hydroelectric power systems and equipment.

Links to Session 2



Electrician

An electrician ensures homes are wired correctly so that people can use electricity to power their electronics and lights.

Links to Session 3



Sustainability Lead

The sustainability lead looks for ways to use renewable energies and produce less waste to create LEGO® products in the LEGO factories.

Links to Session 4

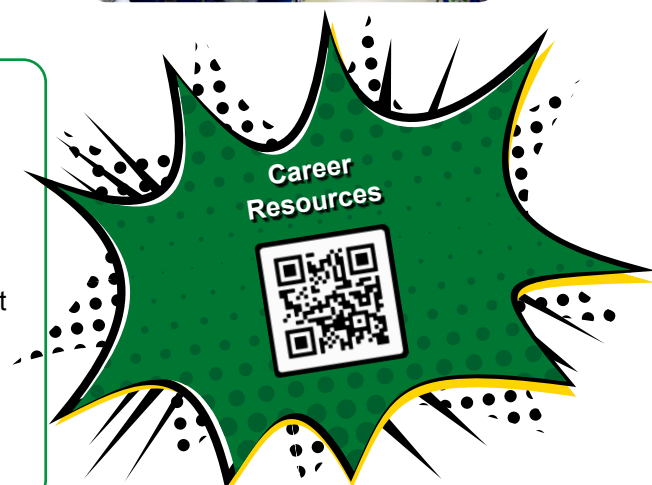


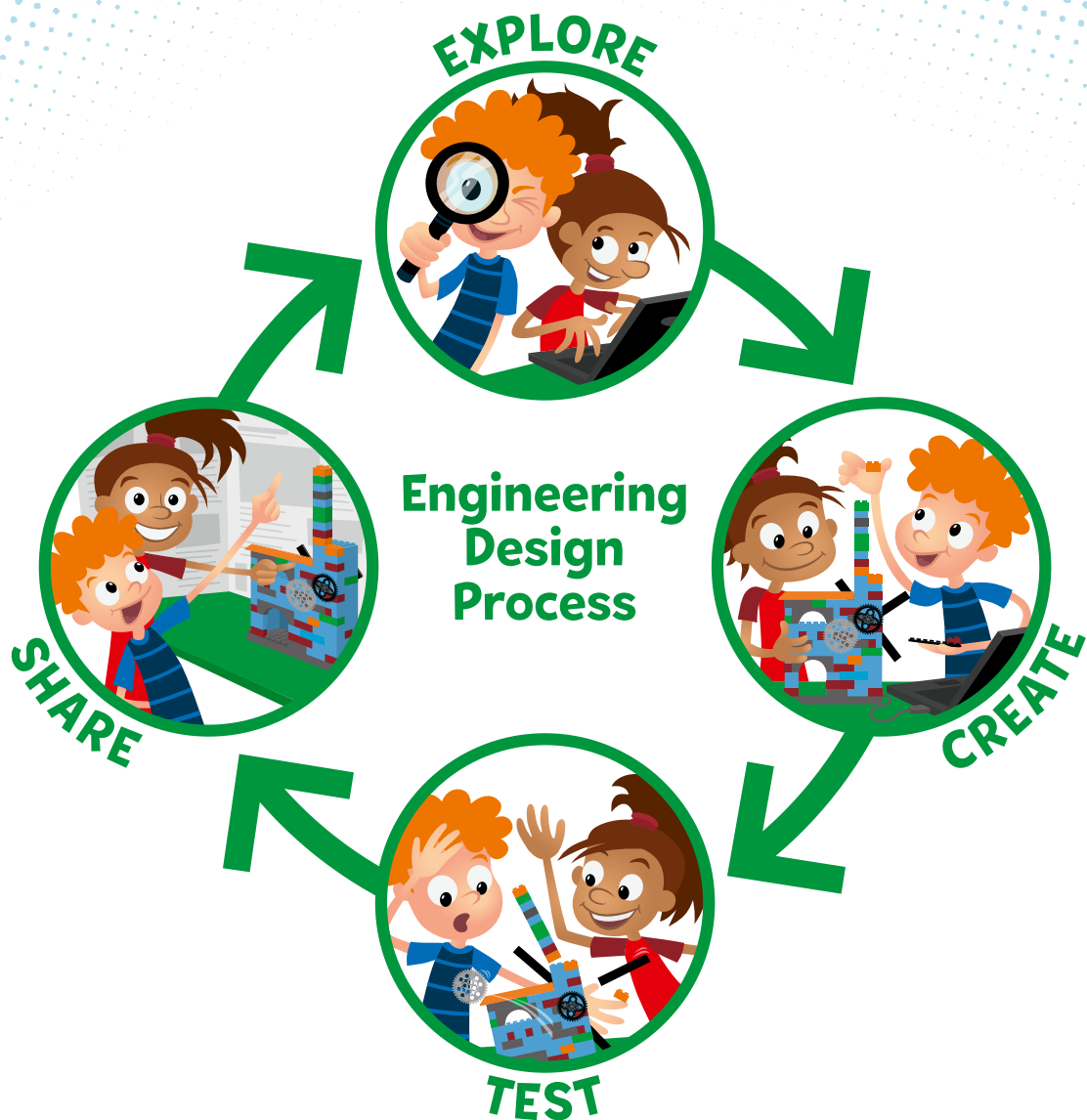
Reflection

(Recommend completing after Session 12)

Look at the careers on these pages. Think about these jobs and what interests you.

- What skills are needed in these jobs?
- What interests you about these jobs?
- Can you think of other jobs that relate to energy?
- Can you explore one of these careers for more information?





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