Sisters in STEM

Stella's Activity Pad

Ages
8-12

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Hi Girls!

My name is Interstella,
but you can call me Stella STEM!

I love all things STEM! STEM stands for Science, Technology, Engineering and Maths. These are the subjects that help our world develop and make new things for you and me.

Throughout history, there have been some super cool women leading the way in STEM. They have been inspirational in their work but also in their quest to ensure women had the same opportunities as men in STEM.

I'm on a mission to prove that STEM isn't just for boys! I will be journeying through history to look at some of the hundreds of inspirational women in STEM – come and join me!

Let's discover together and find out more on these role models and how they can inspire us. Who knows, maybe one day you'll be in a book just like this one!

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Women can wear trousers too. Can't we? Of course we can. No one would ever tell a woman now that they can't wear trousers, but in the 1930s a woman in trousers was considered scandalous. That didn't stop Barbara McClintock though, who worked at the University of Missouri. She was excluded from meetings with the other faculty members and given little support for her work. After finding out the university would fire her if she ever got married, Barbara decided enough was enough. She quit and found a job elsewhere. She went on to win a Nobel prize for her work on genes. That's considered the highest award a scientist can get!

And back further still, in the early 1800s, at a time when a woman's role was thought to be running the home and having babies, Ada Lovelace helped in the creation of the very first computer. Ada wrote the first ever programming language. She also theorised about computers which could create music and images, not just process numbers. This was over a hundred years before what we would consider a computer today had been invented.

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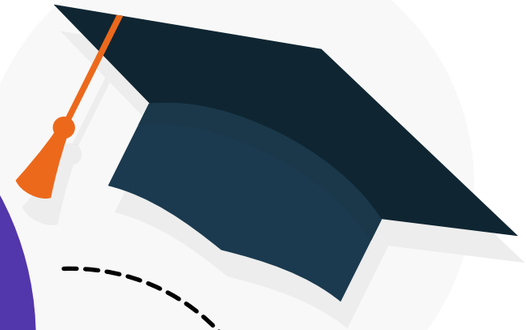
In the 1880s women had to get permission to attend lectures at university, and were not allowed to get degrees, even after attending university. Despite this, Emily Davis and Barbara Bodichon set up the first University College for women. No one was going to stop them from getting an education, or giving it to others!



Throughout history, women have faced opposition and adversity, however they didn't let that stop them from doing incredible things. So let's not stop now. We are calling on you to follow in the footsteps of the incredible women who came before you and be incredible too. Are you up for it? Of course you are!

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Stephanie Kwolek

1923–2014
Nationality: American
Known for: Inventing Kevlar

Stephanie's invention was bullet-proof!

She wanted to be a doctor, but she needed to earn money in order to study. She decided to get a temporary job. Lots of men had gone off to fight in the Second World War, so she managed to get a job at DuPont Chemical Company due to a shortage of staff. She liked the job so much she stayed on permanently!

She discovered a cloudy, crystalline solution (a waste product that was normally thrown away after an experiment), and convinced the technician to test it for her. They found the fibre to be five times stronger than steel! This fibre later became known as Kevlar, which is used in bullet-proof vests. A new field of Polymer Chemistry quickly arose due to Stephanie Kwolek's discovery of Kevlar.

Alice Ball

1892–1916
Nationality: American
Known for: Developing the first useful treatment for leprosy

She was both the first woman and the first African-American to graduate from the University of Hawaii, where she got a Masters in Chemistry.

She went on to work at this university as a Chemistry Instructor when she was only 23 years old. In this role, she researched treatments for an illness called leprosy. Sadly, Alice died due to a research related accident aged just 24, before she was able to publish her research findings. Upon her death, her findings were taken by the Head of the University, who claimed them as his own. He published the findings under his own name, and Alice's credit for the papers wasn't given for many years until the truth came out.

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Science is all around us

Science helps us to understand the natural world through things such as experiments and observations.

There are many different types of science, including:

- **Biology (the study of life)**
- **Physics (the study of matter and energy)**
- **Chemistry (the study of the properties of matter and how matter interacts with energy)**

Have you ever wondered why the sky is blue, why steam is released from a boiling kettle, or how a cake rises in the oven? Science answers all of these questions and more!

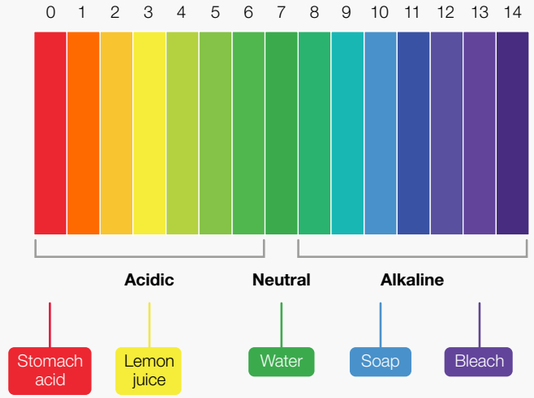
Have you ever seen a PH scale?

A PH scale ranges from 0-14 and tells us how acidic or alkaline a substance is.

- **0-6 on the PH scale is acidic**
The lower the number, the more acidic the substance is.

- **8-14 on the PH scale is alkali**
The higher the number, the more alkaline the substance is.

- **7 is neutral (e.g. water)**
So, to recap: anything below 7 is acidic, anything above 7 is alkaline and 7 is neutral.



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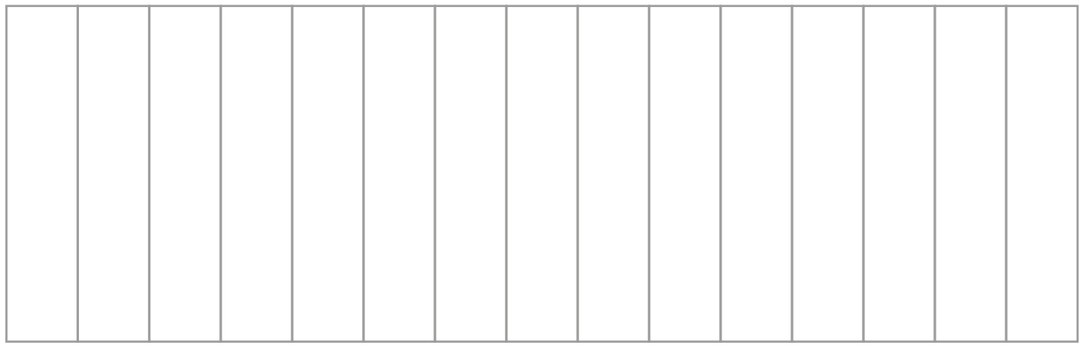
Are these substances acid, alkali or neutral?

Colour in the PH scale and draw a line from the substances to the correct place on the PH scale.



Lemon Juice (PH 2.5)

Bleach (PH 13)

Water (PH 7)

Orange (PH 3.8)

Is lemon juice alkaline or acidic?

If a liquid has a PH of 8, is it a strong acid, a weak acid, neutral, a weak alkali or a strong alkai?

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Marie Curie

1867–1934
Nationality: Polish (then French)
Known for: Pioneering research into radiation

Marie Curie was the first woman ever to win a Nobel Prize!

A Nobel Prize is regarded as one of the most prestigious awards you can get. Marie was the first woman to win one, and the only woman to get the Nobel Prize twice! She received her first Nobel Prize for physics, which she shared with her husband, and then a second for chemistry.

Her achievements include developing the theory of radioactivity and discovering two elements: polonium and radium. During the First World War, Marie Curie worked to develop small, mobile X-ray units that could be used to diagnose injuries near the battlefront.

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Irène Joliot-Curie

1897–1956
Nationality: French
Known for: Discovering how to make designer radioactive elements in a lab

At age 15, Irène impressed the great Albert Einstein with her knowledge of physics!

During the First World War, Irène worked with her mother, Marie Curie, in the radiography corps at the front, using the new X-ray equipment to treat soldiers. Irène's contribution to science was recognised in 1991 when the Joliot-Curie crater on Venus was named after her.

When she was older, she shared a Nobel Prize in chemistry with her husband for their creation of radioactive elements. The elements she created, and similar ones, are still used today in medical procedures that have saved millions of lives.

Cecilia Payne-Gaposchkin

1900–1979
Nationality: American (Born in Britain)
Known for: Theorising that stars were mostly made from hydrogen and helium

Cecilia was a star-gazing genius.

She studied at Cambridge University, however was not awarded a degree because she was a woman. She discovered that hydrogen was the most common element, and that stars were balls of gas made mostly from hydrogen and helium. This theory was rejected because it didn't match what people believed at the time. However, it was later proved correct and re-published by a man who claimed the theory as his own and took the credit.

Valentina Tereshkova

1937–Present
Nationality: Russian
Known for: Being the first woman in space. She went to space when she was only 26 years old

Valentina was the youngest woman to go into space and is still the only woman to go into space solo!

She was recruited by the Space Programme because of her hobby of parachute jumping. She was one of four women selected for the programme, but the only one to make it through the training. The total length of Valentina's space flight was 70 hours and 48 minutes. She orbited Earth 48 times in total (seeing 48 sunrises within the space of three days!).

She is now a Politician, and has received a number of awards including, 'Hero of the Soviet Union' and 'Order of Friendship'.

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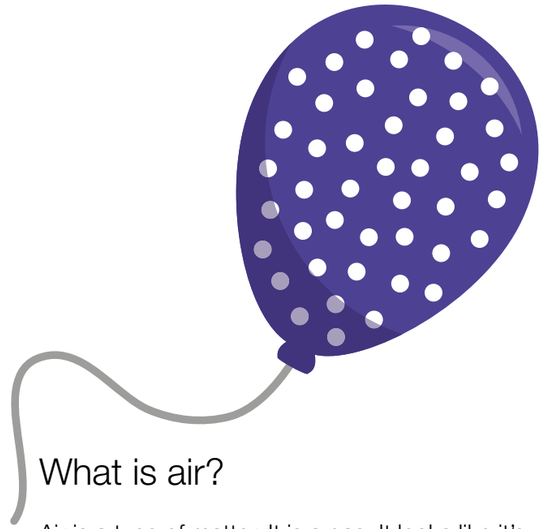
What is physics?

Physics is a scientific subject that studies matter; how matter moves, and how it interacts with energy and forces.

Air resistance

- Gravity pulls objects down towards earth. If you jump you will always come back down. That's gravity. Without gravity we would all float away!
- Air resistance slows down a falling object because the tiny particles in the air are getting pushed out of the way, and they push back.
- The larger the object, the more air particles it will need to move out of the way. Therefore, the greater the air resistance against it will be.



What is air?

Air is a type of matter. It is a gas. It looks like it's nothing, but it's actually made up of lots and lots of tiny, invisible particles (too small to see!).

Think of a balloon that you fill with air. As you push more air into the balloon it expands, and if you tie it shut, it remains expanded. This is because the balloon is full of tiny invisible particles that would normally be spread out in the air. However, as you have forced them into a confined space, they are more densely populated than if they were in the air.

Why don't you test this theory by getting two pieces of paper (one big piece and one small piece) and drop them from the same height. See which one hits the ground first!

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Can you predict the outcome?

Physicists conduct experiments to test a hypothesis (something we believe to be true, which needs further investigation).

Can you hypothesise which objects will have the most air resistance, and which will have the least?

Remember, we know that the larger the object = the more air particles it will need to move out of the way = the greater the air resistance against it.

Order the objects from least air resistance acting against it, to greatest air resistance. Write the number of the objects on the dotted lines.

Can you design a simple experiment to test your hypothesis?

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Annie Easley

1933–2011
Nationality: American
Known for: Being a Computer Scientist for NASA

Annie was a trailblazer in the tech industry.

When human computers were replaced by machines, she evolved with the times and became an adept Computer Scientist.

She helped pave the way for women's rights at the centre where she worked, in both formal and informal ways. Notably, she and her Room Supervisor agreed to come into work wearing trouser suits, like men. This made a statement on what women did, rather than what they wore.

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Edith Clarke

1883–1959
Nationality: American
Known for: Being the first woman to be employed as an electrical engineer in the US

Edith used her skills to help build the Hoover Dam in the US.

She took a summer job as a Computer's Assistant, and was so interested in her work that she stayed on to train and direct a group of human computers (people who performed complicated mathematical problems.)

Her most famous contribution was the ‘Clarke Calculator’ in 1921 a graphical device that simplified the equations electrical engineers used to understand power lines. It was patented in 1925. She helped build the Hoover Dam, contributing her electrical expertise to develop and install the turbines that generate hydropower there to this day.

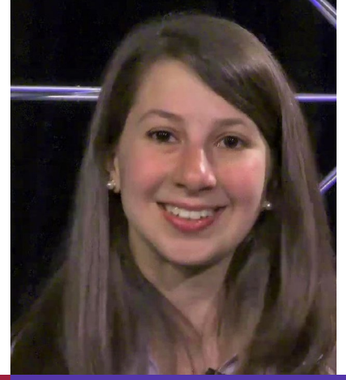
Ada Lovelace

1815–1852
Nationality: British
Known for: Being the first Computer Programmer

Ada's work was so influential that she has an entire programming language named after her, which is still used today!

She theorised that the computer could follow a series of simple instructions (known as a programme), in order to perform complicated calculations. She wrote computer programmes before the computers that could perform them were even built.

One of the earliest programming languages was named after her (Ada), which is still used today. She even has her own National Day (the second Tuesday in October) on which the contributions of women in STEM are honoured.



Katie Bouman

1989–Present
Nationality: American
Known for: Creating the first image of a black hole

Katie and her team captured the first image of a black hole!

She led the development of the computer programme that made the breakthrough image possible, captured in 2019.

Before this, no image had ever been taken of a black hole, and it is thought that this may revolutionise our understanding of the universe.

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Do computers talk?

Computers have their own language, just like us. Computers don't understand English, they only understand code, so we have to communicate with them in code to make them understand what we want them to do.

Ciphers

Ciphers are a way of retrieving a hidden message from within another message. The cipher tells you where in the message to look, or what you need to do to get the hidden message. A cipher could be a set of coordinates, each one a different letter. Once you have all the letters they spell out a new message.

Using the coordinates

(1,7) (2,7) (4,7) (1,4) (3,4) (2,7) (5,4) (3,6)

I space m e t space a n

(2,7) (5,4) (1,2) (1,5) (1,4) (3,6)

space a l i e n

I met an alien

7	I		a	m		s	o
6	h	u	n	g	r	y	
5	i		c	o	u	l	d
4	e	a	t		a		
3	v	e	r	y			
2	l	a	r	g	e		
1	b	u	r	g	e	r	
	1	2	3	4	5	6	7

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Can you talk in code?

Find the hidden message

Can you use the following cipher to find the hidden message in this text?

Cipher: (1,5) (2,4) (3,3) (4,2) (5,1)

H	A	P	P	Y
E	E	L	S	
A	L	L		
S	A	I	L	
T	O		H	O M E

Break the code to answer the questions!

- Sophie is the oldest.
- Clare is 3 years younger than Sophie.
- Joanna is 8 and the second youngest.
- Marie is 1 year younger than Joanna and 4 years younger than Sophie.

Q. How old is Sophie?

Q. Which two girls are the same age?

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Emily Roebling

1843–1903
Nationality: American
Known for: Completing the construction of the Brooklyn Bridge

Emily built bridges (literally!) for women in STEM.

Her husband was the Chief Engineer on the construction project for the Brooklyn Bridge, the longest suspension bridge in the world. However, after he developed a debilitating illness she took over much of the Chief Engineer duties, including day-to-day supervision and project management.

She was the first person to cross the bridge by carriage and today the bridge is marked with a plaque dedicated to her memory.

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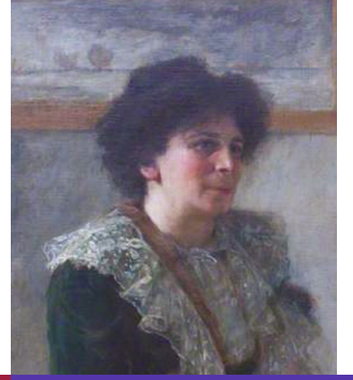


Hertha Ayrton

1854–1923
Nationality: British
Known for: Documenting research into electric arcs, for which she was awarded the Hughes Medal

Hertha was the first woman to be elected into the Institution of Electrical Engineers.

When her father died when she was eight, she was sent to live with her Aunt, who ran a school. She went on to study maths at college, however was not awarded a degree because she was a woman. Despite this, she went on to attend the University of London, and then become a teacher, whilst doing her own projects on the side.

Many of her projects were published in 'Mathematical Problems and their Solutions' in the Educational Times.

Engineering

Engineers solve problems with their inventions. They love figuring out how and why things work. But before things are built (or created), they need to be planned out, which is called engineering. Do you like engineering things?

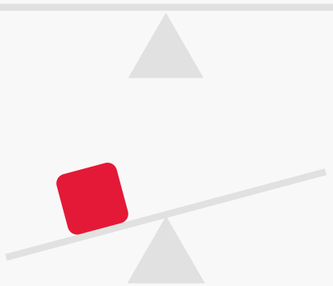
Engineers are creative thinkers, who work in different industries, depending on their area of speciality. Some examples of engineers are: Computer Engineers, Electrical Engineers, Civil Engineers, Aerospace Engineers and Mechanical Engineers.

Engineers need to understand how things interact with each other in order to invent new things or improve existing things.

What type of engineer would you like to be and why?

In this experiment, engineers would study how force (the weights) and distance (how far the weights are from the central pivot) affects the movement of the scale. When there are no weights on the scale it is perfectly balanced and remains level.

When a heavy weight is placed on one side of the scale, the scale tips in that direction, making it unbalanced.



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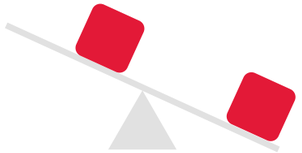
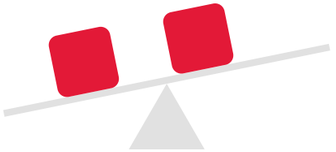
If a lighter weight is placed on the other side of the scale to the heavy weight, but placed further away from the pivot, the scale can be balanced, even though the weight on the right is lighter than the one on the left.

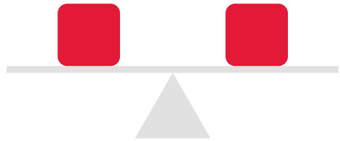
You can test this theory on a see-saw in the playground. How does the see-saw move when you get on? How does the see-saw move when your grown-up gets on the other side, and why?



If an object of the same weight is placed on the scale, but further from the pivot than the first object, then the scale will tip down on the side of the new object even though they are the same weight.

If the new object, of the same weight, is placed on the scales, but closer to the pivot than the original object, then the scales will tip down on the side of the original object.





If the two objects of the same weight are placed the same distance from the pivot on both sides, the scale will be balanced.

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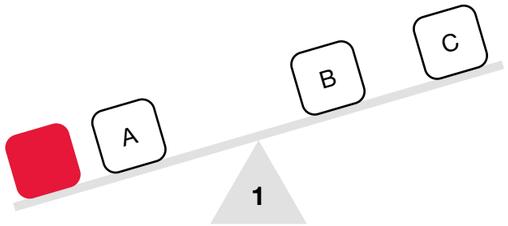
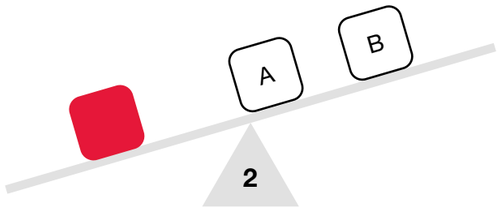
Can you make the scales balance?

1. On the scale to the right, which position should you place the heavier weight in order to balance the scale?



2a. Using the scale to the right, in which position would you place the smaller weight in order to balance the scale?

2b. In which position would you place the larger weight to balance the scale?



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Katherine Johnson

1918–2020
Nationality: American
Known for: Being a Mathematician for NASA

Katherine calculated the path that put the first American astronaut on the moon!

She started high school when she was only 10 years old, and graduated when she was 14 due to her skills with maths. After graduating from college, aged 18, she went to work for NACA (now known as NASA), with a group of African-American women whose jobs were to perform complicated mathematical computations for the engineers. These women were human computers.

She was the first black female to be given credit for being an author on a research report. She was part of the team that calculated where and when to launch Apollo 11 (the spacecraft that put the first person on the moon).

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Hypatia

355 CE–415 CE
Nationality: Egyptian – then Roman
Known for: Being a Mathematician, Astronomer & Philosopher

Hypatia was a philosopher, astronomer, and is often considered the first ever female mathematician.

Her father was the mathematician Theon of Alexandria, who was a Headmaster. Perhaps this is what led Hypatia to become an incredible teacher to students from all over the Mediterranean. She taught philosophy and astronomy at the Neoplatonic school in Alexandria. Hypatia is also known to have constructed her own equipment to aid her astronomy, such as astrolabes (a device for measuring height and distances of objects in the night sky) and hydrometers (used for measuring the density of liquids).

Julia Robinson

1919–1985
Nationality: American
Known for: Solving various mathematical problems

Julia was an award-winning, maths genius!

As a child, Julia got sick with both Scarlet Fever and then Rheumatic Fever. By the time she was better, she had missed two years of school. In only one year, working with a tutor for three mornings a week, she was able to cover four years worth of school work! She returned to school and by her final year she was the only girl in her maths and physics classes. She did very well and received awards in both subjects, as well as the Bausch and Lomb Medal for the Best Science Pupil.

She later worked as a mathematician in a university and published a number of papers that aided in the solution of a number of problems.

Florence Nightingale

1820–1910
Nationality: British
Known for: Being a Nurse and Statistician

Florence Nightingale – perhaps the most famous nurse in the world!

She served as a nurse during the Crimean War, and spent her night rounds giving care to wounded soldiers. This is where she got her nickname,'The Lady with the Lamp'.

When she arrived at the hospital where she served during the war, there was an incredibly high death rate, and patient records were a mess. Florence discovered that many of the deaths were caused by poor hygiene practices by staff. She set about changing people's routines and habits, through things like hand washing and cleaning well and saved many lives. She was the first woman to be awarded the 'Order of Merit'.

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Maths

Maths is all around us. We use maths to tell the time, to play games, to build things and do all sorts of different work.

Squaring and square root are the opposite of each other.

Squaring

A number squared is just the number multiplied by itself.

$4^2 = 4 \times 4 = 16$

So we say, 4 squared equals 16

Think of squaring a number as making a square with a length and height of your number. So 4 squared is a 4 by 4 square. If you count the squares you have your answer.

A Civil Engineer would need to calculate square roots when they build roads coming off a hillside.

Square root

The square root of a number is the highest that when multiplied by itself equals the original number.

$\sqrt{16} = 4$

So we say, the square root of 16 is 4

To get the square root of a number, make a square and figure out what length and height the square would need to be so that the total area of the square equals your number (remember that your length and height need to be the same).

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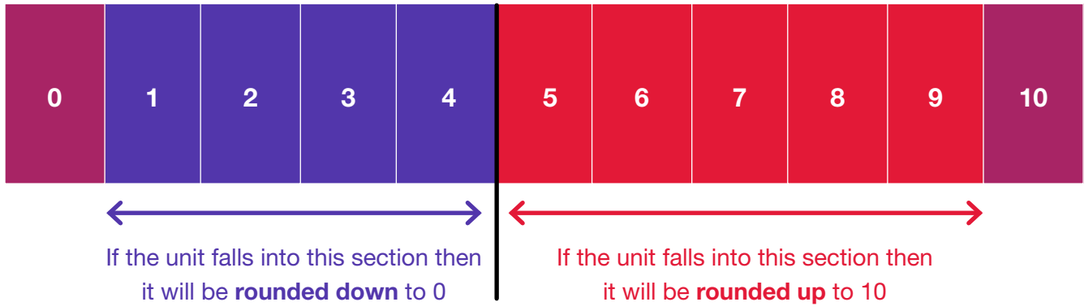
Rounding

Rounding is a term we use in maths to make numbers simpler and easier to use.



You can apply this to rounding with tens, hundreds, even thousands!

Here are some examples of how we round numbers to the nearest 10:

0 ←	3	
	9 →	10
10 ←	11	
	17 →	20
20 ←	24	
	28 →	30
100 ←	101	
	256 →	260

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Can you help to solve these maths problems?

What is the square root of 9?

Tip: make these 9 squares into one larger square. Remember a square has equal sides.

Can you help me round these numbers to the nearest ten?

I have done the first one for you.

13 rounds down to / rounds up to **10**

47 rounds down to / rounds up to ----------

102 rounds down to / rounds up to ----------

81 rounds down to / rounds up to ----------

31 rounds down to / rounds up to ----------

79 rounds down to / rounds up to ----------

56 rounds down to / rounds up to ----------

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STEM Wordsearch

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

ADA LOVELACE

ALICE BALL

ANNIE EASLEY

EDITH CLARKE

EMILY ROEBLING

FLORENCE NIGHTINGALE

HERTHA AYRTON

HYPATIA

JULIA ROBINSON

KATHERINE JOHNSON

KATIE BOUMAN

MARIE CURIE

STEPHANIE KWOLEK

VALENTINA TERESHKOVA

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Well girls, it looks like we've reached the end of our journey through STEM. I had lots of fun – I hope you did too!

Remember that STEM is all around us; it makes the world go round and lets us do really cool things. Without Women in STEM, we might not have lots of the things that are part of everyday life, like portable x-rays that you get at the dentist or hospital, or sports equipment that uses Kevlar, such as snowboards, racing car parts or canoes, and so much more.

If you're interested in learning more about Women in STEM, there are loads of great books to read and women to learn about. Ask your teachers and parents about these, and see what else you can learn!

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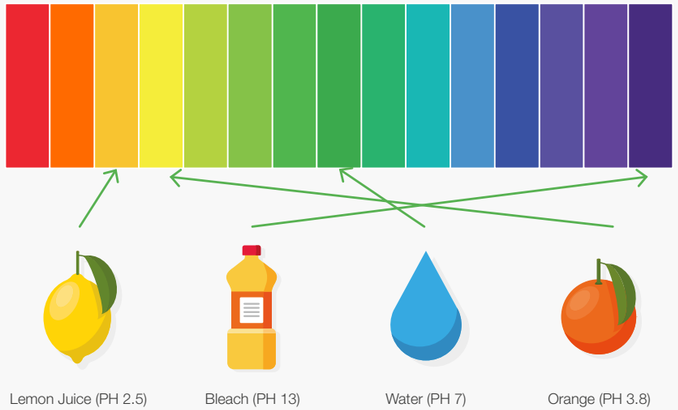
Answers

Page 8



Is lemon juice acidic or alkaline?

Alkaline

If a liquid has a PH of 8 is it a strong acid, a weak acid, neutral, a weak alkali or a strong alkali?

Weak alkali

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4 **3** **1** **2**

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Did you break the code?

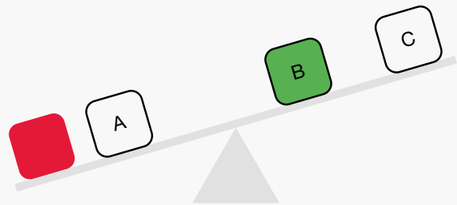
Sophie is 11

Clare and Joanna are both 8

Page 20

1. On the scale below, which position should you place the heavier weight in order to balance the scale?

B

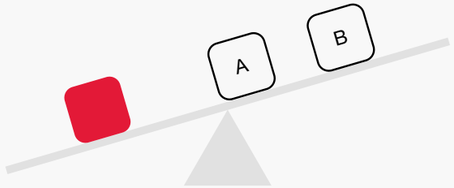


2a. Using the scale below, in which position would you place the smaller weight in order to balance the scale?

B

2b. In which position would you place the larger weight to balance the scale?

A



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Answers

Page 25

Find the square root of nine by making these nine squares into one larger square:

Can you help me round these numbers to the nearest ten?

13 rounds down to 10

47 rounds up to 50

102 rounds down to 100

81 rounds down to 80

31 rounds down to 30

79 rounds up to 80

56 rounds up to 60

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

- ADA LOVELACE
- ALICE BALL
- ANNIE EASLEY
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