

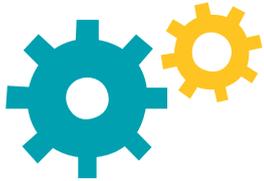
SCIENCE MUSEUM

WONDERLAB: THE EQUINOR GALLERY

The science and maths
behind the exhibits

INFORMATION i	Age	7-11 11-14	Topic	SPACE	🕒 30 MIN
	Location	LEVEL 3, SCIENCE MUSEUM, LONDON			

What's the science?



What more will you wonder?

The science and maths behind the exhibits

Wonderlab: The Equinor Gallery is packed with over 50 hands-on experiments and experiences. You need to look closer, ask questions and get creative to discover what they're all about.

If you're still curious you can find out more about the science and maths behind each of the exhibits using these handy resource packs. Check out each of the seven zones that you'll find in the gallery.

Space

Space is incredibly vast and we only understand a tiny part of it. Some of what happens in space affects our lives here on Earth, such as the northern lights or eclipses of the Sun.

Find out more about the science behind the Space zone exhibits in this pack.

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The science behind the exhibit



Orbits is our model of the Solar System you can ride on, showing just the Earth and Moon as they orbit the Sun. The model isn't to scale. But it does show how the Earth and Moon move and how this movement affects our experiences on Earth. It shows how day and night, the seasons, years, phases of the Moon and eclipses are formed.

One full turn of the Earth is equal to one day. One full orbit of the Earth around the Sun is called a year. Over the year the 23-degree tilt of the Earth's axis causes seasons in each of the hemispheres. For one part of the year the northern hemisphere is pointed towards the Sun, causing summer, and the southern hemisphere is pointed away, causing winter. In the other half of the year the situation is reversed for each hemisphere.

The Moon is the Earth's only natural satellite and it orbits the Earth roughly every 29 days. We call this a month. The same side of the Moon always faces the Earth, and each month we see the face of the Moon changing size from full moon to new moon. This is because we only ever see the same face of the Moon and sometimes it is in shadow.

Sometimes the Moon passes in-between the light from the Sun and the Earth, which people on Earth see as a solar eclipse. Eclipses are rare because the Moon is on a plane with the Earth which is slightly tilted by 5 degrees. Otherwise we would see solar and lunar eclipses every two weeks.

At night we see stars in the sky. These stars are actually in 3D space, but from Earth they appear as a 2D backdrop because they are so far away. The star canopy shows the 500 closest stars and is based on star data from the European Space Agency (ESA).

The science behind the exhibit

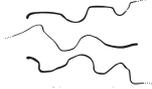


When cosmic rays crash into the Earth from space they hit the Earth’s atmosphere and smash into molecules. This causes a shower of smaller particles such as muons and electrons to rain down on the surface. Another source of particles is background radiation from radioactive material on Earth. When this material decays it releases particles.

The Particle Detector makes these particles visible by showing their paths as they travel through the chamber. When a particle moves through the chamber it causes the alcohol inside to condense around it and form condensation trails. These misty trails look like fine clouds and are similar to the condensation trails that form in the sky behind aeroplanes on a clear day.

Different particles form different condensation trails, which can be used to identify them. By looking closely at the shape of the condensation trails in the cloud chamber you can work out which type of particle is present.

The three most common trails you see in the chamber are...

		
<p>Long, straight tracks These are fast-moving electrons or muons</p>	<p>Short, fat tracks These are alpha particles</p>	<p>Zigzags and curly tracks These are slow-moving electrons</p>

Muons and some of the electrons originate from cosmic rays. Alpha particles and some of the electrons arise from radioactive decay of atoms in rocks or air in our surroundings. This radioactive decay is usually from natural sources such as granite rocks or radon in the atmosphere. Alpha particles are much more likely to collide with other atoms than electrons or muons, which is why they create short, fat trails.

Cloud chambers were the first detectors that allowed scientists to see these particles. Since then particle physicists have built better and better detectors to find more of the particles that make up our universe. The Large Hadron Collider includes four gigantic particle detectors, but they are much more advanced than this one.

Space

Double Gravity Well (40)

The science behind the exhibit



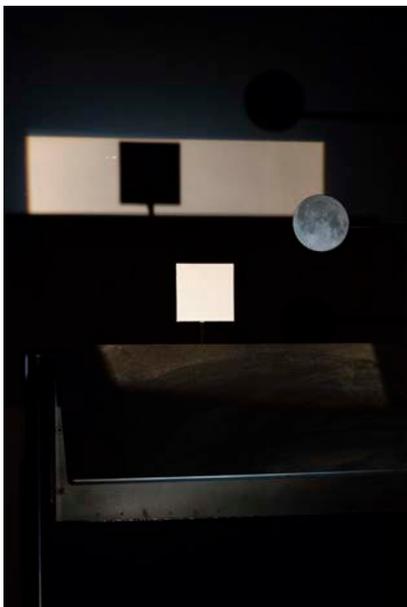
Gravity is a force that attracts objects towards each other. Gravity affects everything from stars and planets to tiny particles. The greater the mass of an object, the greater the force of gravity it exerts. A star has a very large mass. The mass of a star is so great that it curves the space around it into a shape a bit like a well, called a gravity well.

Things travelling near a star such as a planet, comet or asteroid will get caught in the star's gravity well. This causes them to travel around the star in a path called an orbit. In space there is very little friction, and so planets will move around a star in a stable orbit for millions of years.

Unlike our Solar System, most star systems in the galaxy actually have two or more stars. This means there are two or more gravity wells close to each other. It also means that objects that are moving around two stars will have unpredictable and varying orbits.

When you roll a ball around the Double Gravity Well exhibit it behaves in a similar way to a planet orbiting two stars. Depending on how you release it, the ball will roll in a particular orbit shape before it eventually falls into the hole. Balls released at different speeds and angles will roll in different ways. The shapes these varying orbits take can include figures of eight and W shapes, as well as circles and ovals.

The science behind the exhibit

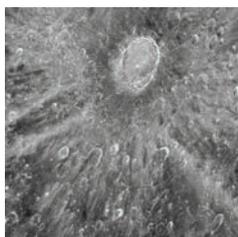


Bright Black Moon shows you an optical illusion that affects the way we see the Moon. Our perception of the brightness of objects is caused by both how the object is lit and its surroundings.

When you press each button it lifts different cards against a black background. The first card is dark grey, but because it appears against a black background and is brightly lit the card actually appears white. This is because the card is reflecting a lot of light but the background isn't. So in comparison to the black background the card appears lighter than it really is.

If you look closely when you lift the next series of cards you'll see that each one gets lighter in colour. As the lighter cards are raised they look whiter and the previous cards look darker in comparison. This shows how our eyes can be tricked into perceiving the colour of an object to be something it isn't.

Our Moon is dark grey in colour, which can be seen in photos of its surface taken during the Moon landings. However, the dark grey rock of the Moon is reflecting a lot of the Sun's light onto the Earth and is therefore brightly lit. We also see the Moon against the black background of space, with no other brighter large objects to compare it against. This makes it appear lighter than the blackness of space behind it, and so we perceive it as white.



Dark grey surface of the Moon



White appearance of the Moon at night

The science behind the exhibit

The Aurora exhibit re-creates the northern lights in a tube. The tube is attached to a vacuum pump, which is keeping the tube at low air pressure – much like our upper atmosphere. When you turn up the voltage this lets charged particles into the tube. When you pull up the air lever this puts a little bit of air into the tube.

The charged particles are similar to the particles from solar flares from the Sun. When charged particles hit air molecules the molecules become excited. When they return to their original energy state they emit this energy as wavelengths of visible light, which we see as colour. Depending on the atoms hit and how much energy they have, different colours of light are emitted.

In the tube the air is mainly low-energy nitrogen and oxygen molecules, and the colours are mainly pinkish and purplish. However, in the northern or southern lights charged particles from the Sun can hit ionised molecules in the upper atmosphere. Just as in the exhibit we see these as glowing lights, but the ionised gases in the upper atmosphere glow green and red when they are excited. This is called the aurora (or northern and southern lights).

The aurora only happens around the North and South Poles as the magnetic field of the Earth attracts the charged particles towards them. In the exhibit you can move the charged particles and coloured lights using a magnet.