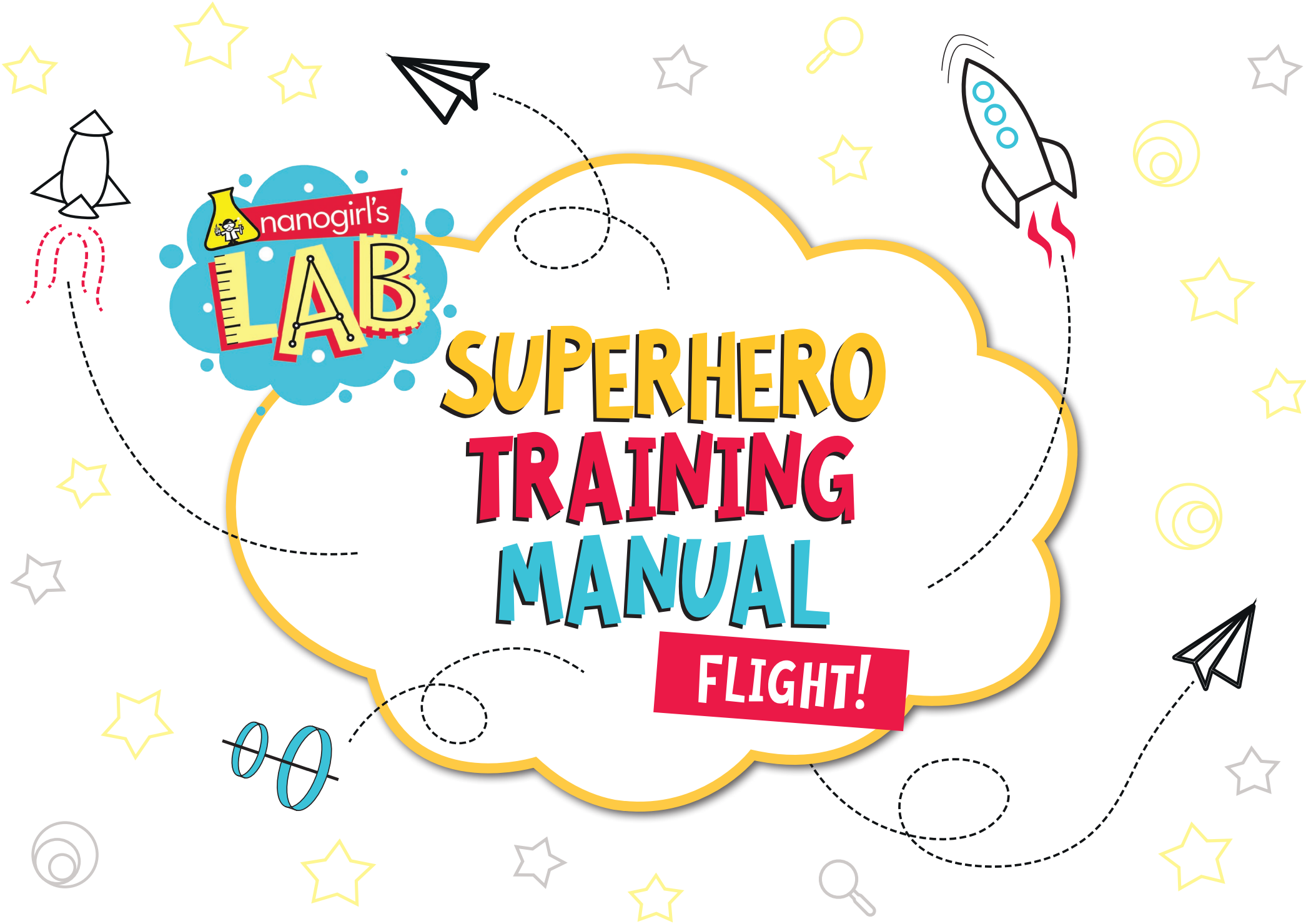

nanogirl's
LAB
SUPERHERO
TRAINING
MANUAL
FLIGHT!

SUPERHERO TRAINING MANUAL

FLIGHT!

Hi, I'm Nanogirl and I'm so excited you've joined me on my quest to become a SCIENCE SUPERHERO!

I've always wanted to be a superhero, have you ever wanted to be a superhero? What superpowers do you wish you had?

As I wasn't born with special superpowers I need to use my SCIENCE AND ENGINEERING SKILLS to engineer my own and I'd love to share these skills with you.

All we need are things that you probably have lying around at home and a space to build your superpowers.

Ask your parents or caregivers to join up to the Nanogirl's Lab Facebook community

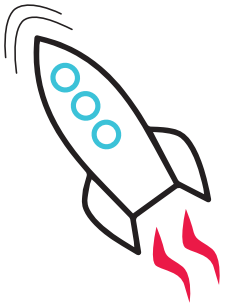
WWW.FACEBOOK.COM/GROUPS/NANOGIRLSLAB

nanogirlslab.com

nanogirl's LAB

SUPER POWER: Flight!

ROCKET LAUNCHER



Today, I'm building a ROCKET! Rockets and planes both need to launch, and as part of my superhero training, I need somewhere to test out and launch my rockets, like a secret cave... OR A SUPER SECRET SCIENCE LAB!

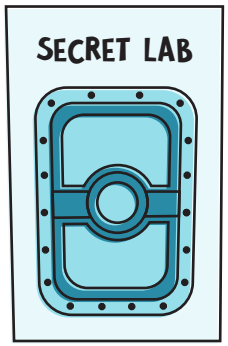
I've created a SECRET LAB in a corner of the room, do you have a space that could be your secret lab too?

Why don't you make a sign to let everyone know where your lab is and what it's called—mine is called NANOGIRL'S LAB. OK, let's start our first superhero training session!

FOR THIS EXPERIMENT YOU WILL NEED

- Empty, clean plastic bottle ◯
- Small plate to draw around ◯
- Plain paper ◯
- Scissors ◯
- Tape ◯
- Ruler ◯
- Pencil ◯
- Colouring supplies ◯

SUPERHERO CHECKLIST

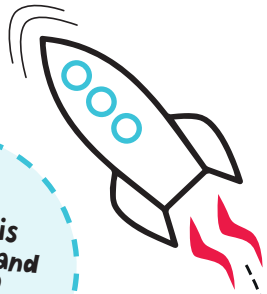


☐ Super-secret SUPERHERO LAB

nanogirl's LAB

SUPER POWER: Flight!

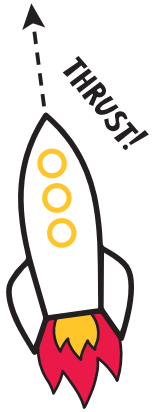
ROCKET LAUNCHER



JOKE:
Q: What is fast, loud and crunchy?
A: A rocket chip!

LAB NOTES...

HOW DOES A ROCKET TAKE OFF?



When a rocket takes off, it needs to create the force of 'THRUST' to be pushed up into space. Rockets create their thrust by setting off a huge controlled explosion.

This creates a build-up of pressure and when the pressure is released, the thrust it creates helps the rocket to overcome the force of gravity.

In this experiment, you forced air to come out of the tube when you squeezed the bottle. This created AN INCREASE IN THE PRESSURE underneath the cone and if that pressure was enough, it should have overcome gravity enough to launch upwards!

TO MAKE YOUR ROCKET...

WATCH & BUILD 15 MINS

1. Watch Nanogirl making her own bottle rocket!
2. Take the top off your bottle. You won't need this.
3. Place the plate on your paper, and draw around it
4. Cut out the circle, then fold it in half and cut along the fold to give you two semicircles.
5. Take the two corners and curl inwards to make the semicircle into a cone shape. Tape it in place. You can experiment with how pointy each cone needs to be to help it fly.
6. Take the leftover paper and cut a rectangular strip off the bottom.
7. Roll this around the neck of the bottle to make a fat straw and tape along the length.
8. Find the middle of the tube, and draw a small cross by making a horizontal and vertical line. Now draw a diagonal line through the middle of that cross.
9. Cut along the diagonal line, this is called a mitre cut.
10. Take one of the cut ends and rotate so that it makes a right angle with the other end.
11. Tape the two half-straws in place making sure no air can escape this joint.
12. Tape one end of the tube over the neck of the bottle, making sure that there are no spaces for air to escape.
13. Hold your bottle with the tube pointing upwards.
14. Place one of your cones onto the open end of the straw.
15. Squeeze the middle of the bottle to launch the cone!

DID YOU KNOW?

Changing the amount of FORCE that you use to squeeze the bottle will change the amount of THRUST you create which affects how high your rocket flies.

nanogirl's LAB

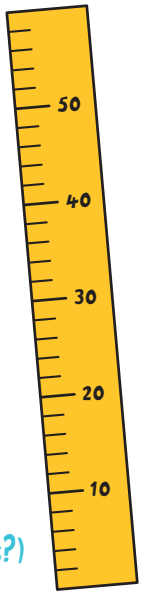
SUPER POWER: Flight!

ROCKET LAUNCHER

YOUR MISSION:

SEE HOW HIGH YOUR ROCKET CAN FLY!

MISSION 1: HOW HIGH DID YOUR ROCKET FLY?



While it may be easy to see that your rocket flew up in the air, it's not easy to remember all of the flights they made to compare them.

How do you think you could measure and compare the height of different rocket launches? (Hint—could you use a phone camera and build a tape measure to record the flights?)

MISSION 2: CAN YOU MAKE YOUR ROCKET FLY HIGHER?

Engineers are always tinkering and trying new ways of doing things. Now that you have built your rocket launcher, what changes could you make to help your rocket FLY HIGHER?

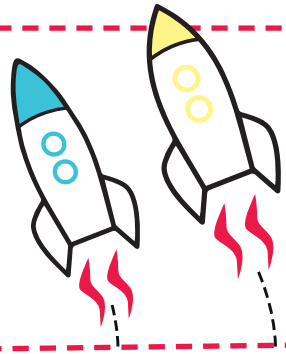
How do you think these changes might help? Why don't you write how these changes affect your rocket in your notebook?

MISSION 3: WHAT HAPPENS WHEN YOU CHANGE THE PRESSURE?

The amount of pressure you create to launch your rocket depends on the amount of air that you push through the nozzle and the speed that the air is moving.

You can change this pressure by changing the size of your bottle. What happens if you use a different size or shape of bottle?

What does that tell you about how the pressure you are creating changes?



MISSION 4: HOW DOES THE NOSE CONE AFFECT HOW THE ROCKET FLIES?

One of the forces that acts on your rocket to slow it down is called **DRAG**. Most rocket engineers try to reduce drag when they want their rocket to fly well and efficiently.

They try to increase drag when they want their rocket to return to earth slowly.

MISSION 5: FINS

If you look at a space rocket you should be able to see that it has fins at the bottom. These are used to help stabilise the rocket when it is flying in the air and prevent it from wobbling.

What happens to the way that your rocket flies if you make fins out of paper and stick them to the base of your rocket body?

Can you see a difference in the flight path of your rocket? You may need to colour in some dots onto your rocket body if you want to observe if your rocket spins during its flight.

DIFFERENT TYPES OF FINS!

You can change the drag force acting on your rocket by changing the shape and size of your **NOSE CONE**.

The more skinny and pointy the nose cone the less drag it should create. What happens if you change the shape of the cone you attach to the front of the rocket? Can you measure this difference?

nanogirl's LAB

SUPER POWER: Flight!

ROCKET LAUNCHER

FUN FACTS!

NASA has launched a total of **166** crewed rockets on space missions.

Rockets have been used in space travel for over **70** years.

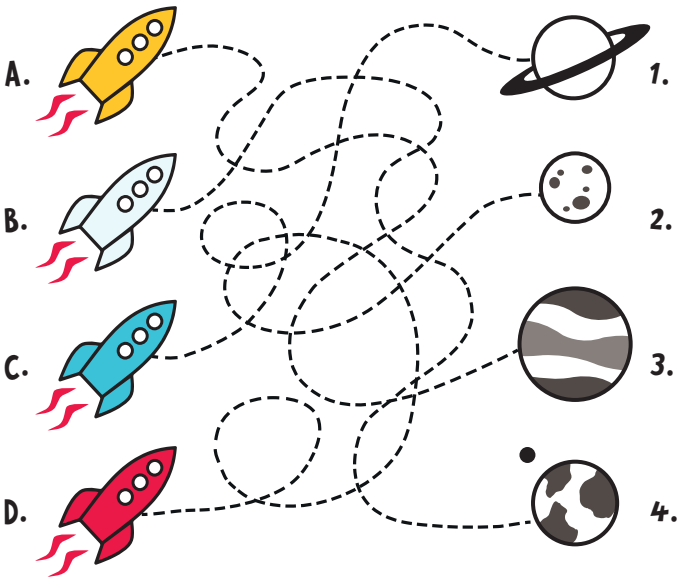
There are **4** types of rockets: solid fuel, liquid fuel, ion, and plasma rockets.

The first rockets were invented and launched around **800** years ago and used as fireworks.

ACTIVITIES

1. HOW MANY WORDS CAN YOU MAKE OUT OF THE LETTERS: ROCKET LAUNCHER?

2. WHICH ROCKET HAS LANDED ON WHICH PLANET?



3. IF YOU WERE NASA, HOW WOULD YOU DECORATE YOUR SPACE ROCKET?

How much paint do you think you would need to cover a whole space rocket?

How much do you think all of that paint would weigh?

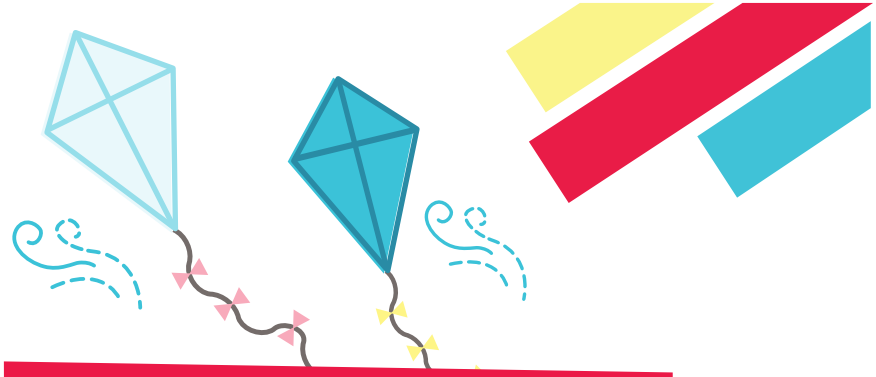
4. LIST THE IMPORTANT THINGS THAT YOU THINK A ROCKET WOULD NEED TO HAVE INSIDE IF IT WERE CARRYING PEOPLE TO SPACE.

(Hint—would it need a kitchen?)

nanogirl's LAB

SUPER POWER: Flight!

SUPERKITES



Today, we are making SUPERKITES! When I first made my superkite, my mini-mate Nano-nanogirl helped me test it out by jumping up onto the kite and riding on it. She is such a daredevil!

Nano-nanogirl is a TINY SUPERHERO SCIENTIST who lives in my pocket, and helps me whenever I need to test one of my inventions.

If you had a pocket-sized superhero version of you, where would they live? Can you draw and cut out your SMALL SUPERHERO FRIEND, give them a name and find them a place in your lab to live?

Then you and your superhero mini-me will be ready to complete today's missions!

FOR THIS EXPERIMENT YOU WILL NEED

- Soft, thin plastic e.g. rubbish bin liner ○
- Scissors ○
- Soft felt tip pen ○
- Ruler ○
- String ○
- 3x long wooden BBQ skewers ○
- Tape ○
- Ribbons, coloured yarn or fabric (optional) ○
- Plain paper and colouring/decorating supplies ○

SUPERHERO CHECKLIST

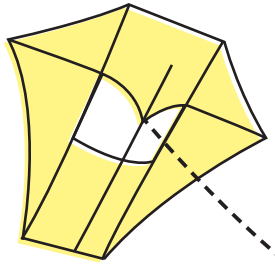
☐ Tiny SUPERHERO MINI-ME

nanogirl's LAB

SUPER POWER: Flight!

SUPERKITES

LAB NOTES...



Marconi's six-sided kite

DID YOU KNOW?

In 1901 the hexagonal shaped MARCONI KITE transmitted the first transatlantic radio signal.

1900's radio

TO MAKE YOUR SUPERKITE...

WATCH & BUILD 20 MINS

1. Watch the video of Nanogirl making her kite.
2. On your plastic or newspaper, draw a 40cm vertical line using your soft felt tip pen.
3. Measure 15cm down from the top of this line and make a mark.
4. At the mark you've made, draw a horizontal line to make a cross shape, 15cm in each direction.
5. Draw straight lines to join up the end cross points to make a diamond shape.
6. Cut out your kite.
7. Lie two skewers vertically along the first line you drew and tape them in place.
8. Tape another skewer into place along the horizontal line of the cross.
9. Cut a piece of string as wide as the kite and tape the ends to the horizontal skewer.
10. Cut a piece of string as long as the kite and tape the ends to the vertical skewer.
11. Cut a piece of string twice as long as your arm.
12. Tie or tape one end of this long piece of string around the centre of the two shorter pieces where they cross, and secure it with a knot.
13. This is your kite! Feel free to decorate both the kite and string.
14. Find somewhere with lots of space to test your kite, hold one end of the string, and run really fast to see if your kite flies!

FUN FACT!

The largest kite ever flown was 25 metres long and 40 metres wide!

nanogirl's LAB

SUPER POWER: Flight!

SUPERKITES

JOKE:
Q: What material makes the best kites?
A: Fly Paper

YOUR MISSION:

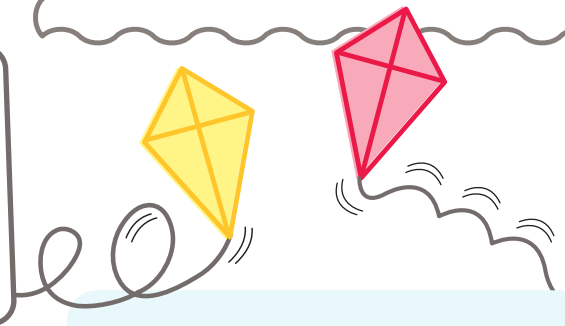
YOUR MISSION: SEE HOW HIGH YOUR KITE CAN FLY

MISSION 1: TRICKS

Can your superhero kite do any tricks? As a superhero, you might need the power of awesome stunts to help you fight crime with your superkite, like a super-swoop or a wild wheely!

Changing how the wind moves around your kite might change how it flies. Can you change how the strings attach to your kite to change how it flies through the air?

You could try moving the shorter string to see if that affects the flight, and carefully look at how your kite moves.



MISSION 2: STEERING

Being able to steer your kite is really important, so you don't crash into any big trees when you're busy saving the day as a superhero. You might have seen that some big kites have two strings.

Having two points where you can hold onto the kite string helps to keep the kite stable in the air.

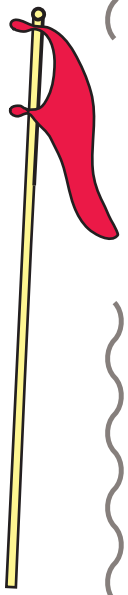
Why don't you try adding a second string to your kite, to see if it flies any better.

MISSION 3: UH-OH! NO WIND!

How could you fly your kite when there's no wind at all? Does your kite fly better when you have a running start? If there's no wind outside, you could create moving air yourself by running really fast.

Making your own wind is another superpower by itself!

Try taking a big running start with your kite, to see what the best way is to get it off the ground when there's no wind.

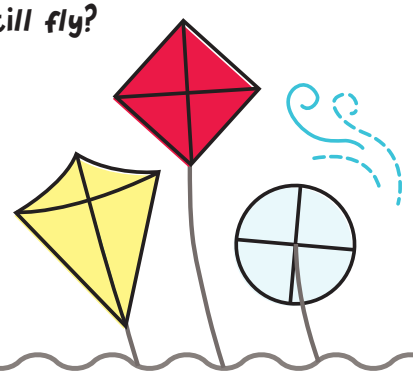


MISSION 4: SHAPE

Sometimes, changing the shape of a kite can change the way it flies. Does a kite fly better if it's a CIRCLE OR A SQUARE? Try making different shaped kites to see which flies the best!

When your kite flew, did you feel the string tugging at your hand? That tugging is the force of trapped air pushing against the kite.

Do you think changing the size of your kite will affect how much force it tugs with? How big a kite do you think you would make that would still fly?



nanogirl's LAB

SUPER POWER: Flight!

SUPERKITES

WHY DO KITES FLY?

Kites fly because when they move, they trap moving air underneath their surface. The trapped air can't go through the kite material, instead it has to go around the kite.

This creates a force called **'LIFT'** which keeps the kite up into the air. The bigger the surface area of the kite, the more air it can trap and so the better it can fly.

The design of your kite is also important. Kites need to be flat, made from a light material and have a large surface area to fly well.

Kites come in all sorts of shapes and sizes, some look like giant octopus while others look like tiny birds. Some are just for fun, others can pull boats and people!

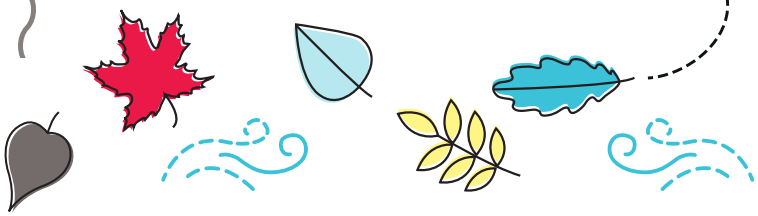
ACTIVITIES

1. DRAW A PICTURE OF YOURSELF AS A SUPERHERO FLYING YOUR SUPER KITE.

Add an arrow to show the wind pushing on the kite and lifting it up.

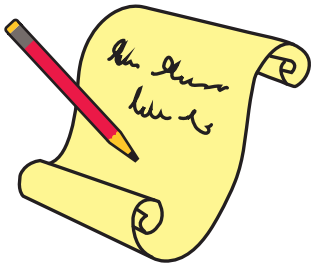
2. NEXT TIME YOU GO OUTSIDE, LOOK AT THE SHAPES OF LEAVES YOU CAN SEE.

Which leaves do you think the wind could lift up easily, and why?



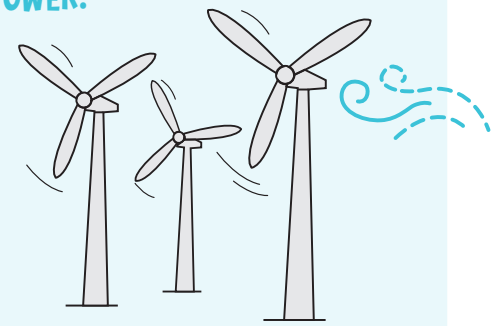
3. HOW MANY WORDS CAN YOU THINK OF THAT RHYME WITH KITE? KITE, FLIGHT...

Using these words, can you write a poem?



FUN FACT!

Wind turbine blades spin using the same idea as kites—they have wide, flat blades with a big surface area that can catch a lot of wind and use it to create RENEWABLE POWER.



nanogirl's LAB

SUPER POWER: Flight!

ROCKET STRAWS

ROCKET STRAWS are a lot of fun, and I love trying out new inventions and seeing how far they can go. Even though these rockets are much smaller than real space-rockets, they can still travel a long distance!

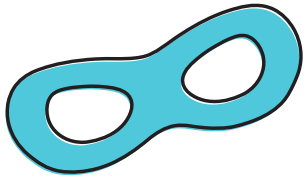
Did you know that my superhero name, "NANOGIRL", comes from my love of engineering very small things? "Nano" means very, very tiny, too small to see, so actually, these tiny rockets are the perfect size for me. And Nano-nanogirl, of course.

Do you have a superhero name? Why don't you think of your SUPERHERO SECRET IDENTITY, and make yourself a badge! That way, you'll always be ready to leap into action. Ok, let's get started on some rocket straws!

FOR THIS EXPERIMENT YOU WILL NEED

- Plain A4 Paper ○
- Pencil ○
- Scissors ○
- Tape ○
- Ruler ○
- Colouring Supplies ○

SUPERHERO CHECKLIST



☐ Superhero SECRET IDENTITY

nanogirl's LAB

SUPER POWER: Flight!

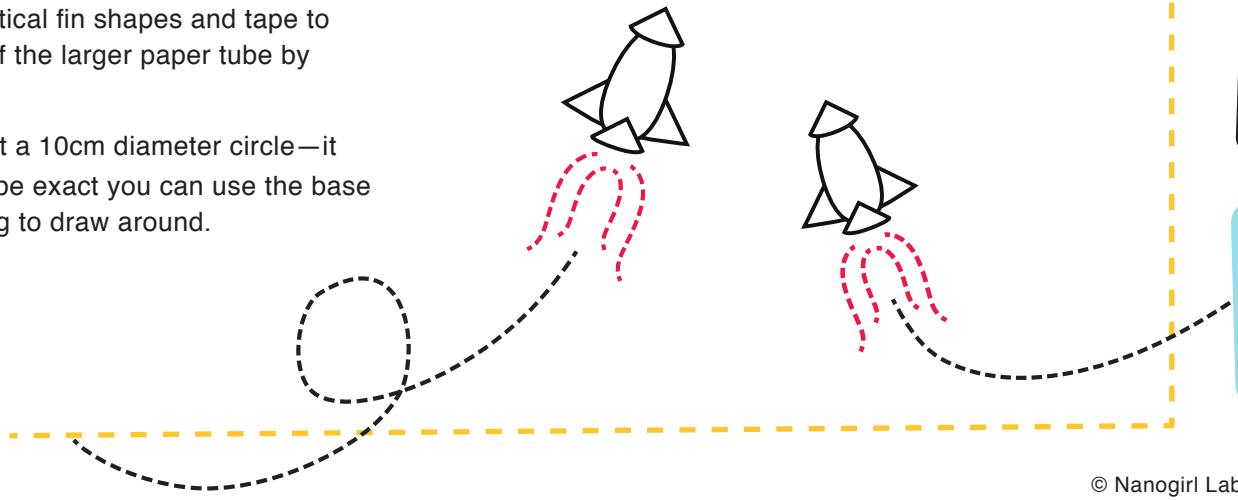
ROCKET STRAWS

LAB NOTES...

WATCH & BUILD 15 MINS

TO MAKE YOUR ROCKET STRAW...

1. You can use a drinking straw for this, but if you don't have one just make a straw by measuring and cutting a strip of A4 paper 5cm wide
2. Roll the paper up into thin straw and tape along its length to secure
3. Take a second strip of 5cm wide paper, and roll it around your straw, making sure that it's slightly wider before taping to secure.
4. Pinch one end of the larger paper tube and tape it shut. Cut to the length of your thumb.
5. Cut out two identical fin shapes and tape to opposite sides of the larger paper tube by the open end.
6. Draw and cut out a 10cm diameter circle—it doesn't have to be exact you can use the base of a glass or mug to draw around.
7. Cut a slit from the edge of the circle to the middle, then take the two cut ends and fold in to make a cone shape. This is the nose of your rocket.
8. Roll tape piece on itself so it's double-sided and use to secure nose cone to sealed tube end.
9. Place the open end of the rocket over the end of the thin straw.
10. Blow hard through the straw to launch it!



HOW FAR CAN YOUR ROCKET FLY?

Find a tape measure and challenge yourself to launch your rocket a little farther each time.

What happens to the flight of your rocket if you change the shape, size and position of the fins?

Is there a fin shape and size which works best?

What happens to the flight of your rocket if you make the tube wider and longer?

What happens if you change the shape and size of the nose cone? Why not try and see?

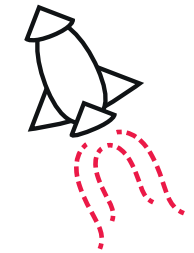
Do you think a wider straw and wider rocket would fly better or worse? Why not try making one to see?

nanogirl's LAB

SUPER POWER: Flight!

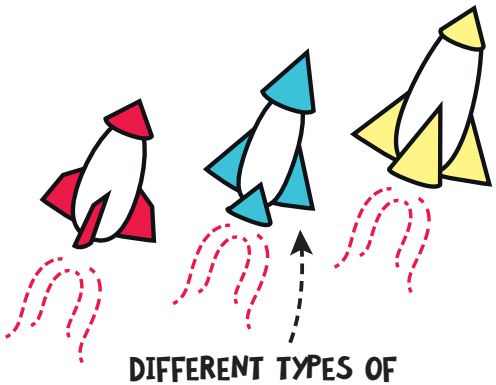
ROCKET STRAWS

FUN FACT! NASA Space Shuttles create **180,000 kg** of thrust to launch into space



YOUR MISSION:

YOUR MISSION: SEE HOW FAR YOUR ROCKET CAN FLY!



DIFFERENT TYPES OF ROCKET FINS!

DID YOU KNOW?

Fins stabilise the rocket as it flies, helping it to stay balanced and stopping it from spinning around.

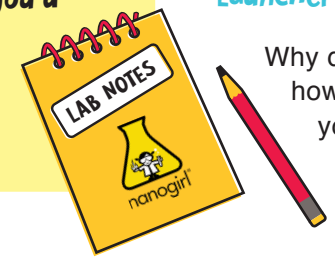
If you were an astronaut inside that rocket, you'd want a good set of fins to stop you feeling sick!

MISSION 1: AIR PRESSURE

Engineers love building, inventing and playing. When you blow into your rocket straw you make a buildup of **AIR PRESSURE.**

Changing the size of your straw will change the amount of pressure you can build up. Try making a longer or larger diameter (fatter) straw. Does this help your rocket to fly farther?

Do you remember what the four forces of flight were? (Hint—you can find them in the Rocket Launcher video).



Why don't you experiment with how these changes can help you achieve your mission, and write down your answers in your notebook?

MISSION 2: BULLSEYE!

Find or build a target, then practice launching your rocket straws at the target. Can you hit the bullseye?

You could set out tape-markers for distance (it's a good idea to do this outside if possible) to measure how far away your target is, then get further away from the target each time you launch.

MISSION 3: SHAPE

You might remember that when you built your Rocket Launcher, you changed the size and shape of the cone to help it fly.

Do you think this could also help your rocket straw to fly farther?

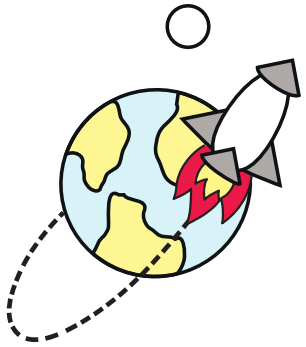
Make some bigger and smaller cones, then measure how far the new rockets fly.

nanogirl's LAB

SUPER POWER: Flight!

ROCKET STRAWS

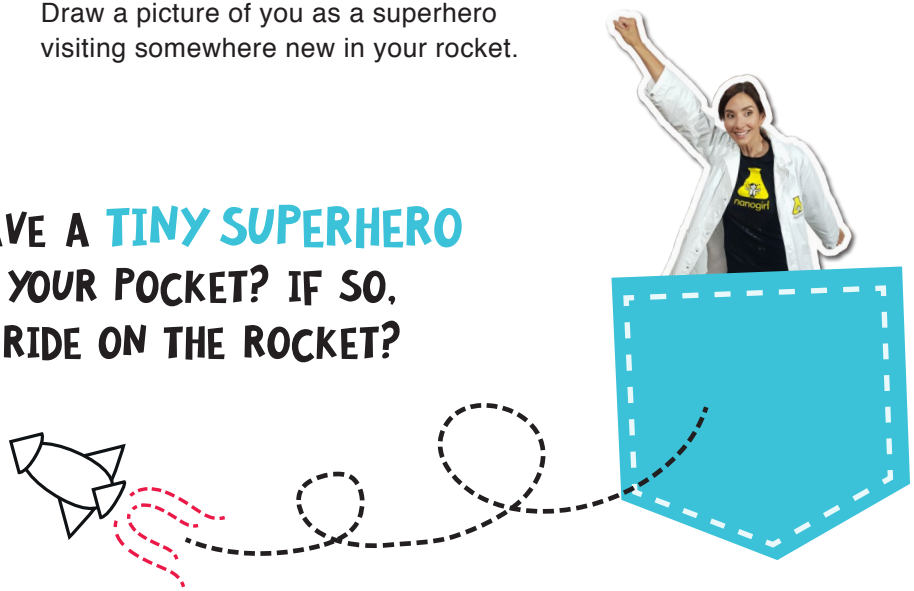
ACTIVITIES



1. IF YOU COULD TRAVEL ANYWHERE IN YOUR ROCKET, WHERE WOULD YOU GO AND WHY?

Draw a picture of you as a superhero visiting somewhere new in your rocket.

2. DO YOU HAVE A TINY SUPERHERO LIVING IN YOUR POCKET? IF SO, CAN THEY RIDE ON THE ROCKET?



JOKE:

Q: How do you stop an astronaut's baby from crying?

A: You rocket!

WHAT IS THRUST?

All rockets need a big force to start moving. Rockets which fly into space need a huge explosion to get them moving.

This explosion creates a pushing force called 'THRUST' which is so strong that it pushes the rocket into the air. If a rocket has enough thrust, even gravity can't pull the rocket back down to Earth.

Your rocket is smaller, and only needs the force of your breath to fly! When you blow into the thin straw, the air can't get out the other side, as you've taped it shut.

This means that air pressure builds up inside the tube, until eventually the force of your breath and the built-up pressure makes the ROCKET FLY OFF THE END OF THE STRAW! The harder you blow, the farther your rocket will fly.

nanogirl's LAB

SUPER POWER: Flight!

AEROFOILS

I'm busy investigating how AIRPLANES FLY, but first, I'm a bit hungry so I think I need a cookie.

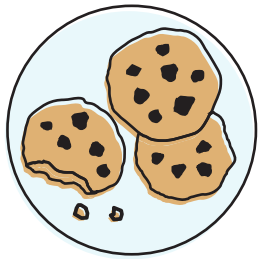
Every superhero needs a SUPER-SNACK, to keep us going on long missions. What could your super-snack be? Do you have a place in your lab where you can eat your snack and chill out after a hard day inventing?

I've got a superhero cookie-jar in my lab, so my snacks are always handy. Ok, now I've had my snack, time to keep working on the SUPERPOWER OF FLIGHT!

FOR THIS EXPERIMENT YOU WILL NEED

- Hair dryer ◯
- Square of toilet paper ◯
- Plain paper ◯
- Cardboard e.g cereal box card ◯
- Tape ◯
- Table or kitchen counter ◯
- Long wooden skewer or stick ◯
- Pencil or pen ◯
- Scissors ◯
- Plasticine or blue tack ◯

SUPERHERO CHECKLIST



☐ Delicious SUPERHERO SNACK

nanogirl's LAB

SUPER POWER: Flight!

AEROFOILS

WATCH & BUILD 10 MINS

LAB NOTES...

TO MAKE YOUR AEROFOIL...

1. Watch the video of Nanogirl investigating Bernoulli's principle.
2. See if you can use fast-moving air to create lift by blowing over the surface of the toilet paper like Nanogirl does!
3. If you have one, see if you can use a hairdryer to lift the ping pong ball in the air and keep it there! Make sure you keep it on the lowest heat setting.
4. If you can do that, can you walk around the room, jump on one leg or do a dance move while keeping the ball in the air?
5. If you don't have a ping pong ball, don't worry. Try this instead: Draw and cut out a rectangle of cardboard 18 cm long and 9 cm wide.
6. Measure 7 cm from one end, and draw a line. You now have two smaller rectangles
7. In the larger rectangle, find the middle of the end, measure 2 cm in, and make a mark.
8. Using a pencil, make a hole in the paper at the mark you've made.
9. Fold the rectangle along the line you drew.
10. Line up the two ends of the rectangle and tape them together. You'll have a shape with one flat and one curved side—this is an aerofoil shape, just like a plane's wing.
11. Find the mark you made and use a pencil or scissors to make a small hole through the mark in the top of the card and down through the bottom piece of card.
12. Using a pencil, make your hole bigger by pushing it all the way through and wiggling it a bit.
13. Make a paper straw by rolling a 5 cm strip of paper around a pencil and taping it in place.
14. Thread the straw through the hole in your aerofoil.
15. Cut the straw so that there is only a little bit sticking out then tape in place.
16. Place one end of the wooden stick into the putty and stick upright on a table.
17. Thread the aerofoil onto the stick with the curved surface facing upwards.

BERNOULLI'S PRINCIPLE tells us that fast-moving air creates **LOW PRESSURE.** Airplane wings create low pressure on top of their wings which, makes them easier to push upwards. We call this pushing force **'LIFT'** because it lifts a plane into the air.

You are using the science of low pressure on top of your aerofoil to lift it up the skewer.

Next time you look at an airplane, notice the shape of its wing—you will probably see that it is the same shape that you made today.

Investigate...

Can you use Bernoulli's Principle to lift the aerofoil model all the way to the top of the stick?

Can you make a bigger aerofoil—does it still lift? What about making it a different shape with more or less curve.

What else has wings apart from a plane, and do you think that Bernoulli's Principle is helping them fly?

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SUPER POWER: Flight!

AEROFOILS

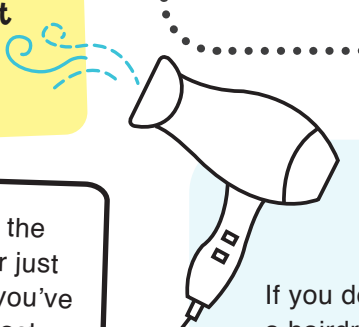
JOKE:
Q: What flies when you are having fun, but has no wings?
A: Time

YOUR MISSION:

MASTER THE FORCE OF LIFT WITH BERNOULLI'S PRINCIPLE

MISSION 1: USE YOUR HAIRDRYER

While airplanes make flight look easy, this challenge can be surprisingly tricky!



Can you lift your aerofoil all the way to the top of the skewer just using the hairdryer? When you've done it once, can you do it faster the next time?

Find a stopwatch and write down how long it took you to lift your aerofoil all the way to the top of the skewer.

Does it make a difference if you move the hairdryer closer or further away? You could use your measuring tape to help you work this out.

MISSION 2: NO HAIRDRYER!

If you don't have a hairdryer, how else can you lift something up? Could you blow through a straw or use a fan?

Try blowing across the top of a piece of toilet paper, like Nanogirl in the video. Can you lift it up?

All these activities use the power of your lungs to create the fast moving air like a hairdryer.

Your lungs don't have a hairdryer inside them, instead you have powerful muscles which help your chest to move, which helps you to breathe hard.

MISSION 3: SHAPES

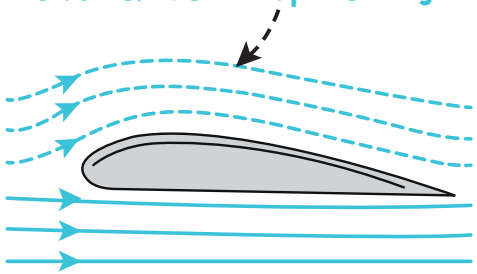
An aerofoil is a special shape which helps create LIFT, but you also know that you can lift a round ball with your hairdryer.

Do you think that the round shape of the ball helps it to stay in the air without falling down?

Test this idea out by gathering objects from your house, or garden like an inflated balloon, leaves, feathers, tissues.

Try and lift each one like the ping pong ball, and see if there are any shapes which float better than others.

The shape of the aerofoil forces air to move faster over the top surface, like an airplane wing!



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SUPER POWER: Flight!

AEROFOILS

ACTIVITIES

1. FIND THE SUPERHERO FLIGHT WORDS BELOW

FLIGHT	AEROFOIL	GRAVITY	WEIGHT
THRUST	KITE	PRESSURE	BERNOULLI
ROCKET	NANOGIRL	FINS	
FORCE	GLIDER	LAUNCHER	

A	G	T	F	L	I	G	H	T	W	F	G	E	K	E	G	J	I	O
D	F	K	E	A	E	R	E	H	F	G	M	B	I	Z	O	O	M	H
P	A	E	M	U	G	A	F	R	O	C	K	E	T	T	Y	N	M	B
F	M	Z	Y	N	X	V	Q	U	H	B	D	C	E	K	S	K	Q	F
U	G	H	T	C	L	I	A	S	A	B	E	R	N	O	U	L	L	I
W	E	I	G	H	T	T	X	T	N	A	N	O	G	I	R	L	N	N
F	C	M	G	E	W	Y	H	R	S	W	L	F	L	L	Y	H	S	S
I	P	A	E	R	O	F	O	I	L	T	H	B	A	K	I	C	O	F
A	S	D	I	G	H	Y	K	L	M	Y	T	R	C	N	D	D	H	L
V	S	B	C	M	N	G	N	V	S	P	R	E	S	S	U	R	E	B
L	E	S	C	I	E	N	C	E	S	F	N	M	Q	E	P	J	N	R

2. CAN YOU MAKE UP A SUPERHERO DANCE MOVE, AND DANCE WHILE YOU LIFT THE AEROFOIL?

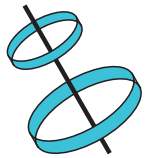
3. CAN YOU THINK OF 5 THINGS WHICH USE THEIR WINGS TO FLY, AND 3 THINGS WHICH FLY WITHOUT WINGS?

4. THINK ABOUT WHAT YOUR WINGS WOULD LOOK LIKE, IF YOU HAD WINGS!

Would they be plane wings, bird wings or maybe even butterfly wings?

SUPER POWER: Flight!

RING GLIDER and HOOP GLIDER



We've been experimenting with the SUPERPOWER OF FLIGHT, and I think we're nearly ready to go on our first superhero crime-fighting mission using our Flight powers.

What would you use the superpower of flight to do? I would fly up to rescue all the kittens which get stuck up trees. I'd also be able to fly up and HIDE MY COOKIES SOMEWHERE SAFE so that Nano-nanogirl can't find them.

Think about how you could use each of the glider shapes in today's experiment to help you on your mission. Ok, let's make some gliders!

FOR THIS EXPERIMENT YOU WILL NEED

- 3 x plain A4 paper ◯
- Scissors ◯
- Tape ◯
- Pencil ◯
- Ruler ◯
- Colouring supplies (optional) ◯

SUPERHERO CHECKLIST

☐ My first crime-fighting SUPERHERO MISSION

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SUPER POWER: Flight!

RING GLIDER and HOOP GLIDER

LAB NOTES...

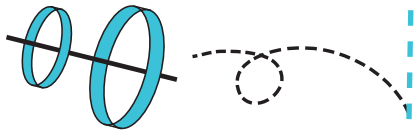
TO MAKE THE PAPER PLANE...

1. Watch the video of Nanogirl making and flying her paper planes
2. Use one sheet of paper to make a traditional paper airplane with a pointy nose and wide, flat wings
3. If you don't know how to make a paper plane follow along with Nanogirl in the video.

WATCH & BUILD 20 MINS

TO MAKE THE RING GLIDER...

1. Take a piece of paper, measure and cut out a rectangle 2.5cm wide and 13cm long
2. Measure and cut out a second rectangle 2.5cm wide and 20cm long.
3. Tape the ends of the longer paper rectangle together to make a loop
4. Tape the ends of the shorter rectangle together to make a smaller loop
5. Make a straw by rolling a 5cm strip of A4 paper into the tightest roll you can, and taping to secure it.
6. Tape a ring to either end of the straw. You want them to line up so if you look through the big ring you can see all the way through the small ring.



AND FOR THE HOOP GLIDER...

1. Use the third piece of paper to make a hoop glider. First, measure and cut a 3 cm strip off one of the short sides of an A4 piece of paper.
2. Taking the larger piece, use the ruler to draw a line between two diagonal corners. Fold the paper along this line to make two triangles which don't quite line up.
3. Fold the edge that has your line on it into the middle about 1 cm, and then do the same again so you have a thick, narrow fold along the base of your triangles.
4. Tape the two ends of the folded part together to make a hoop
5. Make a hypothesis: which plane will fly further—the traditional pointy plane, the ring glider or the hoop glider?
6. Test out your ideas! Launch the planes one at a time. Throw the ring plane gently with the smaller ring at the front and the straw on the bottom. Throw the hoop glider with the pointy bits of the triangle at the back.

All three of these planes are different, but they should all fly.

The paper plane flies because the wide, flat wings trap air underneath them to create lift, like a kite.

That's how a traditional paper plane flies. Your HOOP AND RING PLANES fly because the curved surfaces work like the aerofoil shape of a plane's wing to create a BIG LIFT FORCE.

The larger ring at the back of the ring glider also has a large surface area. It stabilises the flight so that the plane does not turn upside-down in the air.

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SUPER POWER: Flight!

RING GLIDER and HOOP GLIDER

Investigate...

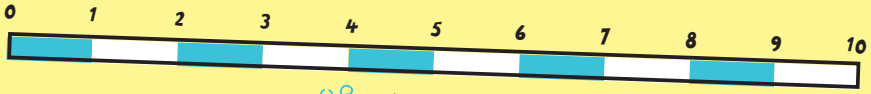
How big a paper plane do you think you could make and it still fly?

Why not try making a huge plane? What about the tiniest plane? Which do you think will fly further, a tiny paper plane or a giant one?

What happens to the flight of your hoop plane if you make the hoops larger or smaller?

YOUR MISSION:

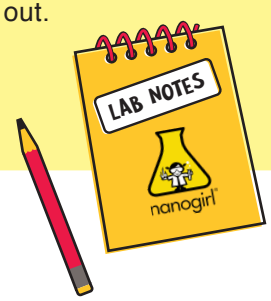
FIND OUT WHICH PLANE FLIES THE FARTHEST



MISSION 1: MEASUREMENT

Why don't you measure how far each one flies, and write it down in your notebook?

You could use a tape measure, or set up a target like you did for the rocket straws, to help you figure this out.



You might have found that some of your planes didn't fly as well as the others.

Engineers sometimes find that their designs don't work well the first time but they try something new. **That's part of being a great engineer!**

Try making some adjustments to the shape and size of your planes to find out which shapes fly the best.

MISSION 2: ENGINEERING

What changes could you make to your planes to help them all fly further?

Why don't you try using different size hoops, or taking a run-up?

These changes might affect how the air moves past your planes, and help you to see how each one could fly differently, just by changing a few things.

Try these things out, and anything else you can think of. You could write down in your notebook how each change affects your planes.

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SUPER POWER: Flight!

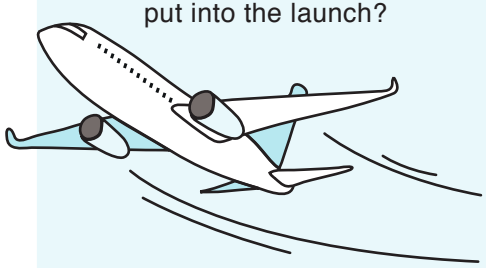
RING GLIDER and HOOP GLIDER

WHICH PLANE SHAPE FLIES THE FARTHEST?

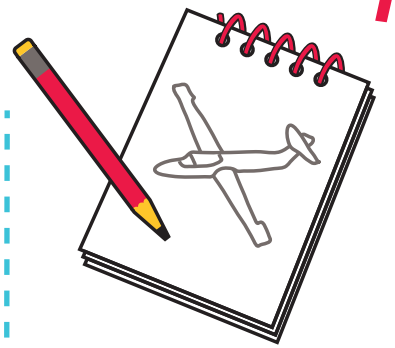
You could use a tape measure, and challenge yourself to push your planes a little further every time you launch.

When a plane takes off, it needs a BIG FORCE and FAST SPEED to leave the ground, and airplanes have big jet engines underneath the wings to help make such a big force.

Where is the force and speed to launch your planes coming from, and what happens when you change the amount of force you put into the launch?



ACTIVITIES

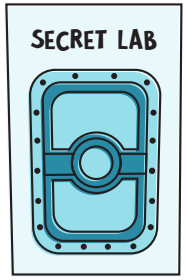


1. DO YOU THINK THAT YOU COULD DESIGN A SUPER-GLIDER? DRAW A PICTURE OF WHAT IT WOULD LOOK LIKE.

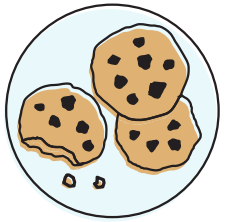
2. LAUNCH EACH GLIDER UPSIDE-DOWN. DO THEY STILL FLY? WHAT DOES THIS TELL YOU ABOUT HOW REAL PLANES FLY?

3. IF YOU COULD DESIGN YOUR OWN SUPERHERO WING-SUIT, WHAT SHAPE WOULD YOU CHOOSE, AND WHY?

We are at the end of our Flight lab. Phew! I've had so much fun experimenting with different planes and shapes, and hopefully you have too. Let's see, what have we done this week?



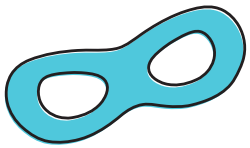
- [x] Super-secret SUPERHERO LAB



- [x] Delicious SUPERHERO SNACK

- [x] Tiny SUPERHERO MINI-ME

- [x] My first crime-fighting SUPERHERO MISSION



- [x] Superhero SECRET IDENTITY

- [x] The superpower of FLIGHT!

What was your favourite activity?
See you again for more Superhero training, Bye!

You can find more of Nanogirl's Science Superhero adventures at
WWW.NANOGIRLSLAB.COM