DIFFICULT | 8 – 13 | 1 – 1 ½ HRS

1. Learn about the work of Stephanie Kwolek
2. Make different salt dough recipes and test them for impact strength
3. Investigate how adapting the recipe may change the material's properties and strength

STORIES IN CHEMISTRY

MEASURING MIGHTY MATERIALS

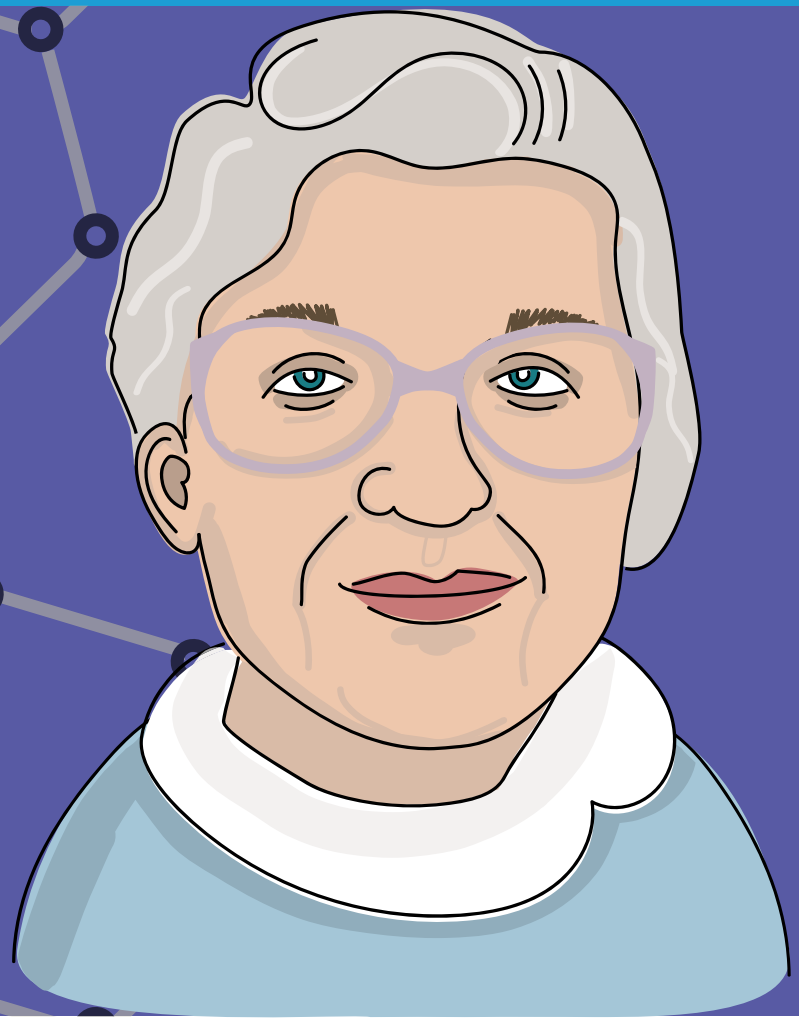


Illustration: Stephanie Kwolek

INTRODUCTION

Stephanie Kwolek was a Polish-American chemist who is known for inventing Kevlar.

Stephanie Kwolek was born to Polish immigrant parents in Pennsylvania, USA. Her father died when she was 10. She was a hard-working student and decided to study for a chemistry degree.

Stephanie's first job was making new super-strong, synthetic (man-made) chemicals. One day, she made something unusual. At first her colleagues didn't take much notice because the chemical looked different to the other materials they had been making.
However Stephanie tested her new chemical material anyway.
To everyone's surprise it was the strongest they had ever tested – it was five times stronger than steel and was named 'Kevlar'.

DID YOU KNOW?

Kevlar is so strong, it was first used instead of steel in racing tyres.

Kevlar can also be spun into fibres and sheets, so the material was later used to make racing boat sails, heavy duty cables and in bullet proof vests. This means that Stephanie Kwolek's invention saved many lives.

SAFETY

- **Avoid any known food allergens – gluten-free flour can be used in this experiment.**
- **Do not eat anything used or produced in a science experiment.**
- **An adult should cook the dough.**
- **This activity should be supervised at all times.**

ACTIVITY

MAKING SALT DOUGH AND TESTING FOR IMPACT STRENGTH.

To commemorate the work of Stephanie Kwolek, the experiment below will test for impact strength in salt dough.

INSTRUCTIONS

1. Measure out the flour and salt using scales. Mix together in a large mixing bowl.
2. Using the measuring jug, add 200ml of warm water to the salt and flour mixture. Mix until the dough is easily kneadable and forms a soft round ball. More water can be added if required. Split the salt dough into 6 equal sized balls.
3. Using a rolling pin, roll out 3 balls of the salt dough into 2cm thick circles. Leave one dough circle uncooked. Place the other 2 dough circles on baking trays and ask an adult to cook one in the oven for 25 minutes at 100°C, and the other for 25 minutes at 200°C.
4. Place one of the dough circles on a baking tray on the floor next to a chair (protect the surrounding floor with a towel). Carefully stand on the chair and drop a ball point pen, point downwards, into the dough. Repeat until you have 3 pen marks in the dough circle. To ensure it is a fair test, make sure you always drop the pen from your waist height.
5. Place a cocktail stick into the indentation left by the pen and mark the level of the dough surface with a marker. Use a ruler to measure in millimetres from the tip of the cocktail stick to the mark. Measure the other 2 pen indentations in the same way. Record your results. Add the three results together and divide the total by 3 to get the average depth.
6. Repeat steps 5 and 6 with each dough circle. Compare your average depth results. Which dough was the strongest?

CHALLENGE

Can you adapt the salt dough recipe to make the best "pen-proof vest" material?
Take the 3 remaining balls of salt dough. To each dough ball, add 2 tablespoons of one of these extra ingredients: sand/rice, sugar, jelly granules, but do not cook these. Knead the dough thoroughly to form 2cm thick circles, then test each using steps 5-7 above. Which is the strongest material and why?

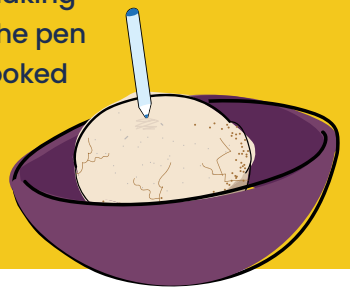
YOU WILL NEED

- 400g plain flour
- 400g salt
- Kitchen scales
- Large mixing bowl
- Measuring jug
- Rolling pin
- Baking tray
- Tablespoon
- 6 cocktail sticks
- Marker pen
- Ruler
- Access to an oven
- Ball point pen
- For the challenge - sugar, rice/sand, sugar free jelly crystals (any flavour)

WHAT'S HAPPENING?

A ball point pen has a pointed tip. Measuring the indentation the pen makes on the different salt dough recipes allows us to test the strength of each different material we have made. The shallower the indentation, the stronger the material is.

Cooking the dough dehydrates it, making it stronger, so the pen makes no dent. Adding hard particles such as rice/sand deflects the pen's energy into the surrounding dough, so the indentation is shallower. Jelly granules absorb any water from the dough, making the jelly dough firm and springy, so the pen indentation is shallower than in uncooked dough. Sugar dissolves in the dough making it soft and sticky, so the indentation is deeper.



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