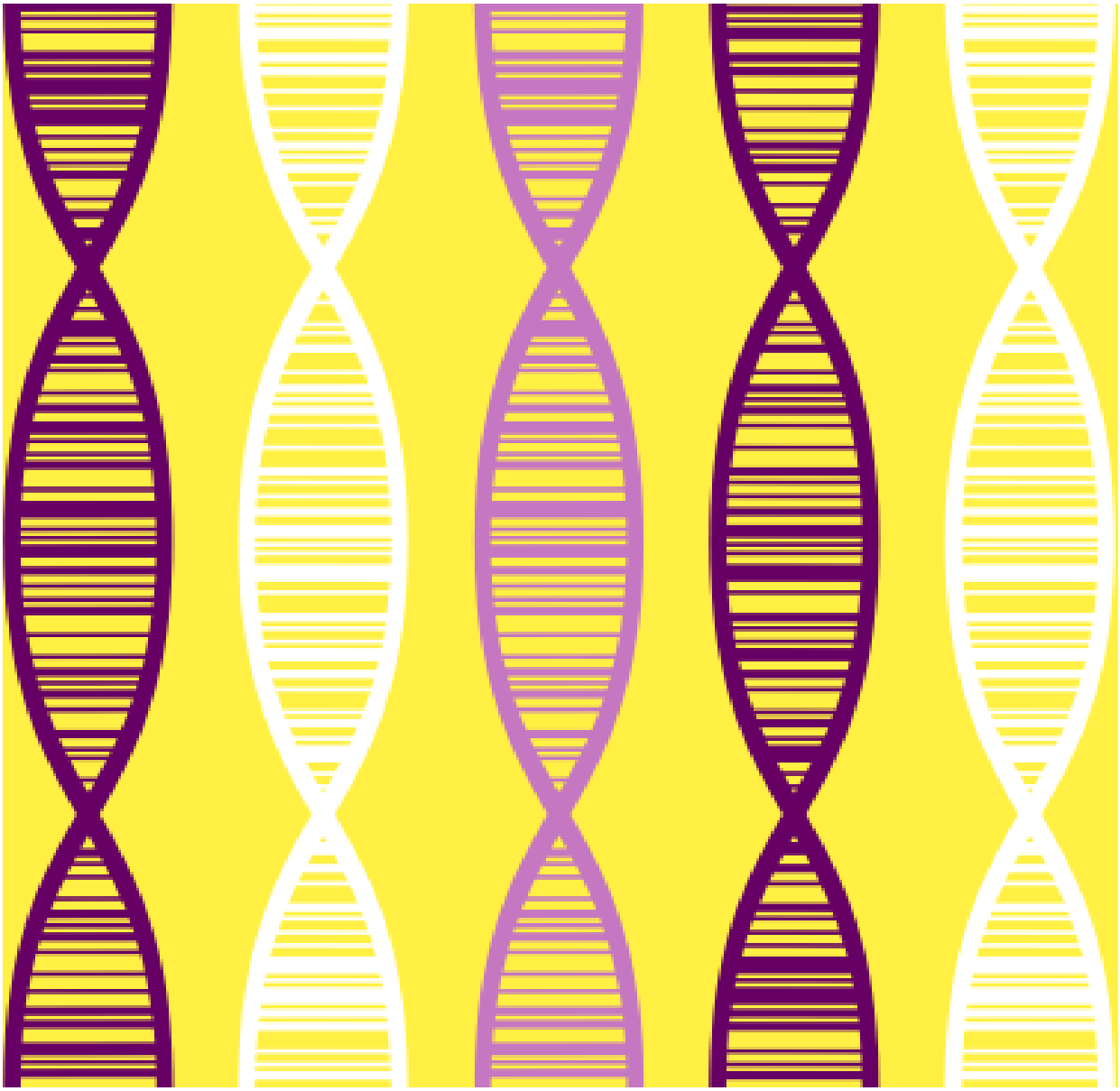
Science is all around us all of the time, which is part of why we think it's super important to continue making people excited about it. Also, it's lots of fun- which makes our job easier.

In the following pages are just some of the busking demonstrations we like to do in YSA, as well as how you can do them yourself super cheaply at home. Each demonstration is accompanied by some suggestions of how you can make it into an experiment. Remember, if you wonder what would happen if you did it a little differently, make a guess and then think of a way you could safely test that! You never know what you might discover.

Each demonstration also has a 'What's Next?' section which asks you to do some thinking yourself. If you get stuck, you might want to ask Mum or Dad to help you research some answers- or test them for yourself!

Best regards, and have fun!
The Young Scientists of Australia: Adelaide



# Contents



Throughout this book we give approximate prices, both a cheap option and then a 'full price' option. In most cases the differences is largely how many times you can perform the demonstration before needing to replace parts (like tinsel vs paper). We tend to go for the more reusable option because we like as many people to see them as possible but this doesn't mean our results will necessarily be better.

# Positively Electric

Have you ever felt your hair stand on end when pulling off a jumper? Have you ever been zapped when climbing out of the car, or perhaps you rubbed your feet on the floor and then zapped a friend when they weren't expecting it? Those are all examples of static electricity!

## What You Need

- Something to collect static (PVC pipes work best, but balloons can also work very well)
- Something to light and dry to pick up- tinsel or torn shreds of paper work well
- Something to create static- the hair on your head can work, although for better results we recommend course sponges

This demonstration can be done for: less than $5
The expensive option is: $20

## What To Do

Note: In less windy environments than Rundle Mall, tinsel can also be tied into a ball and made to levitate with the PVC pipes.

1. Take your PVC pipe (or balloons!) and rub it vigorously with the dry, coarse sponge (or your hair).
2. Hold it over the tinsel strips (or paper) and slowly move it closer until it picks up the tinsel
3. Repeat with a different sizes and see what happens!

## What's the Science?

Electrons are small particles that carry a negative charge. When you rub two things together one may want them more than the other, so it steals them! This makes one of them positive and the other negative. Electrons don't like being together so they want to go back, but plastic materials like PVC and balloons are insulators, so they won't let the electrons move back. When you put it near the tinsel it pushes all the electrons in the tinsel away from the balloon, but this leaves the tinsel nearest the balloon with a positive charge. Because we now have a positive and a negative charge they try to attract each other.

For older kids: have a look at the **triboelectric series** and see what super combinations you can think of for producing static and think about ways to reduce static where it's not wanted.

## What Next?

What do you think would be the best combination to produce static?
Where might you use this in the real world?
Where might static electricity be a bad thing?
How could you reduce the static produced?

# Mathematical Traps

Have you ever looked at a map of train or tram stops for the Adelaide Metro? The tracks seem to mostly go in nice straight lines and are designed to fit perfectly in whatever space they are placed. These are examples of topographical maps.

## What You Need

- Two things to tie two people's wrists together with (we use bright yellow rope- but there is no real advantage for this colour, other than looking good when people take pictures!)

This demonstration can be done for: less than $5

## What To Do

Note: For safety purposes, we recommend having cutting implements nearby, especially for younger kids, in case of choking.

1. Tie an adjustable loop into each end of each rope
2. Have one person handcuff their own wrists together using a single piece of rope
3. Put one hand of the other person in handcuffs, pass the other end between the arms and torso of person 1, and then put it on the wrist of person 2
4. You should now have 2 people with their wrists handcuffed and with the ropes forming two interlocking rings
5. Try your best to escape without taking off the handcuffs, breaking the rope or removing the arm of one of the team members

I won't give you the answer to this one- but remember to think outside of the loop!

## What's the Science?

Topographical maps are a very long way of saying maps where the order is the important part. Direction, shape, size, and anything else you can think of is not important. You don't need to know how far apart two stops are, you just want to know what stop yours comes after. Topology is also the maths of why no rearrangement of two interlocked circle will allow you to break free without changing the topology.

## What Next?

What might happen with 3 interlocked circles?
According to topology, how could you draw different objects (e.g. what do you, a coffee mug and a donut have in common)?
Where else might you see topographical representations?

# Vegetable Power

Have you ever been annoyed when your tablet runs out of power? Have you ever wished you could create your own batteries? Here we do just that- **using potatoes**!

## What You Need

- A potato (or more!)
- An LED light
- Two different metal bars, rods or screws
- Alligator clips (At least 2, for single potato operations)
- (optional)A multimetre (ours cost $8)

Note: all of the electronics can be purchased cheaply and easily from common stores around Adelaide.
This demonstration can be done for: less than $20
The full version (with multimeter): $25

## What To Do

Note: Read a multi metres instructions before using it. Potatoes are very low power, but it still good to teach a budding engineer/scientist electrical care and safety. Avoid connecting the multimeter in series when measuring current. Google if unsure.

1. Stick both metal pieces partway into the potato- but make sure they are not touching!
2. Connect both to different sides of the LED using the alligator clips
3. The light should light up!
4. For multiple potatoes you can experiment with different ways of connecting them. If stuck, look up parallel vs series battery connects.
5. (Optional)Take down notes of what you measure using your multimeter at different stages - what trends do you see?

## What's the Science?

Electricity is the movement of charge. When you put two metals into the potatoes one of them begins to rust, or oxidise. This process causes the metal to shed electrons. These then move through the potatoes using special molecules called ions that travel to the other metal. Here they pass the electrons on and make a new molecule. If there is an incomplete circuit then the reactions stop because the electrons can't move well, and that's why you need the LED to complete the circuit.

## What Next?

How many potatoes would need to power the light in your room?
Would the arrangement of potatoes change this?
Effect does choosing different metal have?
What if it was lemon?

# Everyday Acids

Acids aren't just things which hurt people in movies or video games- they are part of our everyday lives. Whenever you add vinegar to your chips, that is an acid. Your car battery has acid in it… And so do soft drinks!

## What You Need

- Cola- amount depends on how many dilutions you want to do
- Water
- Cups
- PH Testing Kit (We got one for soil testing for $11- cheaper options exist if you aren't reusing the same device lots of times (such as chemical indicators)

This demonstration can be done for: less than $10
Expensive Option: $20

## What To Do

Note: You may want to have paper towels on hand

1. Fill one cup with entirely cola, one half, one a third, one a quarter and so on, remembering to leave the end on empty.
2. Top up every glass with water.
3. Test the pH, are they all the same?

## What's the Science?

'Acid' doesn't necessarily mean dangerous, it just means that it can undergo some different reactions. Our bodies need acid, in our stomachs, to break down our food, and many natural fruits and vegetables contain citric acid. Basic solutions are like the opposite of acids and are commonly found in cleaning products because they help break down fats and oils. When we say something is 'acidic' this just means lower PH than water. PHs are measured on a range 1-14, with water being 7. The lower the pH, the more concentrated the acid.

## What Next?

What about other soft drinks?
What is the PH of other chemicals around the house?
If water is pH 7 and acids have a lower pH, what would be the pH of a base?

# A Letter from the President

Congratulations on your interest in science. I am a little biased, but I personally think it is one of the coolest things there is to learn about in your free time. Whether you enjoy food, colours, electricity, explosions, animals, space… and the list goes on, science has something for you. The best part is that you don't have to be a scientist, or even be that smart to appreciate what science is and what it does.

I was raised to be curious about the world, and to have fun being so, although somewhere along the line that also developed into a desire to work out how to break things (and mostly fix them), which is how I ended up in engineering. Across this time I have worked out that the trick to science (in an engineer's opinion), rather than natural intelligence, is passion combined with disciplined curiosity. That is, find something you enjoy, something you really want to know more about, and poke at it, metaphorically, until you learn something new. Don't swing wildly, but steadily work your way around the issue, coming up with lots of different ideas until you find something which works.

The other key, in science, is to not be afraid to fail. One of the really great things about science is that no-result is still a result. If you expected something to happen and it didn't, try and work out why! This can sometimes be more interesting than what you were trying to test in the first place!

I would also recommend finding someone who inspires you. There are many incredible science communicators out there (people like Bill Nye or Brian Cox) who have an amazing message to share, that of how the universe works and why it is the way it is.

If you come across something new on your trip, something which it appears no-one has written about before- write about it yourself! Test it, and share it- who knows what you may have discovered! Last of all, don't ever feel too young to have great ideas. The older you get, and the more you learn, the more you realise just how little you know. There is still so much to be discovered, developed and created that there is no saying where, or who, it will come from.

Best of luck as you explore the universe through science,
Kevin Clark
President of Young Scientists of Australia: Adelaide