Suitable for 3-7 years

- [x] Solo
- [ ] Pairs
- [x] Groups

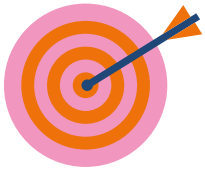
Faisal's activity

Explore materials

How to guide

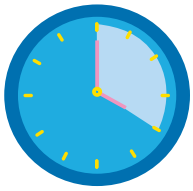
Faisal's activity

Explore materials



Aim

The aim of this activity is to explore different materials and introduce the idea that engineers not only use lots of different types of material but also design new types of materials as well.



Timings

~10-20 mins per activity (3 stations)

Materials and equipment

- A selection of fabric swatches in different colours
- Masking tape (create a loop add to each piece of fabric to stick the fabric swatches to other things)
- Colour changing bath ducks (optional)
- Two Pyrex containers, one large and another small enough to fit inside it
- Vegetable oil
- Cereal box(es)
- Craft sticks
- Duplo or other blocks (of uniform size) – ideally Duplo and base boards
- That's not my X book (any of this set of books)
- Boxes to set up sensory boxes
- Selection of rough and smooth objects

Health and Safety

You know your group of children best so please judge what you think is safe for them. Important parts to note:

- If using colour changing ducks and different water temperature be careful with the warmer temperatures.
- When building the lid with holes in it for the surface mapping ensure an adult pierces the holes and keep sharp objects away from the children.

Instructions

Activity 1: Camouflage

1. Give one child (or group depending on how many children you have) a fabric swatch and ask them to hide it by sticking it to a surface (not allowed to hide it under or in something) within the classroom/play area
2. Ask the others to search for it
3. Repeat to try different colours and for everyone to have a go at hiding
4. Discuss what made it difficult to find the swatch, i.e. the better it was matched to the background colour the harder it was to spot. Give some examples from the animal kingdom of where this hiding strategy is used. National Geographic have a gallery of hidden animals here.
5. To extend the activity you could ask them to create their own camouflage swatches using paper and paint and try them out
6. An alternative extension would be to talk about the idea of some animals changing colour based on their surroundings – chameleons etc will be this to blend in and be camouflaged – and how engineers have been inspired by this to create colour changing materials, e.g. with bath ducks

that change colour in different temperatures (you could try some out in bowls of water but be careful with hot water)

How camouflage works?

When something is camouflaged it is difficult to spot because it blends in with the surroundings. Engineers design materials for camouflage for the army, e.g. for uniforms or tanks, and they also try to design materials which can change colour in different settings, like some animals (e.g. chameleon, cuttlefish, octopus) – we might not always want to use the colour change to hide things but it could be useful to tell us something, e.g. a spoon that changes colour if the food is too hot or a bath duck with changes colour if the water is too hot.

Activity 2: Invisible

1. Read the story Slightly Invisible
2. Demonstrate how we can make things appear invisible with a container, Pyrex bowl and vegetable oil. Fill the large container with oil. Place the smaller container inside making sure to scoop oil into it as you place it in. Alternatively you can add it in and then make it disappear by pouring oil into it .
3. You can also do this with jelly marbles (see activity 4 on Growing with Science) and to talk about how light moves through water visit Nustem here.
4. Talk about whether it is really possible to make things invisible and how scientists and engineers are actually working on it!

How invisibility works?

Scientists and engineers are also working on making things invisible. To do this they have to change the surface of materials so that light is guided around the object to be made invisible. Like camouflage this would be good for the army but car manufacturers are also interested – sometimes when we are driving parts of the car make it difficult to see out and spot things, e.g. other cars or people walking, but if the parts could be made invisible drivers could see everything.
It works for really really small things but we are

still a long way from any applications or being able to make an invisibility cloak for a person. The invisibility experiments in this activity are based on materials with the same refractive index, i.e. how much light bends. We need light to see things and we see because light bounces (reflects) off objects. Normally we can see the Pyrex container (even though it is transparent) because the container has a different refractive index to air so the light travels at a different speed, and bends (see the Naked Scientists for an excellent explanation). When the light bends there is some reflection of the light. Since Pyrex and the oil have the same refractive index the light doesn't bend, there is no reflection and we can't see the Pyrex container.

Activity 3: Rough and smooth and surface mapping

Prep for surface mapping –
Create analysis lid and mark up craft stick (children could help with these tasks depending on age and ability)

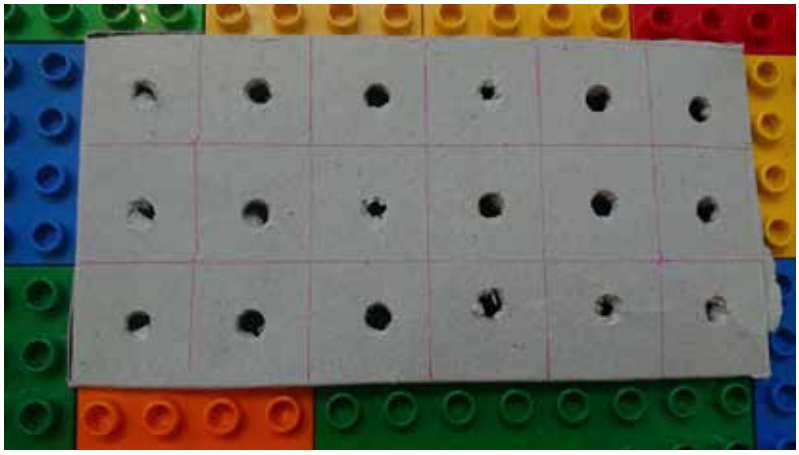
Analysis lid:
Start by drawing around your Duplo blocks – we used a 6 by 12 baseboard and the analysis unit was a 2 by 2 block giving us the 3 by 6 grid shown in the image.

Secondly use scissors or other sharp tool to pierce a hole in the centre of each grid square. Widen using a pen or craft stick

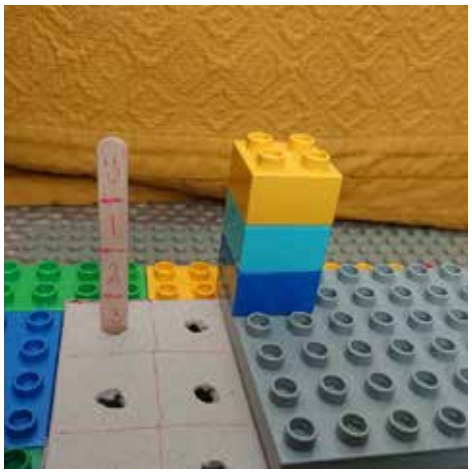
Thirdly fold around the outside edges of the analysis lid and Sellotape the corners

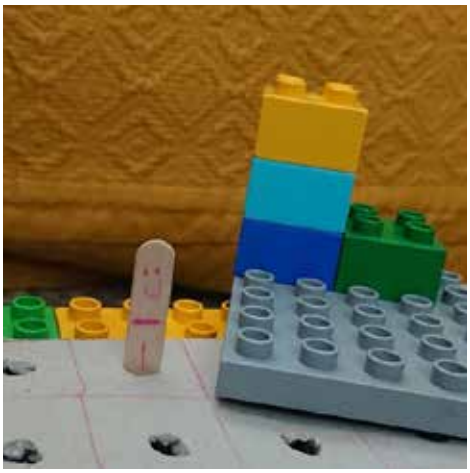
Craft stick
Use a Duplo block to mark out the heights and write the numbers on.

1. Read any of the That's Not My X books to introduce the idea of how materials feel
2. Invite children to explore sensory boxes with different rough and smooth objects and classify them based on rough and smooth. This might be sufficient for the youngest children. Older children can continue with the next steps.
3. Discuss that scientists and engineers often want to investigate the surfaces of materials. They don't use their hands to check how rough or smooth something is but special equipment that allows them to 'see' how rough something is.
4. Show the children a Duplo structure hidden within higher Duplo walls. Cover it with a lid and ask them how they could work out what the pattern of blocks is inside the walls. Subsequently, replace the lid with a lid with holes in it, and get out the craft stick. Explain that when the craft stick is put though a hole in the lid we can investigate what is in the box, i.e. how far it goes depends on the surface inside the box. See images below



5. Ask the children to investigate different structures (these should contain a Duplo structure of different heights – we suggest up to a height of 4 blocks inside the walls allowing for you to construct the walls as 5 blocks high). For each box they put the craft stick through each hole in turn and use the stick to count how many Duplo blocks to add to their model of the surface. Alternatively, to practice number writing they could write the number in a grid. At the end they can open the box and check if they got it right. Children can subsequently build challenge structures for each other. In real-life engineers can't open the box but similar methods are used to map out what a surface we can't see looks like whether that is at a small scale to control material properties or to investigate something like the sea bed.





How rough and smooth surface mapping works?

In order to be able to design materials that change colour, or make things invisible, engineers need to know all about the surface of the materials at a level that can be too small to see. Engineers have made equipment to measure surfaces like an AFM (learn more by finding out about 'Inside the Black Box' experiment) which is basically like a very tiny stick that taps the surfaces at different points and can then build up an image of the surface and measure the roughness at a very small scale.

Extension ideas

Read the comic about designing materials and ask the children to come up with a material they would like to have

The technique of investigating the surface of materials can be applied in looking at small surface changes but a similar method can also be used to investigate the ground, e.g. taking samples at regular intervals to check the type of rocks and soil. Our Geotechnical Engineer Moh does this to see where it is safe to build. Explore the role of foundations with our building on sand and flour activity.

Christiaan is also interested in materials at the small scale for making crystals and computer chips – try this computer chip art activity.

Uwe also investigates materials but he is interested in how strong materials are, particularly corals and bones. Why not try the Under the Sea Drama to find out more about corals, then decorate your own coral designs and test the strength of different materials?