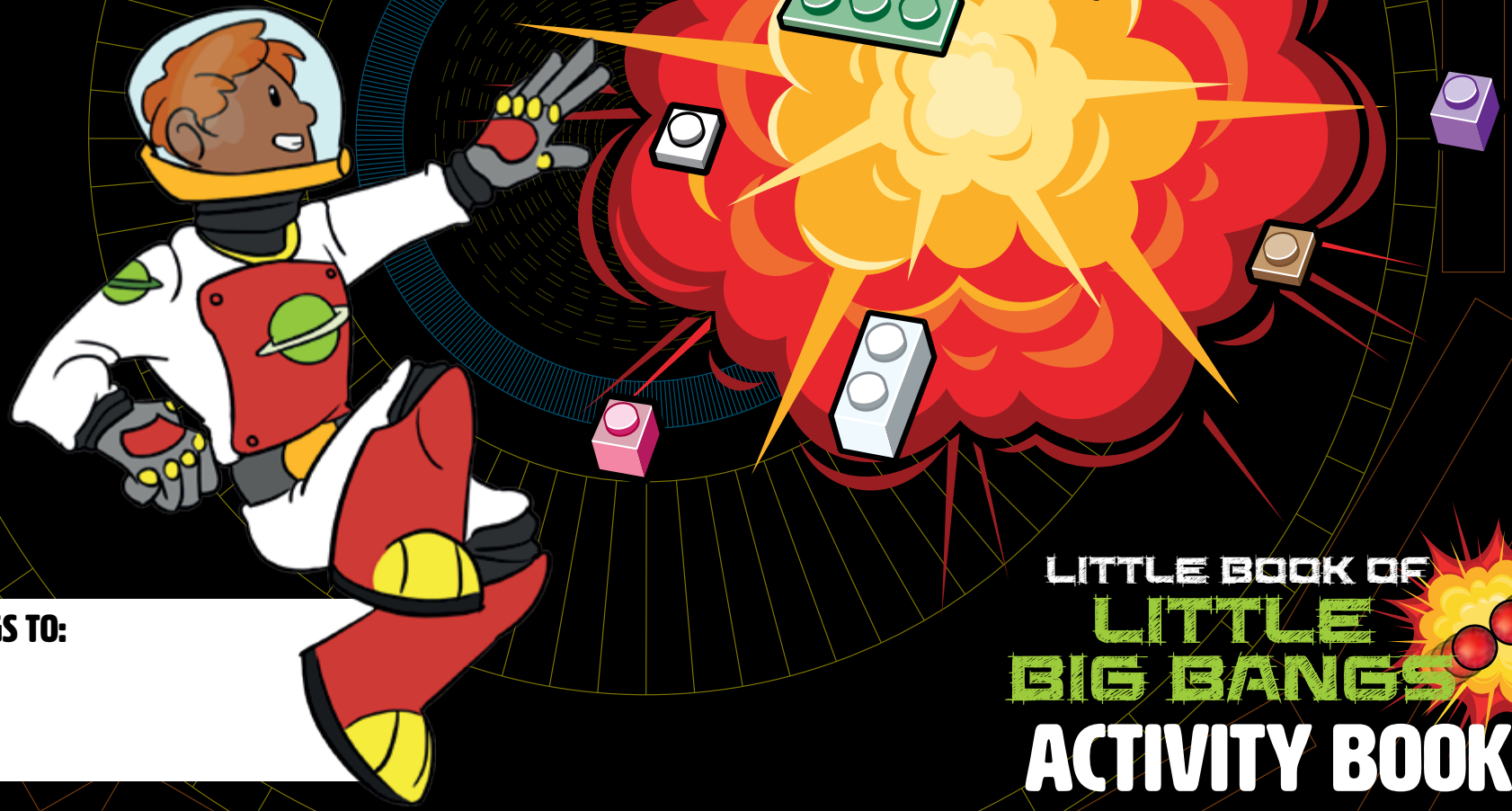
HANDS ON LITTLE BIG BANGS

UKRI Science and Technology Facilities Council

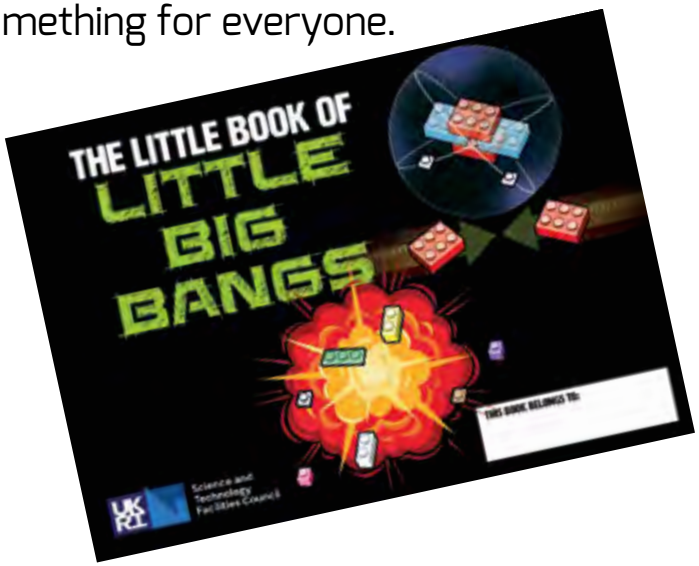


THIS BOOK BELONGS TO:

LITTLE BOOK OF LITTLE BIG BANGS ACTIVITY BOOK

WELCOME TO HANDS ON LITTLE BIG BANGS

Now you have read the *'Little Book of Little Big Bangs'* and had an introduction to particle physics and how we explore this amazing topic it is time to get those neurons firing. Here you will find a selection of activities all based around particle physics: some are science themed, some maths, some literacy, art or cross-curricula – there is something for everyone.



Each activity has been written pitched directly at your students so as their teacher all you need to do it print or photocopy the pages you need and away you go – no extra preparation needed. We have included the teachers notes at the back just in case you need to check anything too.

Activity 7 and 8 both require adult supervision or permission so you may want to check them out before you start.

CONTENT DEVELOPED BY
ELIZABETH AVERY

DESIGN AND GRAPHICS: BEN GILLILAND

UKRI Science and Technology Facilities Council

Hands On Little Big Bangs Daily News

Special edition!

Kid reading this realises they can be a science journalist!

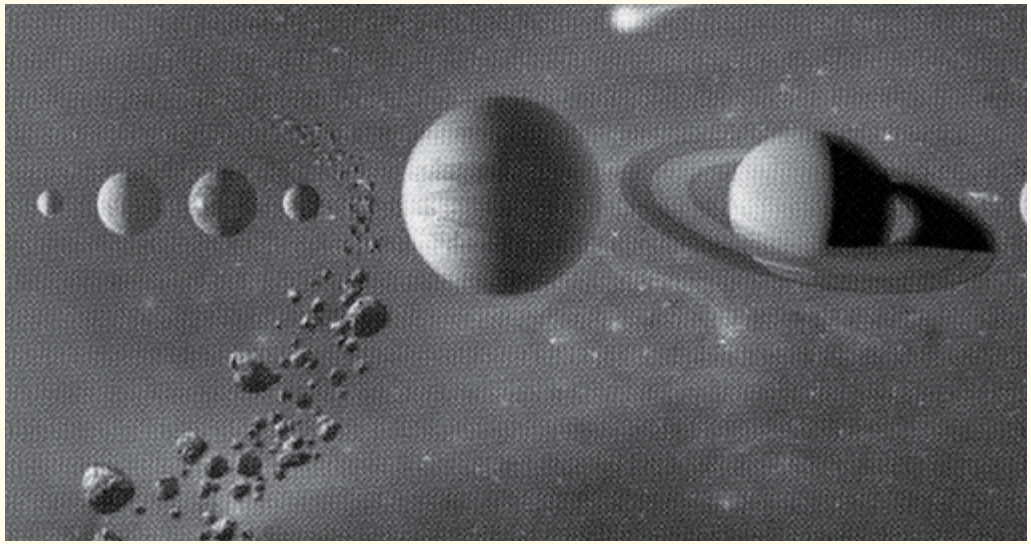
In a shocking turn of events the child reading this has become a science journalist!

Since YOU are the child reading this, you have found yourself asking questions like:

How did the Universe form?

Why are the rocky planets closest to the Sun?

Why are the gas giants further away?



You take the role of a science journalist and tell the story of our Solar System. Here are some things you may like to think about to get you started:

1. We don't know everything there is to know. This sounds like a very difficult thing to explain but don't panic. We don't know everything there is to know and that is OK, it just means there is lots left to discover – exciting stuff!

2. What is the Solar System made of? You may want to think about the building blocks that make up the Solar System, how they make the planets different and what influence they have on where each planet sits.

3. Check your information sources. Be careful with your sources of information so you can make sure the facts you are passing along to your readers are correct. Always make sure to check any statistics you use so you can be sure they are accurate.

4. Tell a good story. Science journalists don't just pass on facts and figures, like any other journalist they will tell a story to hook the reader in. The formation of the Solar System is one seriously dramatic story so make use of that to help you write a gripping tale.

5. Think about structure. Think about what the start, middle and end of your story will be about so you stay on track and your story has a solid structure.

Now it is time to get writing!

2 WHAT'S THE MATTER?
MAKE YOUR OWN GAMESHOW!

HANDS ON LITTLE BIG BANGS

The difference between an element, compound and mixture can be tricky to wrap your head around at first as they can seem very similar.

Element Mixture Compound?

1. Create a list of elements, compounds and mixtures you want to use – around 6-8 of each should be plenty. Write the name of each one on a piece of paper or card.

2. Grab yourself four containers: bowls, washing baskets, old cereal boxes – anything will work.

3. Label the four containers; 'What's the matter?', 'Element', 'Compound' and 'Mixture'. Add your labels from step one to the 'What's the Matter?' container.

4. Take the role of gameshow host (a sequin jacket is optional) and ask your classmates who would like to come and volunteer. You then need to give them 1 minute to sort as many of the labels in the 'What's the Matter?' container into the right containers as possible, you can use music and a timer and alarm to add some more drama and a true gameshow flavour.

5. Count up their score and add it to a leader board. Repeat this with another volunteer until everyone that wants to has had a turn.

6. Go through the answers with the group to see if there were any surprises in there.

7. Announce your WINNER!

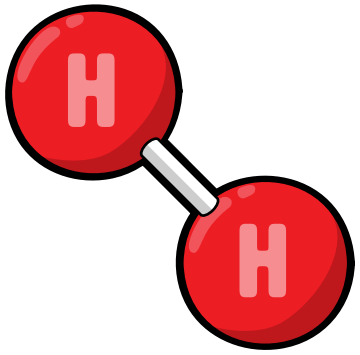
MAKE YOUR OWN MOLECULE MODELS

Making models can be a great way of helping us to understand how things work. Scientists use models all the time to help them work out exactly what is going on behind the scenes. When it comes to particle physics models are especially handy because the particles we are talking about are absolutely tiny and it can be tough to imagine how they work.

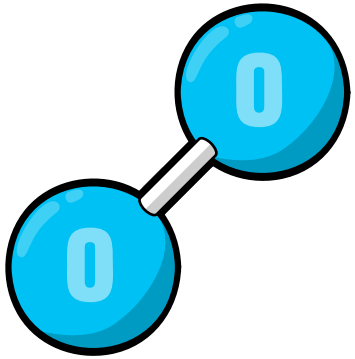
MAGNIFICENT MOLECULES MODELING

Why not make some models of the different elements and even compounds to see how they all fit together. You can use blocks, things you find around your classroom, or even sweets, to make your own edible particles (marshmallows are especially delicious... I mean, scientifically accurate). Here are some great ones to try out:

HYDROGEN

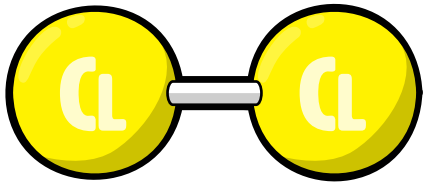


OXYGEN



SODIUM

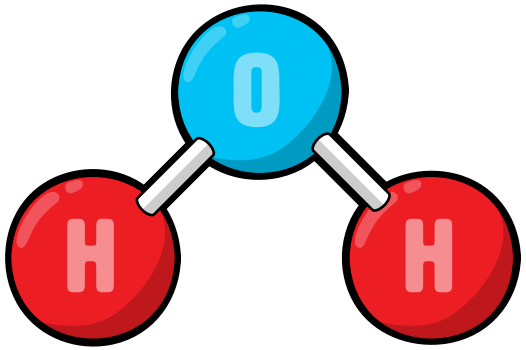
CHLORINE



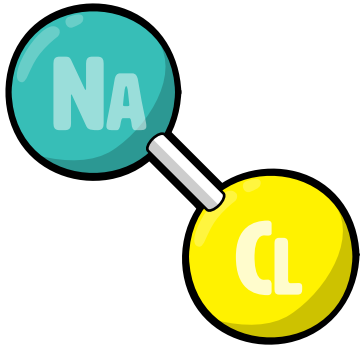
CRAZY COMPOUND CREATIVITY

Now you have your models of the elements, why not take it to the next step and look at compounds. Try to think how your models can help you describe how the two elements combine to form the compound – you can get creative with this one! Why not use the element models you are now expert in and try these compounds:

WATER



SODIUM CHLORIDE



INVESTIGATE FURTHER

Water and Sodium Chloride are both compounds but different sorts. Why not do a little digging to find out what they have in common but also what is different about them too and report back to your classmates on what you find.

4 PUZZLE TIME
THINK LIKE A SCIENTIST

There are many unknowns when it comes to our Universe and scientists flex their brains daily trying to work out what is going on out there.

In this section you will find some puzzles to get you thinking like a scientist. Once you have completed them, turn the page and use the answers to crack the code and find out the secret words. What are you waiting for – get puzzling!

Puzzle 1

For this one you will need to get both sides of the equation balanced to find the answer.

3a + 3a +a = 3a + ?a

Answer:

Puzzle 2

Here you need to convert the decimal number into a percentage.

0.65 = ?5%

Answer:

Puzzle 3

Complete the sentence to find out more about gluons.

Remember, you can refer beck to the resource book if you need to.

A gluon has zero mass or ??????

Answer:

Puzzle 4

Reduce the fraction below so you get it in its simplest form.

1/8 + 2/? = ?/8

3/8 + 3/8 = ?/8

Answers:

Puzzle 5

Below is a very famous number sequence found in nature called the Fibonacci sequence. Can you find the missing numbers?

0, ?, ?, 2, 3, 5, 8, ?, 21, 34

Answer:

4.1 PUZZLE TIME
CRACK THE CODE

HANDS ON LITTLE BIG BANGS

Now use the answers you have gathered to decipher the code and find the hidden word. You can add the data you have already collected into the 'Answers' column below. Use these answers to look at the alphabet grid to find their values and decode the mystery word.

Use this alphabet grid to find the answer's corresponding letter

A	B	C	D	E	F	G	H	I	J	K	L	M
6	7/8	=	4	13	+	0.6	≠	-	2	8	-1	3

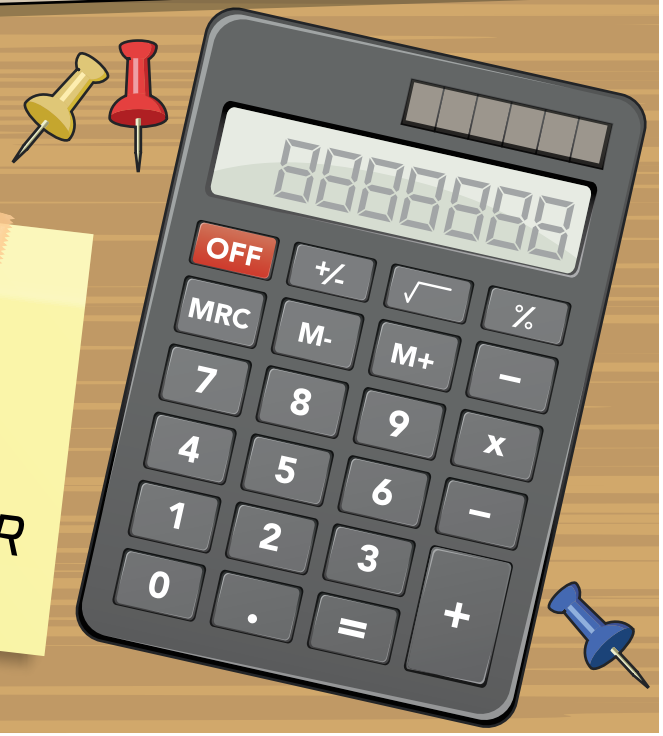
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
100	0.8	5/8	3/5	Charge	Δ	1	1/8	0.9	1/3	2/3	×	÷

Puzzle	Answer	Alphabet value

THE MYSTERY WORDS ARE:

_ _ _ _

_ _ _ _ _ _ R



5 ARE YOU GAME?
COLLIDER CHALLENGE

HANDS ON LITTLE BIG BANGS

There are lots of different particle detectors all looking to answer some of the Universe's most brain-busting questions. In the resource pack you have seen some of them as top trumps – a brilliant game!

Now it is your turn to become the games master and use the idea to come up with your own particle physics game – get as creative as you like.

CREATE YOUR OWN PARTICLE COLLIDER GAME

This might be a board game like 'snakes and ladders', a card game like trumps or something completely new – have fun with it. There is a lot of information to play with and help you structure your game. You might like to think about:

WHAT WE KNOW NOW

Lots of amazing discoveries have been made, some even sound like something straight out of a sci-fi story. The question is are they real or do they sound made up?

WHAT ARE WE SEARCHING FOR?

There are lots of mysteries left to solve. Could your game be a quest to find out any answers?

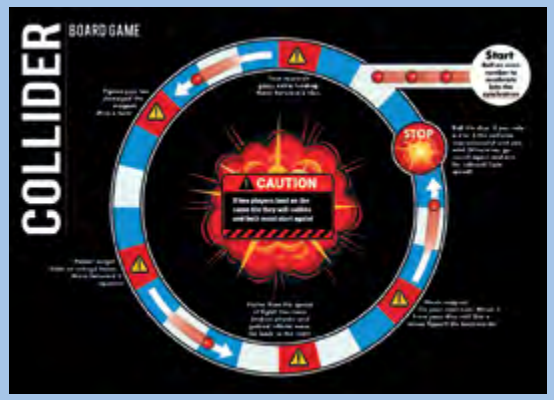
WHAT ARE DIFFERENCES BETWEEN DETECTORS?

As well as their seriously individual and funky names there are other defining features that make each detector a specialist, could that help with your game?

WHO WORKS ON THEM?

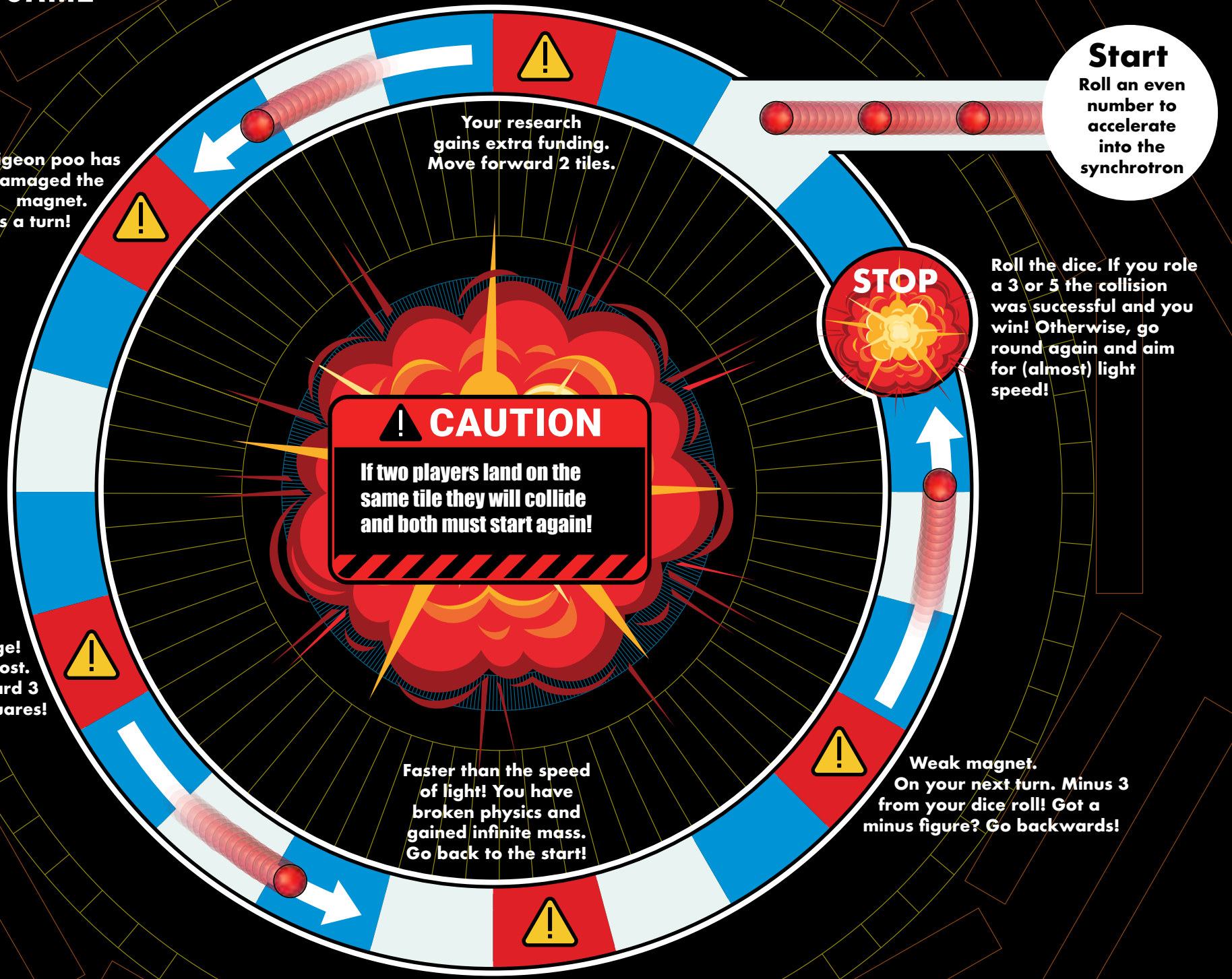
There are hundreds of people working on these amazing detectors, can you include their profiles in your game?

We couldn't resist making our own board game. Turn the page, grab some counters and a single dice to give it a go!



COLLIDER

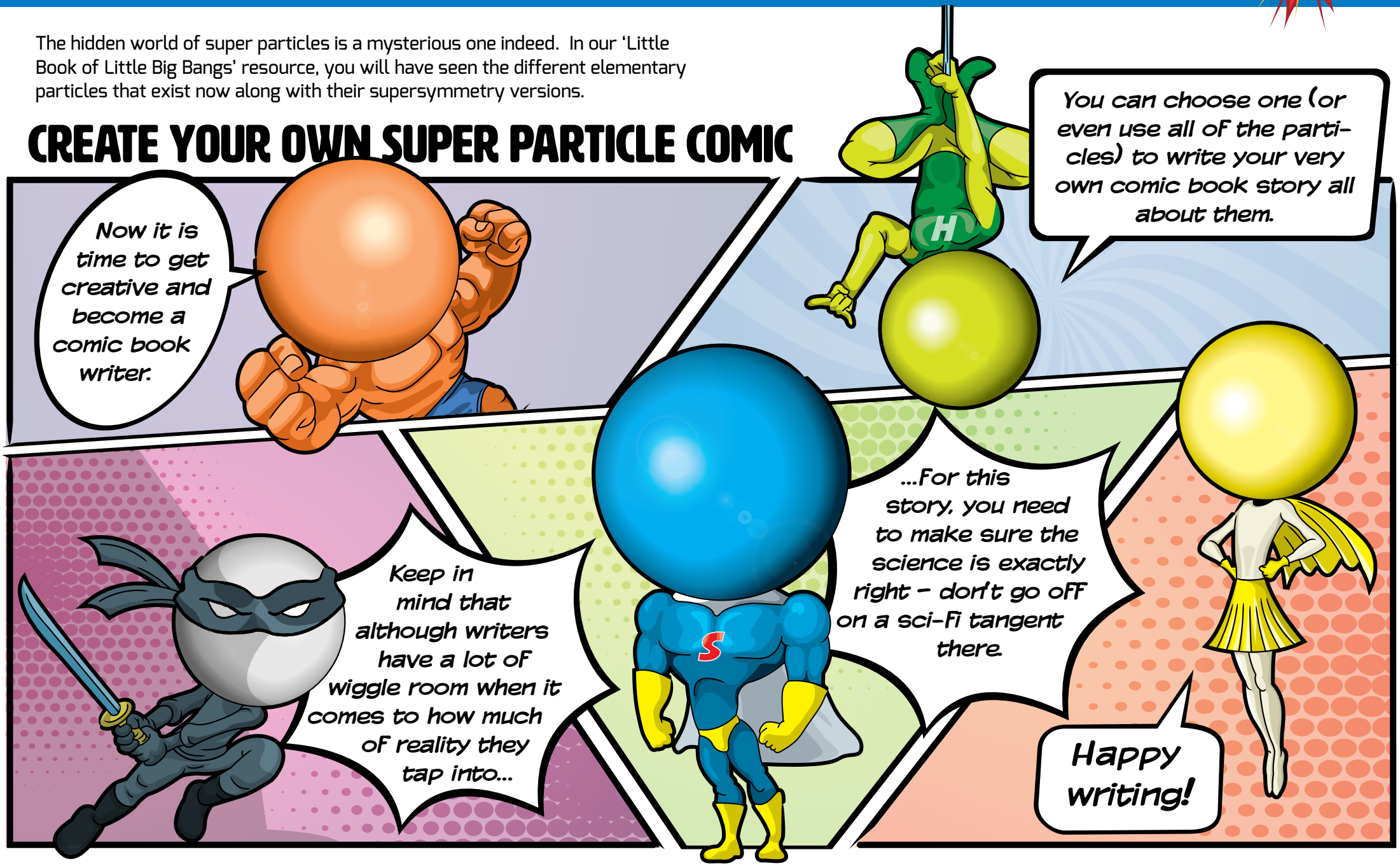
BOARD GAME



6 SUPER PARTICLES COMIC CHALLENGE

The hidden world of super particles is a mysterious one indeed. In our 'Little Book of Little Big Bangs' resource, you will have seen the different elementary particles that exist now along with their supersymmetry versions.

CREATE YOUR OWN SUPER PARTICLE COMIC



BOTTLE OF SPACE: NEBULA IN A BOTTLE

This is a very famous quote from Carl Sagan and he makes a very good point. In this activity we will make our very own bottle of space model!

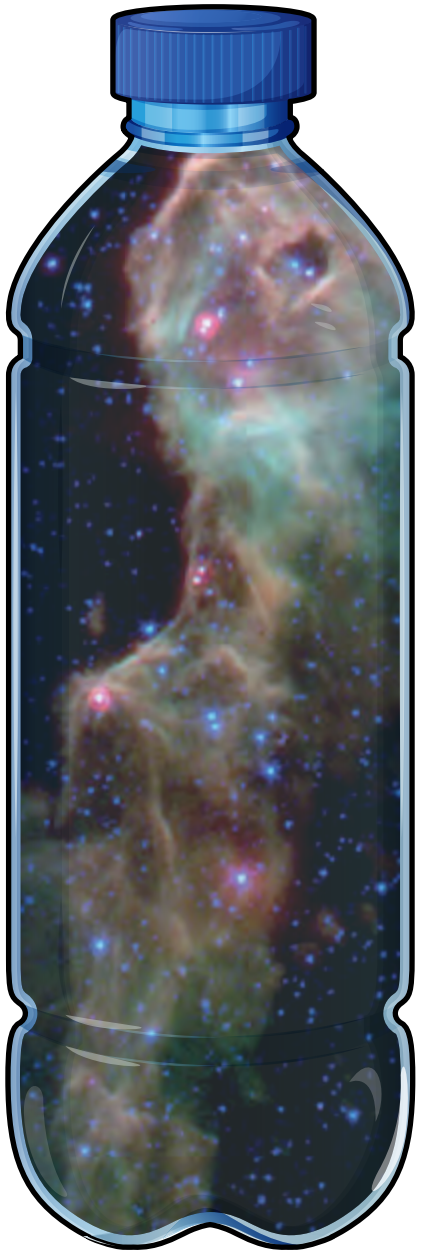
First of all let's think about light. When a light source like a light bulb or even better, a star gives off energy as radiation, we actually see some of it as visible light. Radiation comes in lots of different forms which you may have heard of before: visible light, ultraviolet and infrared to name a few.

What can different forms of radiation actually help us to see? Let's say we want to look at some beautiful baby stars – who wouldn't right? This can be a really tricky business as they often form in what we call a nebula, which is a star nursery.

A nebula is a HUGE collection of moving dust and gas, usually left over from when an old star has died - you could think of it as a star recycling unit. It is not quite so impressive when you want to see through all the dust and gas to study the stars. Nebulae can also make things extra difficult for us as astronomers because they can reflect the light from nearby stars or even make their own glow – pesky things!

We tend think of stars as being bright, shiny and yellow don't we? Well actually that isn't completely true, you see the visible light from stars can be all sorts of colours: red, white and even blue. Their colour depends on how old they and how hot they are. Young hot stars tend to look more of a lovely blue colour and older cooler stars often look red.

Scientists have been using different colours of light and types of radiation to peer into undiscovered areas of the Universe for some time now. Don't take our word on how amazing it is though, give the experiment on the next page a go and see if using different forms of light changes what you can see.



This bottle contains the Elephant's Trunk nebula. Nasa used their Spitzer Space Telescope to take this photo using infra-red light. The infra-red allows us to look into the nebula and see the new-born stars (the bright pink ones) in its star nursery.

MAKE YOUR OWN 'BOTTLE OF SPACE'

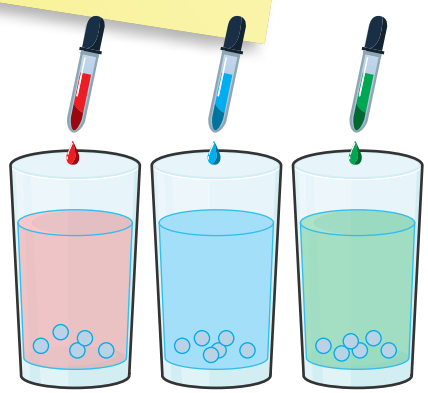
This experiment will help you make your very own nebula in a bottle that you will then look with different forms of radiation, UV and Visible light. Remember though - the dust, gas and stars in nebulae can be very far apart and move very slowly so you will have to stretch your brain a bit and pretend we have sped up time and are looking at things from a different perspective.

YOU WILL NEED:

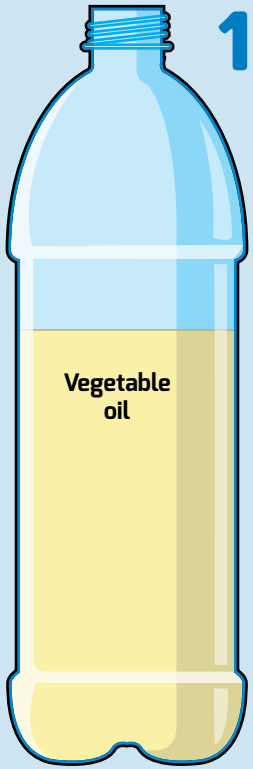
- A funnel
- A torch
- A UV torch
- A jug
- Some gel balls (these are used by florists)
- Rice
- Vegetable oil
- Tonic water
- A large empty bottle
- 3 cups
- 3 different colours of food dye
- Effervescent tablets (you will need to ask an adult for these).

BEFORE YOU START

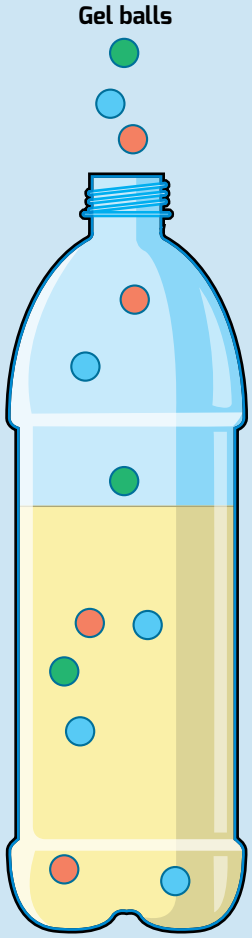
Get your three cups. In each one put a little tonic water and a squirt of food dye (a different colour in each). Add a few gel balls to each. These will hydrate (soak up water) of the different colours so you need to leave them for a few hours until they get to around the size of blueberries.



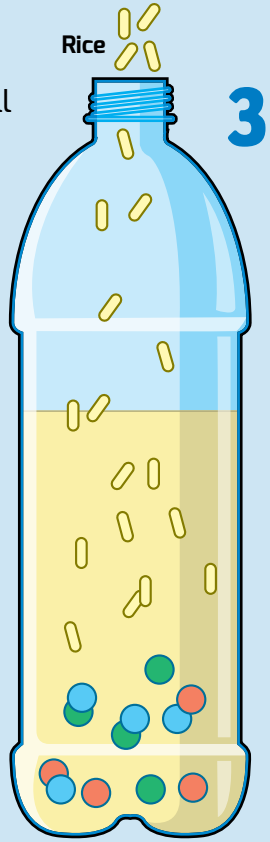
STAGE 1



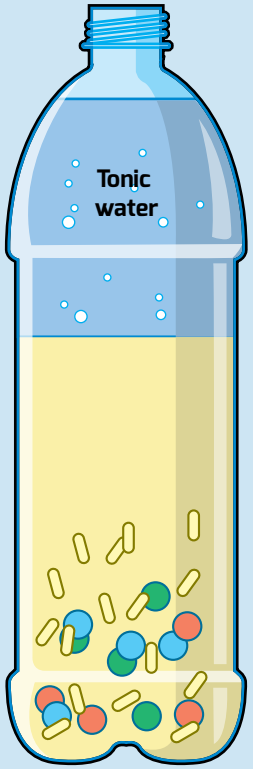
1 Fill the bottle 2/3 full with oil. Be careful doing this, it can be very messy.



2 Add in your different coloured gel balls – these can represent the different colour and therefore, different aged stars.



3 Add in your rice – this will represent the dust.



4 Add the tonic water – this represents the gas clouds in a nebula.

7.2 A BOTTLE OF SPACE
MAKE A YOUR OWN NEBULA

Now that you've thrown all the ingredients together, things in the bottle might start to look a little strange right about now but don't panic!

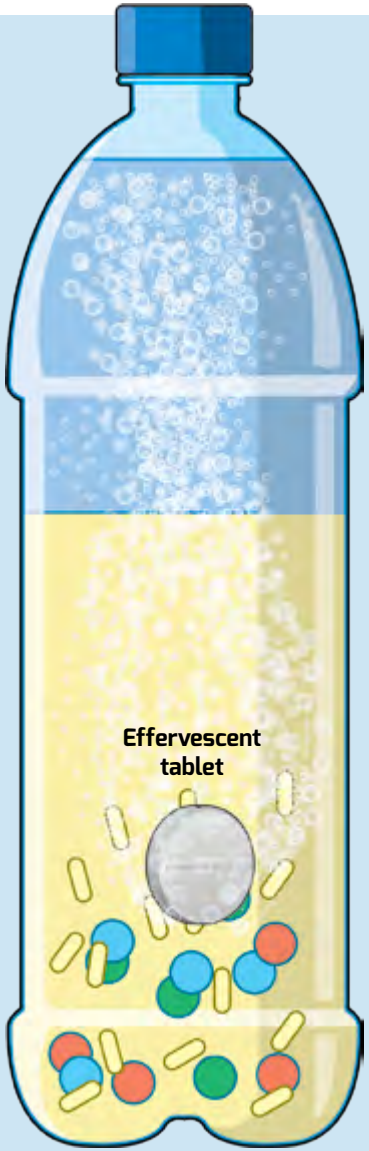
As you have put two different liquids in there they will want to separate, one liquid will sink to the bottom and one will float on top. Make sure you leave the bottle alone to separate – it will be worth it.

STAGE 2

Before you can test your experiment, you need to add an effervescent tablet to the bottle. Ask an adult to help you do this. Make sure you add it quickly and screw the bottle lid back on super-fast or things will get messy.

If we didn't add the effervescent tablet we wouldn't be able to create any movement in the bottle, it would still look beautiful of course but we want to make it as realistic as possible.

When you have done all this you are ready to get testing – best to do this in a darkened room as it really adds to the drama!



TESTING TIME!

VISIBLE LIGHT

What do you see if you shine the visible light torch on the bottle? Can you see the gas clouds (tonic water), particles (rice) moving and also the stars (gel balls) too? Now try the UV torch.

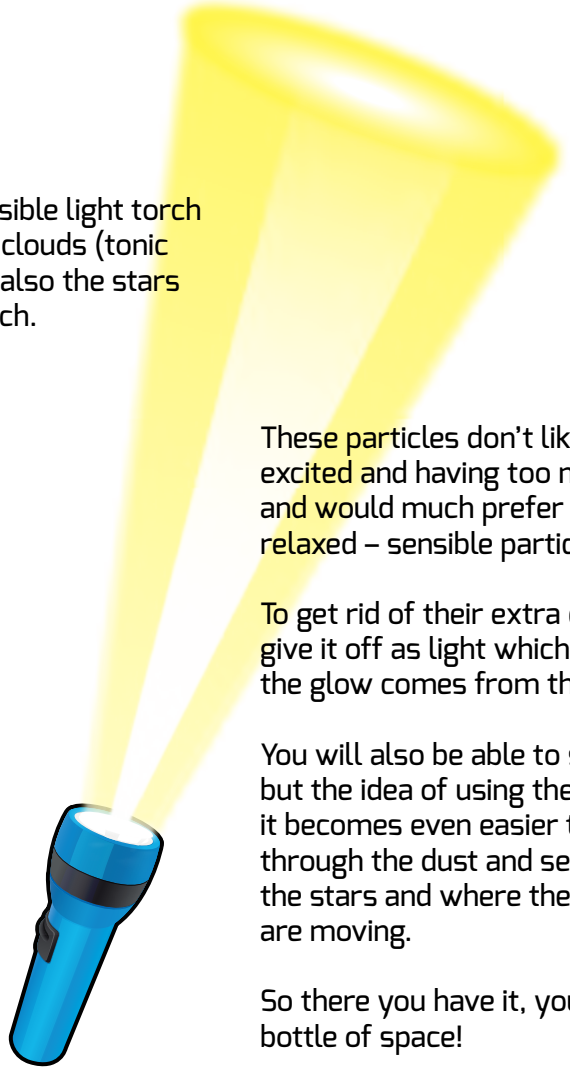
VISIBLE LIGHT

What do you see now?
Has anything changed?
What is happening?

You will see the gas cloud and gel balls begin to glow when you shine the ultraviolet torch on the bottle.

This is because tonic water is very sensitive to UV light and the gel balls have been soaking that up too so they will be also.

The UV light excited some of the particles in the tonic water.



These particles don't like being too excited and having too much energy and would much prefer to be relaxed – sensible particles.

To get rid of their extra energy they give it off as light which is where the glow comes from that we see.

You will also be able to see the dust but the idea of using the UV is that it becomes even easier to cut through the dust and see things like the stars and where the gas clouds are moving.

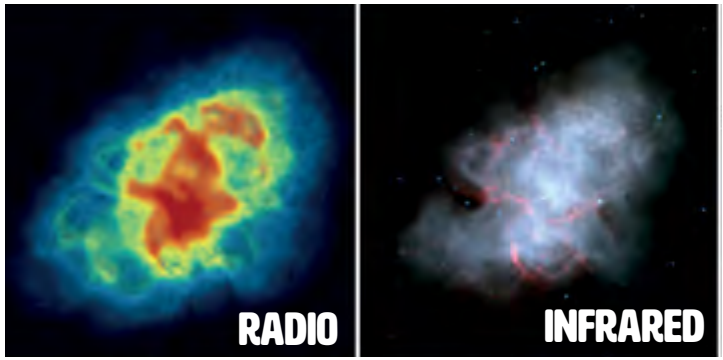
So there you have it, your very own bottle of space!

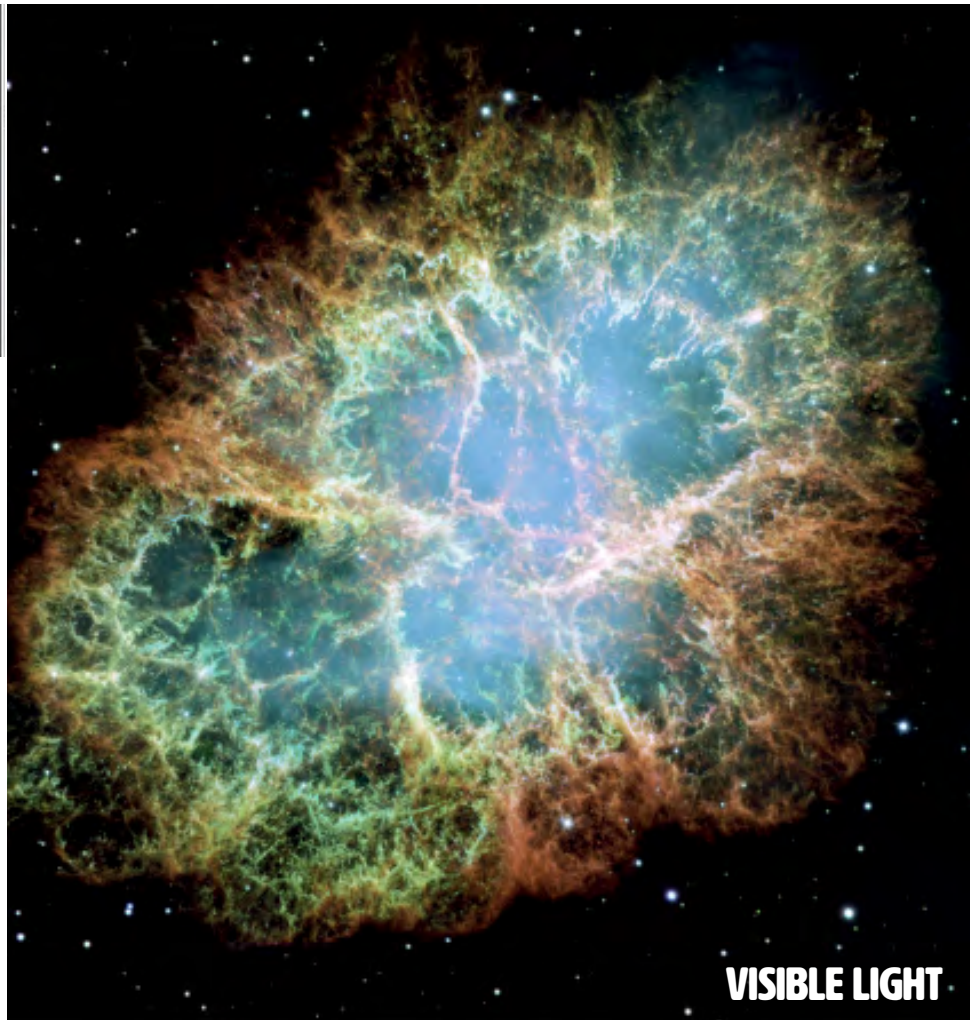
8 SUPERNOVA!
MAKE A YOUR 'BIG BANG'

Space is a weird and wonderful place, it is also a very beautiful place. In this activity you will get the chance to create your own 'big bang'... well an artist's impression of one anyway.

Astronomers are able to study some of the Universe's most jaw-dropping explosions and analyse what is going on.

MEET THE CRAB NEBULA





The Crab Nebula is a great example of what astronomers can see. It is the cloud of gas and matter that is left over when massive star came to the end of its life in very dramatic supernova explosion in 1054 AD.

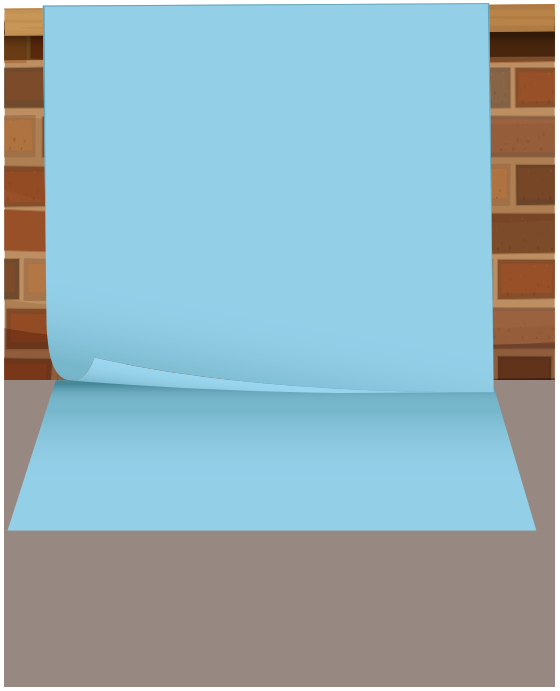
Using different telescopes we are able to get different views of this amazing nebula that help us to uncover what is swirling around inside this cloud of dust and gas.

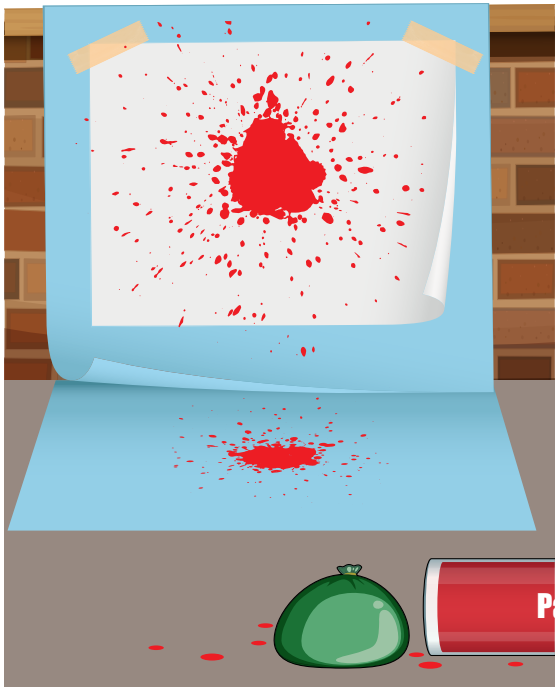
The images on this page are all of the Crab Nebula taken using different forms of wavelengths of light and even some filters on ground-based telescopes. It almost doesn't look like the same object does it?

MAKE YOUR OWN SUPERNOVA NEBULA

Now it is over to you, time to create your very own 'big bang'!

WARNING!
THIS ACTIVITY IS MESSY!





YOU WILL NEED:

- Water balloons
- Water soluble paint
- A big sheet of paper
- A large dust cover
- An outside wall

1 Attach your dust sheeting to on outside wall making sure to fully cover it and the floor directly in front of it too, up to around one metre from the wall should do it.

Before you begin this activity make sure you have permission to use this wall – things can get a little messy when re-creating big space bangs.

2 Attach your paper to the middle of the dust sheet. Fill your water balloons up with paint and tie them off.

Why not see if you can use different colours to recreate different views of some of the most famous explosions in space.

3 Now it is time to launch your balloons at the paper to create your big bang!

Stand back and admire your work. If you take the paper down immediately after the 'explosion' it will stop the paint running and mean it looks much more like the remnants of a supernova explosion.

TEACHER'S NOTES

Here you will find the answers to some of the sections within the booklet.

4.1 PUZZLE TIME
CRACK THE CODE

Puzzle 1

For this one you will need to get both sides of the equation balanced to find the answer.

$3a + 3a + a = 3a + ?a$

Answer:

4

Puzzle 2

Here you need to convert the decimal number into a percentage.

$0.65 = ?5\%$

Answer:

65%

Puzzle 3

Complete the sentence to find out more about gluons.

Remember, you can refer beck to the resource book if you need to.

A gluon has zero mass or ??????

Answer: Charge

Puzzle 4

Reduce the fraction below so you get it in its simplest form.

$1/8 + 2/? = ?/8$

$3/8 + 3/8 = ?/8$

Answers:

8,3,6

Puzzle 5

Below is a very famous number sequence found in nature called the Fibonacci sequence. Can you find the missing number?

0, ?, ?, 2, 3, 5, 8, ?, 21, 34

Answer:

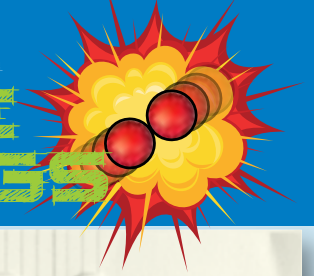
1,1,13

Puzzle	Answer	Alphabet value
1	4	D
2	6	A
3	Charge	R
4	8,3,6	K,M,A
5	1,1,13	T,T,E

THE MYSTERY WORDS ARE:

D A R K

M A T T E R



NOTES

Need to make some notes or doodle some ideas?
This is the place to do it!

CHECK OUT OUR ACCOMPANYING RESOURCE

UKRI
Science and
Technology
Facilities Council