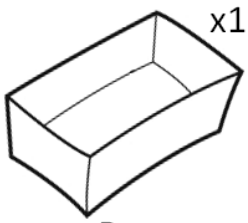
Facilitator Guide

Duration: 90 Minutes
Suitable for ages 7-14

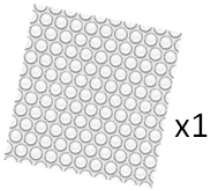
Mom is sleeping off a bad headache, but you have to practice your piano for your recital tomorrow. How can you sound proof your room so you don't wake mom up and make her very angry?

Equipment per team:

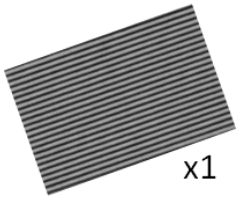


Box
3"H x 8"L x 6"W approx.

Plus a choice of up to 3 of the following:

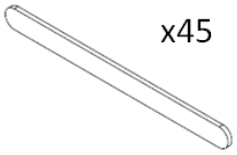


Bubble Wrap
2 ft

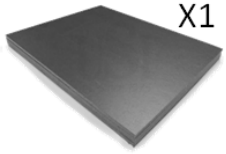


Corrugated Paper
3 ft

Plain Paper
8.5x11"

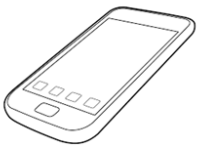


Popsicle Sticks
9mm width

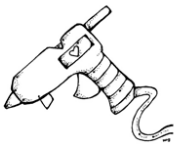


Foam
1 ft

Additional supplies:



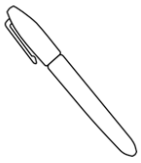
Smart Phone
Install 'sound meter' app



Hot Glue
(optional but recommended)

Tape

Scissors



Pens/pencils
(optional)

Printed Resources:

- Engineer Flashcards
- Instruction sheets (page 6)

Don't Wake Mom!©2017

Activity 1: Engineer Game

Duration: 20 minutes

This activity uses the printed Engineer cards from **Appendix A.**

Option 1: Quiz

This version is best suited for ages 7-8 or smaller groups < 5

Use roughly half of the deck. Review the types of engineer with the group then divide into teams and ask questions such as which engineer works with chemicals? Or name one thing a mechanical engineer might do. Winning team is the one who gets the most correct answers!

Option 2: "Does/is your Engineer…"

Each participant is given one card and becomes that type of engineer.
Divide the room into two halves. One side is 'yes' and one side is 'No'. The participants should then decide if the statement you read out applies to them (yes) or not (no) and move to that side of the room. Some questions have a definite correct answer as shown on their card and some will require them to think more deeply.

Examples:

Easy	● Use a screwdriver? ● Use a computer? ● Sometimes work outside? ● Design a place to live? ● A man or a woman? (Follow up – do they have to be that gender?)
Medium	● Drive a train? ● Help you turn on the lights? ● Care about the environment? ● Ever wear a hardhat or lab coat? ● Solve problems?
Harder (Age12-14)	● Do something to allow you to brush your teeth in the morning? ● Work in a team? ● Use Math?/Chemistry?/ Physics?

Key learning outcomes

- There are many types of engineers and some have very specific and interesting jobs.
- We use things every day that were designed by engineers, and most things need more than one type of engineer working together.

Activity 2: Making Waves

Duration: 15 Minutes

We're used to making things louder; for example we always want better speakers to play music louder. Engineers also spend a lot of time trying to make things quieter.

What are some examples in this room?

- windows are double paned to reduce outside noise coming in
- floors are made with some sponginess to absorb the footfall and reduce some noise

What is noise?

If noise is unwanted sound, then what is sound?

Sound is caused by tiny vibrations in the air, called sound waves. The shape of these waves and their reactions when they hit different materials is why we hear different sounds.

Participants should join hands to form a circle along which the 'wave' can be passed. Demonstrate and explain what each of the following represents then play a game passing the wave around the circle and calling out the commands.

High	A high pitched sound comes from when the wave peaks are close together.	Everyone take a step closer together and pass the sound wave around the circle.
Low	A low pitched sound is when the wave peaks are far apart.	Everyone take a step back so they are further apart
Amplify	The amplitude it how high the wave is. Amplifying a wave makes it sound louder.	Arms wave as high and low as possible (really high and down to ground)
Dampen	Dampening reduces the height of the wave and makes it quieter.	Lock elbows to sides to make low height.
Reflect	Sounds reflect off hard surfaces, these make echoes. The more they reflect the more energy they lose and the quieter they get.	Wave goes back the other way
Absorb	Most materials don't absorb sound waves fully, they just cause a damping effect. A perfect sound absorber would not allow the sound the pass through at all.	Stop the wave from passing through.
Transmit	The sound wave passes through the material without any change.	No action

Activity 3: Measuring Noise

Duration: 5 minutes

Sound is measured in Decibels. The decibel scale is not like the scale on a ruler, which is a linear scale i.e. goes up evenly. Instead it is to the power of ten, so 2 decibels is 10 times as loud as 1 decibel!

Take an ambient noise measurement (when everyone is silent) and a loud noise (everyone makes as much noise as possible). Explain that it is not possible to reach zero as there are small sounds all around us!

Some useful examples of average decibel levels are:

Ticking watch	20dB
Normal conversation	60dB
Busy Street	80dB
Thunder	120dB

Activity 4: Sound Proof Room Building activity

Duration: 30 minutes

Before starting demonstrate the ‘beep sound’ and the test layout.

Participants should be split into groups of 2-3 and provided with a box and an instruction sheet. They should be given up to 5 minutes to choose their additional materials.

The premise of this activity is that Mom has a really bad headache and wants to sleep it off but your piano recital is tomorrow and you need to practice! How can you insulate your bedroom to keep the sound in so you don’t wake Mom?

Aim

Reduce the noise of the beep as much as possible.

Rules:

1. Choice of up to 3 materials only and once collected materials cannot be exchanged!
2. Materials may only be attached to the INSIDE of the box, not the outside.
3. You must leave room for the speaker inside the box.

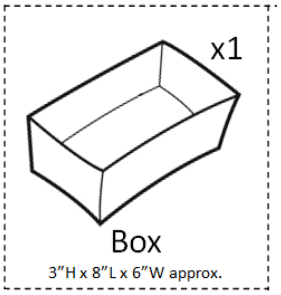
Groups can use their materials any way they choose so long as they do not break the rules.
Older participants who have cell phones may use them to create sound for individual group testing, though the final test will be kept uniform for fairness.

Groups may submit their design for testing after 10 minutes to speed up the test process.

Instructions

Mom has a really bad headache and wants to sleep it off, but your Violin recital is tomorrow and you need to practice! How can you sound proof your bedroom to keep the sound in so you don't wake Mom?

Equipment:



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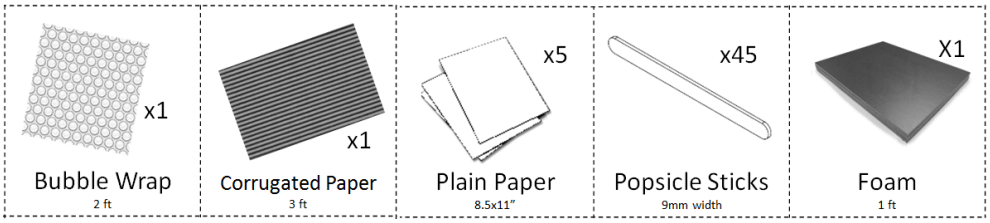
Choose three (3):



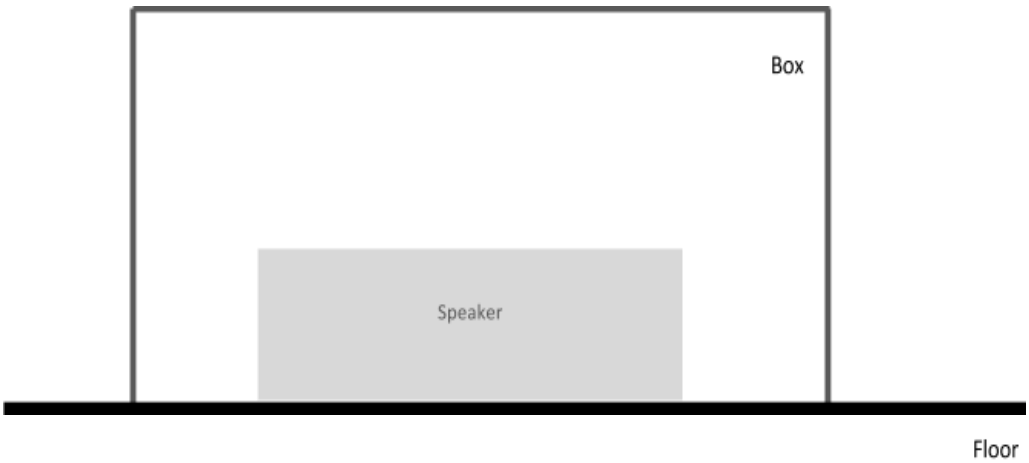
Rules

1. Choice of up to 3 of the materials on the right only and once chosen materials cannot be changed!
2. Materials may only be attached to the INSIDE of the box, not the outside.
3. You must leave room for the speaker inside the box.

Things to think about:

- Which materials can you to use to reflect or absorb the sound?
- How can you attach the materials to the box to make the sound quieter?

Test set up:



Testing and Wrap Up Discussion

Duration: 25 minutes

For each group ask a team volunteer to explain their design. Set it up for testing by placing the speaker inside underneath the box and the cell phone at a set distance away (closer is better to reduce sound dissipation over distance).

Make sure the room is at ambient sound levels before the test starts. Record each teams dB output.

Questions:	Reflection:
What were the differences between the quietest and loudest bedrooms?	The aim is to show that the material choses made a big difference. The best combinations should be ones that utilise both reflective and absorbing materials.
How did the way the materials were applied change the effectiveness?	Multiple different designs works, there is no single right answer- engineering allows room for creativity! More surface area for reflection improves the ability to dampen the noise.
Did any teams change their design during building?	Often engineering requires design changes; Engineers do a lot of iterative design to make their products better. They also learn from their mistakes so being wrong the first time isn't a bad thing!
Would this be a practical solution for your real bedroom?	Maybe not- how many teams left room for a person and furniture to fit into their 'bedroom '? Brainstorm other ideas (get mom some noise cancelling headphones or ear plugs!)
What kind of skills did you use that would be important for an engineer to have?	The skills will be dependent on the group. Try to reflect on the activity and note any good examples you saw of these. Teamwork- Working together as a team to build the rover. Creativity-To come up with ideas for how to put the materials into the box Problem solving- To figure out why the design isn't working and fix it Resourcefulness- Being able to use the materials provided Helping others- letting mom sleep undisturbed! Hands on skills-Being able to build something from scratch.

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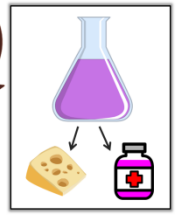
STEPHANIE

CHEMICAL ENGINEER



As a chemical engineer, Stephanie uses science to process raw materials and chemicals into safe products we can use like food or medicines.

SUPER POWER | Chemicals

TOOLS

2

MARK

SOFTWARE ENGINEER

As a software engineer, Mark uses his coding skills to create the 'brains' that bring electronic products or games to life for us to use and enjoy.

SUPER POWER | Code Wizardry

TOOLS | </>

3

ALESSIA

CIVIL ENGINEER

As a civil engineer, Alessia designs buildings that give us safe places to live and roads and bridges to connect us to other places.

SUPER POWER | Portals

TOOLS

4

STEVE

STRUCTURAL ENGINEER

As a structural engineer, Steve makes safety a priority so that his large structures and buildings stay up!

SUPER POWER | Supersizing

TOOLS

5

LIZZIE

ELECTRICAL ENGINEER

As an electrical engineer, Agnes creates circuits that send signals and make electronic products, like cell phones and street lights, work.

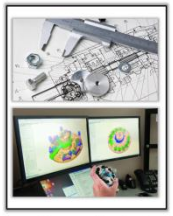
SUPER POWER | Electricity

TOOLS

6

RACHEL

MECHANICAL ENGINEER



As a mechanical engineer, Rachel often designs parts of machines using 3D design software. She builds prototypes to make sure that the parts don't overheat or leak.

SUPER POWER | Assembly

TOOLS

7

BRAD

INDUSTRIAL ENGINEER

As an industrial engineer, Brad helps make everything run smoothly and on-time by improving systems of people, money, materials.

SUPER POWER | Change the future

TOOLS

8

KAREN

AUTOMOTIVE ENGINEER

As an automotive engineer, Karen works in a team of many types of engineers to design and make cars, buses and other vehicles.

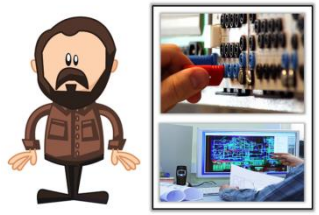
SUPER POWER: Speed

TOOLS:

9

TERRY

ENGINEERING TECHNOLOGIST



As an engineering technologist, Terry applies engineering principles to design, install and maintain new technologies using hands-on methods.

SUPER POWER: Experimentation

TOOLS:

10

DAVE

BIOMEDICAL ENGINEER

As a biomedical engineer, Dave works alongside doctors to design equipment like artificial legs and devices to make people get better.

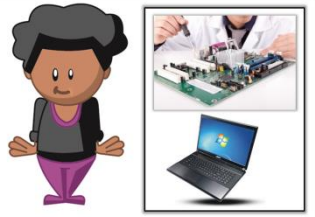
SUPER POWER: Healing

TOOLS:

11

JASMINE

COMPUTER ENGINEER



As a computer engineer, Jasmin works with both electronics and software to create systems from tablets and phones to giant scientific computers.

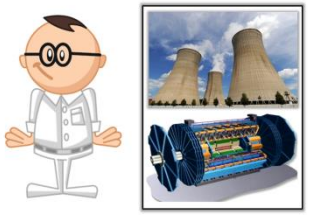
SUPER POWER: Super-computers

TOOLS:

12

JOHN

NUCLEAR ENGINEER



As a nuclear engineer, John helps design the reactors that provide energy to power our homes and schools.

SUPER POWER: Energy

TOOLS:

13

NICKI

ENVIRONMENTAL ENGINEER

As an environmental engineer, Nicki works to solve problems like pollution and providing clean water to keep people and the planet healthy.

SUPER POWER: Nature

TOOLS:

14

GABRIELLE

FORENSIC ENGINEER

As a forensic engineer, Gabrielle works as a detective to find out why things, like bridges, fail and how we can make them better.

SUPER POWER: Detecting

TOOLS:

15

BOB

MILITARY ENGINEER

As a military engineer, Bob is involved with weapons design, minefield clearing and temporary bridge construction to protect soldiers in warzones.

SUPER POWER: Explosions

TOOLS:

16

JEREMY

GENETIC ENGINEER

As a genetic engineer, Jeremy uses biology to alter genes to change plants and make them grow faster and stronger or taste better.

SUPER POWER: Cloning

TOOLS

17

ELSA

MINING ENGINEER

As a mining engineer, Elsa finds ways to get useful metals and other materials out of the ground without damaging the environment.

SUPER POWER: Tunnelling

TOOLS

18

MIKE

MATERIALS ENGINEER

As a materials engineer, Mike uses science to improve materials we use every day to make them work better- like making planes lighter!

SUPER POWER: Strength

TOOLS

19

ED

SYSTEMS ENGINEER

As a systems engineer, Ed turns ideas like how to get water from the lake to your tap or move people through a hospital into real systems.

SUPER POWER: Efficiency

TOOLS

20

KYLIE

MECHATRONICS ENGINEER

As a mechatronics engineer, Kylie uses electronics, mechanics and software to create robotic systems.

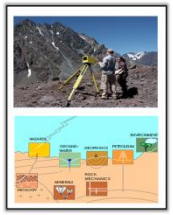
SUPER POWER: Robots

TOOLS

21

EMMA

GEOLOGICAL ENGINEER



As a geological engineer, Emma finds ways to use the earth's resources wisely and protect people from natural disasters like volcanoes and earthquakes.

SUPER POWER: Earthquakes

TOOLS

22

GEORGE

COMMUNICATIONS ENGINEER

As a communications engineer, George helps us stay connected with each other through our phone and the internet networks.

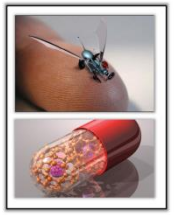
SUPER POWER: Communicating

TOOLS

23

NANCY

NANOTECHNOLOGY ENGINEER



As a nanotechnology engineer, Elisha develops new technologies that are 100 times smaller than a hair to solve problems like getting medicine into the body faster.

SUPER POWER: Shrink Ray

TOOLS

24

VICKY

PRODUCT DESIGN ENGINEER

As a Product Design Engineer, Vicky uses her creativity to design and manufacture safe and useful products that people use at home, like pet toys or kitchen tools.

SUPER POWER | Imagination

TOOLS

25

HUGO

QUALITY ENGINEER

As a quality engineer, Hugo checks that products or systems work as they were designed so that they are safe to be used.

SUPER POWER | Knowledge

TOOLS

26

VANESSA

TECHNICIAN

As a technician, Vanessa applies science and engineering for drawing, installing, inspecting, maintaining and repairing important equipment.

SUPER POWER | Repair

TOOLS

27

JOE

RENEWABLE ENERGIES ENGINEER

As a renewable energies engineer, Joe finds new, reliable energy sources that don't hurt the environment.

SUPER POWER | Solar Rays

TOOLS

28

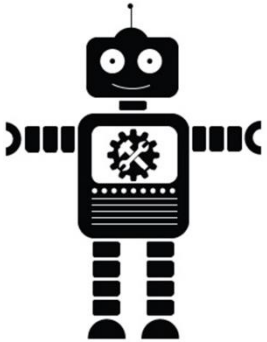
SAM

AERONAUTICAL ENGINEER

As an aeronautical engineer, Sam helps design and test new aircraft to make them faster and safer.

SUPER POWER | Flight

TOOLS



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