Get Me Into Orbit – Video 1 – Introduction

Hello! My name is Zara and I'm a scientist from Glasgow Science Festival. Welcome to Get Me into Orbit!

Over the next few weeks, we'll be following a journey from planet Earth into space.

Along the way, we'll meet some real-life space scientists and engineers based here in Glasgow. We'll also be doing some fun, hands-on activities in the classroom, from rocket-building to making your own satellite.

I'm super excited to get started. So, without further ado, let's go!

What is a satellite? Well, a satellite is something that orbits around something else.

Like this!

You can leave now, Tom.

You're standing on a satellite right now. Let's zoom out.

Right now, we're all standing on planet Earth. And planet Earth is orbiting the sun.

Earth moves around the sun in a roughly oval shape. It's a satellite!

How many days does it take for planet Earth to orbit the sun?

Pause the video and see if you can answer!

It takes just over 365 days - 1 year - to get around the sun! And in that time, Earth travels 584 million miles.

[singing] Well I would orbit 584 million miles and I would orbit 584 million more

So, Earth is a satellite because it orbits the sun. But does anything orbit Earth? Do we have any satellites? Hands up for yes. Hands up for no.

The answer is… yes. Here's one satellite that you might know: the moon! Can you guess how many days it takes the moon to orbit Earth? Pause the video now!

Are you ready for the answer? The moon takes around 27.3 days to orbit the Earth.

Did you know, one of the reasons we have tides in our oceans is because of the gravitational pull of the moon?

The moon also explains why there are so many werewolves running around at night. Just kidding!

Moving on…

Planet Earth and our moon are examples of natural satellites. They weren't made by humans. For the rest of this project, we're going to look at artificial satellites. Ones which humans have made, and launched into orbit.

We'll start by looking at the very first satellite made by humans to make it into orbit. Ahem. My time machine please!

The story begins in 1957. This is Sputnik 1. The first satellite made by humans to be launched into space. It was only about the size of a beach ball and it had four antenna, which transmitted radio signals that sounded like this…

[beeping noise]

Sounds like a guinea pig is sending us messages from space!

This satellite, which some people called the "baby moon", was a huge step forward for space technology. Scientists soon realised that they could use Sputnik's radio signals to figure out where Sputnik was at any one time.

"It's over there!"

They could map Sputnik's orbit.

Later on, scientists realised that not only could they use their radio receiver to figure out where Sputnik was… but they could use Sputnik to figure out where the radio receiver was. In other words, where they were.

"Sputnik, the satellite, can tell me exactly where I am. So I'll never get lost. This could come in useful…"

And it did. Let's go back to the present.

Today, the satellite navigation system is called GPS.

Ever used google maps?

The GPS receiver in your phone uses signals from 25 satellites up in space to figure out where you are.

So that little dot on your phone screen actually represents signals from space!

Why do we need so many satellites? 25 seems an awful lot. Let's pause for an activity.

GPS has lots of other uses. You can watch our GPS video to learn more.

GPS is just one example of how useful satellites can be. What else can we use them for? And how do we make them? I think it's time we spoke to a space engineer….

What are satellites for?

With me now is Dr Hina Khan, from the University of Strathclyde's Scottish Centre in Excellence in Satellite Applications

Hello Hina
Hi Zara
Thank you for coming along to Get Me into Orbit

Now, Hina, we've learned that satellites can be used for GPS but what other things can they be used for?
Well actually, lots of different things. There are a number of really good examples. One thing is actually looking at the Earth and this is called Earth Observation.

Why would we want to look at the Earth?

Well you might think that looking at the planet might be a little bit tedious but actually we can see what's happening all around the Earth and one of the biggest things is actually looking at the weather.

Hmm OK. How do satellites tell us about the weather?

Well the weather forecast uses information collected by weather satellites that monitor the climate of the Earth. And they can collect information on things like snow cover, dust clouds, ocean currents and ice caps. They can also watch the activity of volcanoes and changes in the Earth's environment like vegetation cover and the colour of our oceans.

Can you give us an example?

Yes actually. There's a number of satellites which were launched recently by the European Space Agency called the Sentinel satellites, one of which is Sentinel 5P which was launched in October 2017, just recently. Sentinel 5P is tasked with atmospheric monitoring. That means it's monitoring the air quality, ozone and surface UV and climate, all of which impact us on Earth, you've heard about global warming.

We can see some images that Sentinel 5P has taken. What are we looking at here?

These images were taken by Sentinel 5P and here we're looking at the ash and smoke from a volcano eruption in Indonesia. Using this information, we can work out the impact on the Earth and that provides us with weather warnings, and input into large climate models.

Wow, that's pretty cool! So what else can satellites be used for apart from GPS and apart from Earth Observation?

Well one of the other things is we use satellites for actually looking into space, such as space telescopes. These are telescopes that avoid the problems of using telescopes on the Earth, such as light pollution. And you can observe certain ultra violet and gamma ray frequencies that are usually blocked out by the Earth's atmosphere. An example of this would be the Hubble Space Telescope which was launched into orbit in 1990.

Seems like a long time ago.

It does!

Here is an image that we captured: the formation of newborn stars and planetary systems. It allowed us to learn about how planetary systems were created. Now, 1990 was a long time ago. More recently, in the next couple of years, we're going to be launching a new space telescope, called the James Webb Space Telescope. And it's going to be launched in 2018/2019. This is much bigger than the Hubble Space Telescope and therefore will provide us with much better image quality, with much better mirrors. So there's a lot more things that we can discover from the universe by looking using this space telescope.

It's got lots of different parts, this big new James Webb telescope. Where are these parts made? Is it true that some of it is made in Scotland?

Yes actually. So, some of the telescope pieces – it's like a jigsaw puzzle that they have to put together – each piece is designed in a different place because that's where the experts are who are able to do that. And you're right. Some of the aspects of the telescope, the mirrors in particular, are being developed here in Glasgow and over in Edinburgh. Some of the instrumentation is designed to work at huge temperatures from 235 degrees Celsius right the way down to way, way colder than what you would expect to find on Earth. Those mirrors need to be coated in a particular way and the material that we use is gold, because it doesn't react with anything, so it allows us to be able to use something which is quite stable when we have these extreme temperatures. And you'll be surprised to hear that it's a little bit like a time machine as well.

A bit like my time machine?

Possibly!

It's more like a time machine where we're looking back into space. So what's happening is that the light that's coming into the space telescope actually started a very, very long time ago. It means that we can understand what happened at the very early universe when we see the images from the space telescope.

So you could look into space into a time when say, the dinosaurs existed?

Yes absolutely, even further beyond that as well. We're looking at things maybe from 13-14 billion years ago when the universe was first created. And that allows us to understand how the universe was created and how it's going to evolve in the future.

OK so we've got GPS, Earth observation, space telescopes. Is there anything else that we can use a satellite for?

Well you mentioned GPS there. Linked to that is communications satellites. Most people have got satellite television in their houses. Most people are actually surprised to learn that the signals that are coming from their television are actually being relayed through satellites. And there are a number of satellites that orbit the earth that allow us to get that information. And without that, we wouldn't be able to watch this video or we wouldn't be able to watch things that people enjoy watching from different parts of the world.

In the future these communications networks are going to be much more important. And we're moving to a system which is called a 5G network – that is a satellite relay network – and that will allow us to communicate even further and into much more remote parts of the world.

So I could climb to the top of a mountain and still get phone signal?

Yes and it's already happening in some parts of the world, we already have that. It's something to look forward to as we move forward into the 5G network.

Fantastic. Thank you, Hina.

Thank you very much.

Let’s have a recap.

So far we’ve learned…

Satellites orbit around objects like the Earth.

The first artificial satellite to orbit Earth was Sputnik 1.

And satellites have lots of uses including Earth observation, space telescopes and communications.

Next, we’ll explore what satellites look like.

What do satellites look like?

Hina, what shapes and sizes are satellites?
They come in all different shapes and sizes.

The very first satellite was Sputnik 1, the shape of a beach ball.

But the very first Scottish satellite was called UKUBE-1 and it was a small cuboid shape. It was almost the size of shoebox. And it was called a Cubesat. And it was built here in Glasgow and launched in 2014. The company that actually built it is called Clyde Space and some of the work that I do works quite closely with them to think about the different satellites that they are developing. Some satellites are even smaller than that. We have things that are called Pocketqubes that are only about 5cm square, little boxes. And then we have Space Dust satellites as well and these can fit inside your hand. So it really depends on what you want to do with the satellites. One of the advantages of small satellites is that they take much less energy and cost significantly less than the large satellites to get into orbit. But the bigger satellites do have advantages. You can get a lot more instruments on, you can get a lot more scientific information out of the instrumentation that you can put on a large satellite. It also means that you can work more closely with some of the science research that is going on across the world.

What kind of features do satellites have?

Again, that depends on what you want to use the satellite for. There are a number of standard features that satellites need to have and you might want to think about that.

Can you guess what these feature are? What does a satellite need to work? Pause the video and have a think.

So, did you manage to guess what the different features of a satellite are? Hina, can you tell us what they are?

Well to make a satellite work, you need a number of really important parts.

So you need a radio with an antenna. The satellite will need an antenna and radio so that it can talk and send signals back from space.

You’ll also need a power supply. A satellite needs electricity to work. One way that you can generate electricity in space is to absorb energy from the sun. So many satellites have solar panels that power rechargeable batteries. There may also be single use batteries on board. We then need to have a computer. This controls what the satellite is doing. It monitors onboard systems, communicates with the Earth via the radio and stores the data as required.

The satellite also needs a pointing system. This is called the Attitude Control System. This is used to make sure the satellite is pointed in the right direction. Sensors like Sun sensors, Magnetic field sensors and Earth sensors sense the direction that the satellite is facing. Then devices like thrusters are used to change direction, a bit like a jet pack.

The next thing we need to think about is a thermal control system. It can get really hot and really cold in space. The thermal control system keeps the temperature of the satellite at a nice level.

Finally, we need to think about the structure of the satellite. satellites have a structure which holds everything together. This needs to be lightweight but strong enough so that everything can survive both at launch and whilst we are in orbit.

All satellites have the things that we've we mentioned. But depending on the Mission of the satellite, there will all be other parts that require scientific equipment to come on board.

These can include things like communications equipment, cameras, environmental monitors, telescopes… and all sorts.

Thanks Hina! So there's lots of different features that satellites will all have but then depending on what you use it for, you add these different instruments like camreas and different sensors.

Yes, absolutely.

So, we've learned what a satellite is, we've had a look at how they're used and the different features. Now it's time for you to explore satellites in the classroom.

You'll have the change to learn more about natural satellites like the moon and make your own model artificial satellite. Have a think about what you want to use your satellite for, then use the mtaerials to build one that's fit for the job. Ask your teacher to share photogrphs of your satellties with us by tweeting @GlasgowSciFest. One last thing: during the last week of Get Me into Orbit, we'll be pitching your questions to Hina and other space scientists and engineers here in Glasgow. If you have a question about satellites, space, what it's like to be a scientist or anything else on your mind, write it down and ask your teacher to send it to us by the end of the week. Have fun and I'll see you next week!