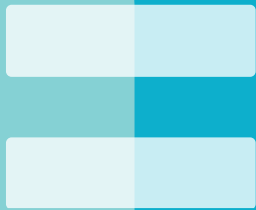




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Classroom Resource



**Which materials
make the best
raincoat?**



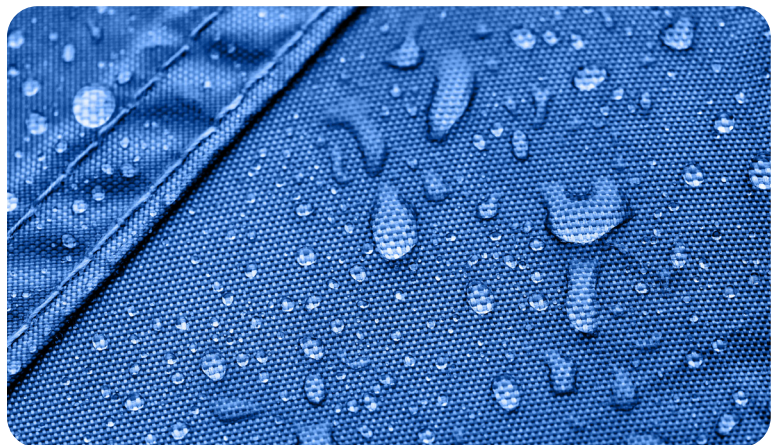
Design Challenge

Which materials make the best raincoat?

Class Level - Junior/Senior

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/vocabulary:	Waterproof, water resistant, watertight, natural and synthetic fabrics
Focail nua:	Cóta báistí (Raincoat)
Cross curricular links:	Maths: Measures: weight, capacity, shape, Geography: Weather, Visual Arts: design, History: Manufacture of waterproof fabrics
Equipment/materials	<ul style="list-style-type: none"> • Range of materials to test for waterproofing - selection of fabrics, waste, soft plastic, newspaper, old foil wrapping, or reused bubble wrap from packaging • Equipment for testing – basins or trays, cups or bowls, jugs, spray bottle, syringes, or water droppers • Materials and tools needed for making the raincoat will be identified by learners as part of the design process but may include scissors, safety pins, string, glue, tape etc





Engage

Prompt questions

- Can you name some types of materials that are waterproof?
- What materials in nature might be waterproof?
- Are humans waterproof? Are animals waterproof? (The protein keratin in your skin and the sebum oil on your skin help to make it 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 clothing, umbrellas).
- What happens if our clothes get wet in the rain? Our bodies lose heat quickly and it is uncomfortable. We want to go back inside.
- What type of materials do we need on a wet day?
- What do we mean by waterproof?
- Is it fun being out in the rain if we have the right clothing?
- The book **“What if rain boots were made of paper”** is a nice prompt for investigation of materials.

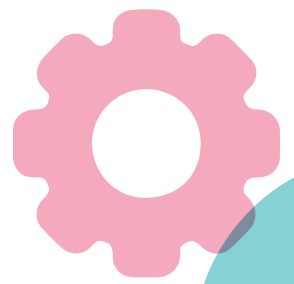
Background information:

Waterproof material is relatively unaffected by water and is commonly used in wet environments. It refers to the penetration of water in its liquid state. Waterproofing is used in many ways e.g. buildings, watercraft, clothing, electronic devices, liquid cartons. Over the years, humans have made clothing to protect themselves from water using materials such as furs, plant materials, and even animal intestines to stay dry. Animals, birds and marine mammals have evolved to stay warm and dry. In the 1820s a scientist called Charles Macintosh invented a waterproof material made of two layers of fabric with a layer of rubber in between. Macintosh patented his invention and people still use his name as another term for raincoats - Mackintosh or Mac.

Real-world application

In Ireland, it is important to dress properly for the wet weather we regularly encounter, to comfortably enjoy time outside. Waterproof coats, boots, and shoes play an important role in keeping us dry and warm. For camping, hiking and other outdoor activities, waterproof trousers are also important. If we choose the right clothing to keep us warm, dry, and comfortable, we can make the best use of the outdoor environment, whatever the weather. There is a saying that “There is no such thing as bad weather, just bad clothing.”





Investigation

Before designing the raincoat, learners will need to find a suitable material. A simple fair test investigation can help to identify some waterproof materials.

Starter questions:

Which materials are waterproof?

Prediction:

Learners can examine a number of materials, e.g. different types of fabric scraps (wool, cotton, nylon, polyester, or blends) or waste materials such as old newspapers, magazines, used foil or plastic wrapping. They might also examine balloons or latex gloves. They then predict which ones might be waterproof, giving reasons for their predictions.

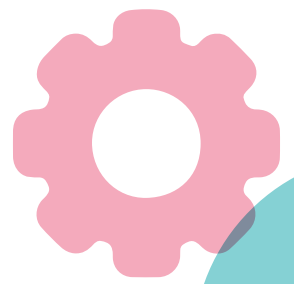
Investigate:

Learners can work in groups to carry out the investigation. They can discuss what way is best to carry out their investigation and how they will determine which materials are waterproof. One way would be to stretch the materials over a bowl or cup using an elastic band and drop or pour water on them. Standing the bowls in a basin would catch any spills. If water gets through the fabric, it is not waterproof.

Sharing Data / Results:

Once they have carried out the test, they can divide materials into those that are waterproof and those that are not. Is there a third category? Some fabrics will hold off the water for a certain length of time, but water will eventually start to seep through. These types of materials are described as water-resistant. A water-resistant coat would be fine for light showers.





Design challenge: Which materials make the best raincoat?

Explore

Finding out which materials are waterproof could be the first part of the exploration. Once learners have identified a number of waterproof materials, they can then start to explore other features of waterproof coats.

Examine a number of different water-resistant or waterproof coats. These could be children's coats in school or a selection of different coats at home. How are they made? What do they look like? How do they fit? Does the hood fit properly? Do any of them pack away for carrying in a rucksack? Do they have any other features such as zips, buttons, or pockets? Examine the seams to see if they are waterproof.

Plan

Learners can work in groups to make their raincoats or can work on them at home. Consider the following questions when planning:

- Who is the raincoat for?
- Would all of the waterproof materials tested be suitable for a raincoat? Why/why not?
- What activities will they be using it for? (For a short walk to school in winter, a warm water-resistant coat might be fine, but for a long walk in the woods or on the mountains, a coat should be fully waterproof.)
- Does it need to be warm? A winter coat could be warm and waterproof, or it could be designed with enough room to put other warm layers inside.
- Is it breathable, or will it get very sweaty inside on a warm day?

- Will it be flexible enough to move comfortably?
- Will it be very heavy to wear?
- How will it be closed? – zips, buttons, or capes etc.

Draw a design for the raincoat. Decide what material or combination of materials would be best to use and how to put it together.

Make

Make a small version of the raincoat to suit a toy or action figure. Choose a toy that won't be damaged if it gets wet during testing. Some parts of the initial design might be difficult to make so consider easier options such as safety pins or strings to hold it closed instead of zips. If you can't sew it together, consider using tape or glue, but don't glue the coat to the toy.

Evaluate

- Test the raincoat by putting it on the toy and spraying some water over it – think of how best to simulate a rain shower. Does it keep out the rain?
- Is it waterproof or just water resistant? Would it be good for a light shower or a downpour?
- Do you think the raincoat would be comfortable to wear? How would it feel? Would it be flexible enough to allow movement?
- What does the raincoat look like? Would you like to wear it yourself?
- Were you happy with your design, and would you change anything about it?



Take the Next Step

An alternative investigation could be to take small pieces of paper or cotton and investigate ways of making them waterproof using oils or wax crayons.

Adapt for home:

This design challenge can be completed as a group project in school or an individual project at home.

Adapt for junior/senior level:

Junior classes might do the investigation of waterproof materials, examine their own coats, and discuss how to design a raincoat. They might make a simple cape for a toy using a circle of their chosen material with a central hole.

Senior classes could be encouraged to put more detail into their design and consider comfort, fit, and how the raincoat will be used.

Follow-up challenge/project/citizen science link

- Research waterproofing of buildings and equipment used in the marine environment.
- Research waterproofing in nature. How do animals cope with wet environments? How do birds waterproof their feathers, and what happens when they get wet? What are the effects of oil spills on birds' feathers?
- Investigate the history of waterproof clothing and boots: Tanning of hides and making leather; use of animal intestines such as the Kamleika robes made by the people of the Aleutian Islands; the Mackintosh made of a layer of rubber sandwiched between fabric layers; oilskins made of oiled cotton and wax jackets made of cotton impregnated with paraffin wax, polyester and nylon raincoats and use of modern breathable waterproof fabrics.
- Investigate the environmental impact of waterproofing, such as man-made materials and waterproof treatments. Are there more environmentally friendly alternatives? Research sustainable fabrics and clothing production.
- Clingfilm and tinfoil are waterproof fabrics that are often used in the storing and cooking of food, but their use is mostly unnecessary at home. Investigate ways to replace their use in your kitchen, such as compostable (not siliconized) baking paper, beeswax food wraps, and reusable containers.

