Science Foundation Ireland sfi For what's next

Engineers Week

Human Life, Properties and Characteristics of Materials

Classroom Resource Booklet

Developed for

STEPS
Engineers Week
Feb 27 - Mar 5 2021

Discover Primary Science and Maths
www.primaryscience.ie

Ireland esero

DPSM/ESERO

Framework for Inquiry

THEME	Overall theme	
CURRICULUM	Strand:	
	Maths:	
	Strand Unit:	
	Curriculum Objectives:	
	Skills Development:	

ENGAGE		
THE TRIGGER	WONDERING	EXPLORING

INVESTIGATE			
STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS

TAKE THE NEXT STEP		
APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

Considerations for inclusion

REFLECTION	

DPSM/ESERO
Framework for Inquiry

THEME	ENGINEERS WEEK 2021 – ENGINEERING DESIGN
CURRICULUM	**Strand:** Living Things, Materials; Energy and Forces; Environmental Awareness and Care. **Strand Unit:** Human Life, Properties and Characteristics of Materials. **Curriculum Objectives:** Explore and investigate how people move; Understand how materials may be used in construction; Explore the effect of friction on movement through experimenting with toys and objects on various surfaces. **Skills Development - Working Scientifically:** Questioning, Observing, Predicting, Analysing, Investigating, Recording and Communicating; Design, plan and carry out simple investigations; Designing and Making: Exploring, Planning, Making, Evaluating; Work collaboratively to create a design proposal; Communicate and evaluate the design plan using sketches, models and information and communication technologies; Using small models and/or sketches showing measurements and materials required; List the equipment needed consider the resources available; Evaluate the effectiveness of the new product and suggest modifications to the designing and making task, suitability of materials chosen, aesthetic outcomes, and the extent to which objects fulfil needs identified earlier.

ENGAGE

THE TRIGGER

Introduction to Materials and Engineering

Book: What if rain boots were made of paper? http://online.pubhtml5.com/kyrh/zndh/#p=1

Raincoat

Singin' in the Rain – Gene Kelly

https://www.youtube.com/watch?v=swloMVFALXw

Prosthesis

David Aguilar - Hand Solo https://www.lego.com/en-us/kids/videos/star-wars/howibuildmyprostheticarmwithlegoo ct19-b3e2f3032bf046a682a2e65cb22e24e9

Wheelchair

Izzy Wheels www.izzywheels.com

https://www.youtube.com/watch?v=3aLkbRNpOnc&feature=emb_logo

WONDERING

- What do engineers do?
- Are there different types of engineers?
- Do engineers only work on big things like roads or buildings?
- What other projects do engineers work on?
- What types of materials do engineers work with?
- Can anybody be an engineer?

There are many types of Engineer and their job is to design or invent materials, devices or structures that help solve problems or do things in a better way. If you were an engineer what would you like to do:

- What problem would you fix?
- What would you invent?
- How would you improve on an existing design?
- What could you design and make that would make someone's life better?

EXPLORING

- Find out about the different types of engineers. List as many types as you can and find out what they do.
- Do you know any engineers? If you do then ask them about their job.
- Look around your house or your school. What things can we find that were designed by engineers?
- Look around your local area. How were engineers involved in shaping the built environment?

We are going to work as engineers. We have 3 different engineering challenges for you to choose from.

- You can work as a textile engineer to develop and test waterproof fabrics and design a raincoat.
- You can work as a biomedical engineer to design a prosthetic limb.
- You can work as a mechanical engineer to design a wheelchair.

Considerations for inclusion

Consider potential area of difficulty for students with Special Educational Needs.

DPSM/ESERO
Framework for Inquiry

DESIGN CHALLENGE A – DESIGN AND MAKE A RAINCOAT

STARTER QUESTION (EXPLORE)	PLANNING (PLAN)	CONDUCTING THE INVESTIGATION (MAKE)	SHARING: INTERPRETING THE DATA / RESULTS (EVALUATE)
Before designing the raincoat, we need to investigate suitable fabrics. Design a simple fair test investigation - test a number of fabrics to see which ones are waterproof. Or Carry out an investigation to make your own waterproof fabric by waterproofing cotton. Examine a selection of coats at home or in school. See which ones are waterproof and look at other design features.	Decide who you will make your raincoat for. You might consider what is need for a full-size raincoat and then make a prototype for a toy. Consider the materials you will use. Remember that not all waterproof materials will be suitable for making a coat. Consider flexibility and comfort. Think about how you will assemble your coat – will you sew it, glue it or use strings or elastic bands to tie it on? Draw your design.	Make a coat for a teddy, doll or action figure. Chose a toy that will not be damaged if it gets wet during the testing process. Fit the coat onto the toy. Update your initial plan as necessary to make note of any changes you have to make.	Test your coat by spraying water on when it is being worn by the toy (think about the best way to simulate an actual rain shower when testing). Ask yourself the following questions: ▸ Did your raincoat work? ▸ Did the toy stay dry? ▸ Do you think the raincoat would be comfortable to wear? ▸ Did it stay together properly? ▸ Would you like to wear a raincoat like this? ▸ Were you happy with your design? ▸ Would you change anything about your design?

DESIGN CHALLENGE B – DESIGN AND MAKE A PROSTHESIS

STARTER QUESTION (EXPLORE)	PLANNING (PLAN)	CONDUCTING THE INVESTIGATION (MAKE)	SHARING: INTERPRETING THE DATA / RESULTS (EVALUATE)
Before designing a prosthesis, we need to think about who we are designing for. ▸ Perhaps you are designing for yourself or someone you know. ▸ Perhaps you know of somebody who would use a prosthetic limb or you could use a character from a book or film for inspiration. ▸ Look at pictures or videos of different types of prosthetic limbs.	Think about the person you are designing for. Decide what type of prosthesis you will be making? What materials will you use? – think about strength, durability, comfort. Think about the materials you would use for a real prosthesis. What features does it need to have? support, balance, grip. Is it designed for a specific function? – e.g. running blades for Paralympic athletes What will it look like – is it designed to blend in or stand out? Why?	Make a model / prototype of the prosthesis – maybe you could fit in onto a toy. Chose materials for your model from what is available. The materials chosen for you model might represent other real life materials. If possible, fit the prosthesis onto a toy or show in some other way how it would fit. Update your initial plan as necessary to make note of any changes you have to make. Think about how your prosthetic will look.	▸ Were you happy with your design? ▸ Do you think your prosthesis would work in real life? Why or why not? ▸ Were you happy with the design process? ▸ What would you do differently next time? ▸ Think about superpowers you would like to have. How could you enhance your powers (strength, flight, speed) with a prothesis e.g. extra arms, wings, spring stilts.

Considerations for inclusion

Consider potential area of difficulty for students with Special Educational Needs.

DPSM/ESERO
Framework for Inquiry

DESIGN CHALLENGE C – DESIGN AND MAKE A WHEELCHAIR

STARTER QUESTION (EXPLORE)	PLANNING (PLAN)	CONDUCTING THE INVESTIGATION (MAKE)	SHARING: INTERPRETING THE DATA / RESULTS (EVALUATE)
Before designing a wheelchair we need to think about the person we are designing for. Think about the different uses of wheelchairs and the different people who use them. Think about how wheelchairs move. Do some exploring with wheeled toys and see how wheels and axles work together for movement. Think about friction and how wheels work on different surfaces.	Decide what type of wheelchair you are designing. Is it manual or electric? Is it for everyday use of for a specific sport? Think about the materials you will use. Think about those you might use in real life and those you will use for your model / prototype. Think about how your wheelchair will move. Try out different types of wheels and axles and see how they will work. Draw a plan of your wheelchair.	Make a small sized model of your wheelchair. Maybe you could design it for a toy. Update your initial plan as necessary to make note of any changes you would like to make. Make sure that your wheelchair can move and that it is stable. Can you design your own Izzy wheels?	Test your wheelchair by pushing it around. ▸ Do the wheels spin easily? ▸ Is it stable or will it fall over? ▸ How does it move on different surfaces? Think about other considerations. ▸ Do you think your wheelchair would be comfortable to sit in? ▸ Would it provide enough support? ▸ Are you happy with the design? ▸ Would you change anything about it?

TAKE THE NEXT STEP

APPLYING LEARNING | MAKING CONNECTIONS | THOUGHTFUL ACTIONS

Raincoats

- Think about what makes a good raincoat. What outdoor activities could you do with a good raincoat. What other waterproof clothes or footwear would you need?
- Research the use of waterproof clothing through history.
- Find out how different animals keep themselves warm and dry in the rain.

Prosthetics

- When were prosthetic limbs first used? Research different types of prosthetic limbs. How have designs changed over time.
- What do we mean by expressive design? How are people using design to express themselves and reduce stigma associated with disability?
- Research Paralympic sports and find out about some Irish Paralympic athletes.

Wheelchairs

- When were the first wheelchairs made? What did they look like? How have designs changed over time?
- Think about wheelchair access and assess your home, school or neighbourhood for wheelchair access.
- Design a wheelchair lift.

Cross Curricular Links

- Geography: Weather links for raincoat, the built environment – accessibility; History – history of design; Art: Expressive design; Maths: Measures, ratios, scale for models; Language: Stories, diaries, procedural writing.

Considerations for inclusion

Consider potential area of difficulty for students with Special Educational Needs.

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TAKE THE NEXT STEP

APPLYING LEARNING | MAKING CONNECTIONS | THOUGHTFUL ACTIONS

Connections with SFI Discover Science and Maths Awards

Any one of these Design and Make challenges could count towards STEP 3: Engineering.

Alternatively, as they all involve investigating materials, they could be included in STEP 1: Science.

Remember to include each activity **only once in your log of evidence. You cannot include the same activity under more than one step.*

Connections with Sustainable Development Goals

Goal 3: Good Health and Wellbeing
Ensure healthy lives and promote well-being for all, at all ages.

Goal 10: Reduced Inequalities
Reduce inequality within and among countries.

Goal 12: Responsible Consumption and Production
Ensure sustainable consumption and production patterns.

Considerations for inclusion

Consider potential area of difficulty for students with Special Educational Needs.

REFLECTION

- Did I meet my learning objectives?
- Are the children moving on with their science skills?
- Are there cross curriculum opportunities here?
- What went well, what would I change?
- Did I consider the individual learning needs of my students with SEN? What differentiation strategies worked well?

Design Challenge **Duration:** 60 minutes **Class Level:** Senior

Design and Make a Prosthesis

Curriculum Links

Strand:	Living Things, Materials
Strand Unit:	Human Life; Properties and Characteristics of Materials Curriculum Objectives: Explore and investigate how people move and understand how materials may be used in construction.
Skills Development:	Recognise a need to adapt or change an object, or surroundings; Work collaboratively to create a design proposal: Communicate and evaluate the design plan using sketches, models and information and communication technologies use small models and/or sketches showing measurements and materials required, list the equipment needed, consider the resources available.
Cross curricular links:	History - when was the first prosthetic arm made? SPHE/PE- Paralympic games; Art – construction; ICT – using construction apps for design.
New words:	Prosthetic/prosthesis, Mobility, Mobility aid, artificial.
Equipment/Materials:	A range of construction materials. Cleaned recyclables diverted from the recycling bin; Lego or K'nex; Model clay or plasticine; Pens and paper. Crafting tools: Scissors, glue, ruler, eraser, string.

Engage

Trigger questions:

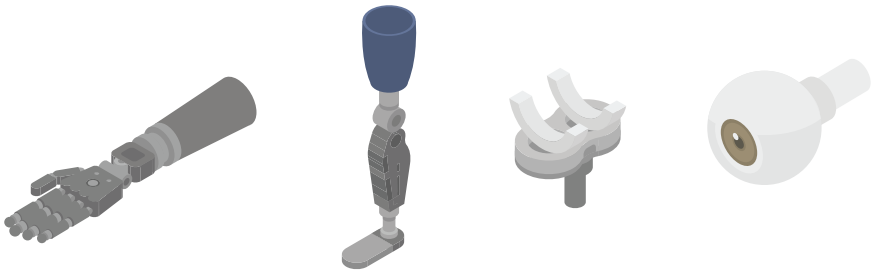
- How do we move?
- What features help us move around and complete day to day tasks?
- Does everybody move in the same way?
- What mobility aids can help people to move and how do they work? – walking sticks, crutches, wheelchairs.
- What is a prosthesis and how does it help with movement?

Background

Medical Science helps people to move in a vast array of ways. Crutches, walking sticks and wheelchairs come in a variety of different shapes and sizes, each catering specifically to the needs of the user. A prothesis is an artificial device that is designed to replace a missing body part. Prosthetics, or artificial limbs aid the user in carrying out daily activities like walking, eating, dressing etc.

Real world application

Knowing how the body moves helps scientists, engineers, and medical professionals design new technology to aid mobility. Knowing how joints work led to the design of artificial joints like hips and knees, which can now be replaced in a routine medical procedure. Special prosthetics and aids have been designed specifically for athletes to participate in sports, for example the running blade prosthetic. Early replacement limbs would have had limited functionality, but technology has improved so that newer prosthesis can perform a wider range of functions.



Design challenge

Explore:

Learners are asked to design either a prosthetic limb or a mobility aid catered to a specific individual's needs. They will be designing a model of the actual prosthesis but should be encouraged to think about how a real version would function and the materials used to make it.

Pictures and videos could be used to create discussion around movement. Look for the following videos on YouTube to think about ideas.

- The story of David Aguilar (Hand Solo) from Andorra who built his own prosthetic arm from Lego. He was only 9 when he built the first model, and he perfected the design as a teenager.
- The story of Ben Ryan who created a 3D printed prosthetic arm for his son and now creates them for other children around the world.

Before deciding what to make, brainstorm ideas around prosthetics or mobility aids.

- Think about the person you want to design for. Perhaps you are designing for yourself or someone you know. Otherwise, you could get inspiration from a real person or even a character from a book or TV show.
- What type of prosthesis would the user need? What functions would it need to perform?

Plan:

Learners draw out a plan on paper and decide on what materials they would use for their design. Learners can make their models from any resources readily available and even incorporate ICT methods such as Solidworks apps for kids if available. In their plan, learners can describe what each material they use represents in reality, for example, cardboard represents aluminium and clay represents rubber etc.

- Think about the design. Does the user want their prosthesis to blend in or stand out? Can it help to express their personality?
- Think about scale. Are you going to build it life sized or a prototype model that you might fit onto a toy?
- Think about materials for your model (you can use materials found at home).
- Will your model be static or movable? Will it have hinges to allow it to move?
- Brainstorm ideas and draw a plan.
- In your plan, show the materials you will use for your model and what they represent. e.g cardboard represents aluminium and clay represents rubber etc.

Make:

Using the tools and materials available, learners create their designs according to their proposed plans. Plans can be adjusted, as necessary.

Evaluate:

After the models have been made, learners discuss how their models work with the class.

- Did the design have to be revised or was the model built to the original plan?
- Do you think the model would work in reality? Why or why not?
- What materials would be used in real life?
- Discuss the pros and cons of the design. Are there suggestions in the class as to how each model could be improved?
- Were you happy with your design? What did you like most about it?
- What did you learn from the design process? Would you do anything differently next time?

Take the Next Step

Adapt for Home:

This lesson can be carried out in school as a group project or from home as an individual project using the resources that are available.

Adapt for Junior / Senior:

Junior classes might draw a picture or plan for a prosthetic or might work on a simpler mobility aid such as a walking stick.

Follow-up challenge/project/citizen science link:

- Write a story about how your prosthetic has changed the life of the user.
- Find out about how starfish can regenerate missing limbs and how scientists are researching how this could possibly be adapted for human prosthetics such as joint replacements.
- Think about how the user of the prosthetic could be involved in the design process.
- Research the idea of Expressive Design and how people are using design to challenge perceptions around disability.

Sustainable Development Goals (SDGs) Links:

Goal 3: Good Health & Wellbeing
Ensure healthy lives and promote well-being for all at all ages.

Goal 10: Reduced Inequalities
Reduce inequality within and among countries.

Design Challenge **Duration:** 20 - 60 minutes **Class Level:** Junior

Which materials make the best raincoat?

Curriculum Links

Strand:	Materials.
Strand Unit:	Materials - Properties and characteristics of materials.
Curriculum Objectives:	Observe and investigate a range of familiar materials in the immediate environment. Know about some everyday uses of common materials. Investigate materials for different properties. Identify and investigate materials that absorb water and those that are waterproof.
Skills Development:	Exploring, Planning, Making, Evaluating.
New words:	Waterproof.
Cross curricular links:	Maths: Measures: weight, capacity, shape SESE Geography: Weather Visual Arts
Equipment/Materials:	Empty yoghurt containers, pots, beakers, measuring cylinders or syringes, elastic bands, crayons. Range of materials, e.g. old umbrella, woollen cloth, recyclable plastic bag, newspaper, tinfoil, bubble wrap.

Engage

Trigger questions:

- Book: What if rain boots are made of paper?
  http://online.pubhtml5.com/kyrh/zndh/#p=1
- What type of materials do we need on a wet day?
  Present images of people on rainy day.
- What do we mean by waterproof?
- Can you name some types of materials that are waterproof?
- What materials in nature might be waterproof?
- Are humans waterproof? Are animals waterproof?
  (Sebum oil on your skin is one of the ways it stays waterproof. Bird feathers are not naturally waterproof but birds can make them water resistant by applying waxes from their preen glands. It is essential for birds to preen their feathers to keep them in good shape by distributing waterproof oils and powders).
- What types of objects need to be waterproof?
  (e.g. boats, buildings, outdoor gear, umbrellas).

Background

Waterproof material is relatively unaffected by water and is commonly used in wet environments. It refers to penetration of water in its liquid state. Waterproofing is used in many ways e.g. buildings, watercraft, clothing, electronic devices, liquid cartons. Humans have made clothing to protect themselves from the rain for thousands of years. In Mesoamerican cultures such as the Maya and Olmec a latex-like extract from rubber trees was used to create waterproof clothing and footwear.

Animals such as birds and marine mammals have evolved to stay warm and dry. Humans have often used materials such furs, plant materials and even animal intestines to stay dry. An example of this is the Kamleika which was used by the people of the Aleutian Islands and usually made from the intestines of sea otters.

In the 15th century sailors treated boat sails with linseed oil and a mix of other waxes to make weatherproof capes. This is likely where the term "oilskin" came from.

Modern waterproof fabric was invented by a scientist called Charles Macintosh in the 1820s. Macintosh patented a double textured fabric around a layer of rubber. This textile coating technology was so important that people still use his name as another term for raincoats - mackintosh or mac.

https://en.wikipedia.org/wiki/Kamleika#/media/File:Parka_(Kamleika)_Aleutian_Islands.JPG

https://upload.wikimedia.org/wikipedia/commons/0/05/Kamleika%2C_Yupik_Eskimo_-_Ethol%C3%A9n_collection%2C_Museum_of_Cultures_%28Helsinki%29_-_DSC04906.JPG

Real world application

Rain jackets, weather, wellington boots, waterproof protective clothing for people working outdoors.

Design challenge

Explore:

Learners should be encouraged to examine, explore and compare the materials that will be tested for this challenge at the beginning of the activity. They should make predictions about which materials they think will be waterproof or not and why they think that.

- How might we design an activity to investigate which type of materials will make the best waterproof jacket?
- How will we determine which material works best?
- How could we record our results?

Plan:

We need to design a new raincoat, and in order to do that, we need to first determine which material will
best keep us dry in rainy weather.

The learners should be shown the various materials and asked "Can you say which of these do you think would make the best life jacket?" and "why do you think that?"

Can the learners think of a way they could waterproof paper using materials found in the classroom? (wax crayons could be used to waterproof paper)

Conduct a short investigation by stretching different materials over beakers or pots (secured with elastics) and investigating if water poured onto the stretched material dripped through into the beaker. If the water dripped through it is not waterproof. If the water stays on top, the material is waterproof.

Ask learners to record their results listing which materials are waterproof and which are not.

Fair testing: How will we make it a fair test? E.g. different materials, size of material, amount of water, period of time.

Material	Was the material waterproof?
Bubble wrap 	☐
Compostible bag 	☐
Tablecloth 	☐
Woollen fabric 	☐
Tinfoil 	☐
Newspaper 	☐

Make:

Now that the learners have tested which materials are waterproof or not, have them draw out a design for a raincoat. In the design have them label what materials they have selected and why.

Think critically - Consider why not all waterproof materials may be suitable for a rain jacket, which material do we think would be BEST and why. Possibly have the learners consider how to improve the design with materials not provided in the experiment but with materials they can think of from their everyday life.

Can they use their design to make a raincoat for a doll or teddy bear?

Evaluate:

- Do the learners think their rain jacket design would be comfortable or warm? E.g., a raincoat made of rubber is more flexible and comfortable than one made out of aluminium, despite both materials being waterproof.
- Can they put the materials in any order? If so, what factors are they using to do this (i.e. why are they putting them in this order?). What is the “best and worst” material for a rain jacket?
- If they were doing it again would they do anything differently?

Take the Next Step

Adapt for Home:

This design challenge can be easily adapted for home. Learners are encouraged to look at raincoats at home and test them to see if they are waterproof. With a guardian they could wear a raincoat outside and be sprayed with a water hose to see if different jackets are waterproof.

Adapt for Junior / Senior:

At senior level learners could research waterproofing of buildings and equipment used in the marine environment. How do divers stay warm? How do birds waterproof their feathers and what happens when they get wet?

Follow-up challenge/project/citizen science link:

Investigate the effects of water or vegetable oil on found bird feathers e.g. compare feathers before and after being dipped in the water or oil. These liquids can impair waterproofing, buoyancy and expose the skin to extremes in temperature.

http://oiledwildliferesponse.ie/

"Designing and Making a Dry Suit for Scuba Steve" Marine Institute

https://oar.marine.ie/handle/10793/1008

Weblinks:

http://online.pubhtml5.com/kyrh/zndh/#p=1

http://oiledwildliferesponse.ie/

https://oar.marine.ie/handle/10793/1008

Design Challenge **Duration:** 1 hour **Class Level:** Junior/Senior

Design a wheelchair

Curriculum Links

Strand:	Materials, Living things.
Strand Unit:	Properties and characteristics of materials, myself, human life.
Curriculum Objectives:	Observe and investigate a range of familiar materials in the immediate environment. Investigate materials for different properties. Explore and investigate how people move. Investigate how materials may be used in construction.
Skills Development:	Exploration, Planning, Making, Evaluation.
New words:	Assistive device, durable, manoeuvrability, robust, prosthetic.
Cross curricular links:	SPHE
Equipment/Materials:	**Design** – paper, pencils, colouring pencils, computer program such as MS Paint, MS Office, Whiteboard, photographs/images of different wheelchairs in different environments **Make** – everyday classroom materials that can be reused or would normally be recycled, dolls or teddy bears, wooden skewers, scissors, sticky tape, glue, milk carton lids, assortment of carboard boxes/ corex card/ balsa wood, kids hacksaws, cold glue gun/ PVA glue.

Engage

Trigger questions:

- Who uses wheelchairs?
- What type of wheelchairs are there?
- Does one wheelchair suit everyone?
- Can you use the same wheelchair in all environments?
- Can you think of any sports with wheelchair users?
- Are wheelchairs cheap or expensive?
- What are the main parts of a wheelchair?
- What materials could be used?
- What material properties are needed for different wheelchairs?
- How important are the tyres?
- Would the same tyre be suitable on all terrains e.g. road, beach, basketball court?

Background

Wheelchairs are one of the most commonly used assistive devices for enhancing personal mobility. A well-designed and well-fitted wheelchair is a means by which users can exercise their human rights and achieve inclusion and equal participation. A wheelchair provides mobility, ensures better health and quality of life, and assists people with disabilities to live full and active lives in their communities.

When designing wheelchairs a number of factors need to be considered

- Provides proper fit and postural support
- Safe and durable
- Maintenance and services should be at an affordable cost e.g. spare parts
- Physical needs of users
- How will the wheelchair be used
- Materials and technology
- What environment will the wheelchair be used in e.g. rough outdoor environments needs to be robust and more stable on rough ground but indoor settings on smooth floors require manoeuvrability in small spaces

Real world application

Engineers follow the engineering design process to create solutions that improve all our lives. Assistive technology is any device, software, or equipment that helps people work around their challenges e.g. wheelchairs, hearing and visual aids and prosthetics.

Regular users who enjoy exercise and elite athletes who compete in international competition such as the Paralympics require the right wheelchair to perform at their best. Specialist sports wheelchairs can be designed for speed, mobility and ruggedness. A range of sports such as wheelchair basketball, wheelchair rugby, para athletics and many more require different considerations compared to everyday wheelchairs.

https://www.tinkercad.com/things/1VSSl65c2vx-garfield-at-wheelchair

Design challenge

Explore:

- Walk around your school and identify what type of surfaces there are indoors and outdoors. Are there ramps. What kind of playgrounds and sports grounds are there? Are they suitable for wheelchairs? How could the surfaces be improved?
- Interview a learner who uses a wheelchair or has mobility issues on what they think would make their school easier to get around.
- Identify materials and shapes that might be suitable

Plan:

- Work in groups to design the wheelchairs.
- Take a close look around the classroom to identify materials and shapes that might be suitable
- Brainstorm within group and report back to class with ideas.
- Draw a colour-coded map of school grounds showing areas that are good and bad for wheelchairs.
- Draw the wheelchair and identify the materials that will be used e.g. drink cans for wheels, cardboard for seat and back.

Make:

- Ask learners to design and build small-scale wheelchair prototypes.
- Identify appropriate materials and construct a model.
- Test the scale model using dolls or teddy bears and on different surfaces.

Evaluate

Evaluate the initial design and completed model

- Were you happy with the original plan?
- Were you happy with the final model?
- Did you encounter any problems?
- How did you fix problems?
- Did the plan change as you developed it?
- How would you improve your design?
- What was your favourite part of this design challenge and why?

Take the Next Step

Adapt for Home:

Easily adapted for home by exploring the immediate environments such as house and garden and using materials to hand. This can be extended to neighbourhood and community.

Adapt for Junior / Senior:

This design challenge could be changed to using materials such as Lego, K*Nex, 3D printers and also incorporating design software such as TinkerCad or LeoCad.

Follow-up challenge/project/citizen science link:

Design an accessible school.

http://nda.ie/Publications/Education/Education-Publications-/Improving-the-Accessibility-of-School-Buildings.html

Websites:

https://www.tinkercad.com/things/1VSSl65c2vx-garfield-at-wheelchair

http://nda.ie/Publications/Education/Education-Publications-/Improving-the-Accessibility-of-School-Buildings.html

https://youngengineers.ie/

https://www.engineersireland.ie/

Useful web links to support activities:

Materials for Design (for junior classes):
What if rain boots were made of paper? http://online.pubhtml5.com/kyrh/zndh/#p=1

Izzy Wheels:
https://www.youtube.com/watch?v=3aLkbRNpOnc&feature=emb_logo

David Aguilar - Hand Solo:
https://www.lego.com/en-us/kids/videos/star-wars/howibuildmyprostheticarmwithlegooct19-b3e2f3032bf046a682a2e65cb22e24e9

All Ireland TY Wheelchair Basketball:
https://www.youtube.com/watch?v=m9oAqNZzKN8

How a Carbon Fibre Running Blade is Made:
https://www.paralympicheritage.org.uk/running-blades-and-their-evolution

Big Life Fix – RTE Player:
Engineers and Inventors using design to solve people's problems – episode one
https://www.rte.ie/player/series/big-life-fix/SI0000006774?epguid=IP000064569

How to Train Your Dragon:
A new tail for Toothless
https://www.youtube.com/watch?v=jFQUE_6Zhn0
or a new leg for Hiccup
https://www.youtube.com/watch?v=H7muODd2pCo

Science Foundation Ireland For what's next

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