

Visuals: Space-port with city nearby

C1-Captain:

Hello passengers! This is Captain Lambert on the flight deck. Welcome to The Audio Universe Tour of the Solar System. Before we get started please listen carefully to our pre-flight information.

Sound effect: *pre flight screen sound FX*

Music: *Start Music for pre-flight video*

Visuals: Bring up a pre-flight video.

C2-Captain:

Newcastle University, the Science and Technology Facilities Council and the Royal Astronomical Society welcome you on board.

Our spacecraft is equipped with an amazing sonification machine. This device turns light into sound. For most of the tour we will use different musical instruments to represent the light from different objects in space. You will be informed when a sound is coming. Remember, sound cannot travel through the vacuum of space. Instead our marvellous device converts the light it detects into sound.

Throughout our journey, please follow all safety instructions from the crew. For now, sit back, relax, and enjoy your flight.

C3-Captain:

Before take-off we must test our sonification machine. For our first test, red and blue lights will flash outside the spacecraft. The red lights will be converted into low notes and the blue lights into high notes. Let's begin.

Sonification: *Red-blue light test*

Visuals: Have blue and red lights flash around the space-craft to match the dialogue

C4-Captain:

"That was, two red - front left"

"Two blue - front right"

"Two red - back right"

"Two blue - back left"

C5 - Captain:

First test complete. For our second test we will listen to the light reflecting from a mirror that will circle the spacecraft. I will re-tune our sonification machine to turn this light into the sound of

string instruments.

Sound effect: *Re-tuning sonification machine (long)*

Visuals: Mirror appears that has a bright light reflecting off it - this will rotate around the spacecraft to match the audio track.

C6 - Captain:

Ok, test ready. Let's begin, starting at the front.

Sonification: *Mirror orbiting test*

C7 - Captain

There it goes to the left.

At the back now.

Around to our right.

Back to the front, for one more circle.

Visuals: Remove mirror.

C8 - Captain:

We're ready to go!

Now, a place like this is not good for enjoying the wonders of the Universe. If I open the flight deck window you will hear how busy it is in the city behind us.

Sound effect:

Window opening, whilst fading in City Sounds

City Sounds

Window closing, whilst fading out City Sounds

C9 - Captain:

There are too many people around here, who are producing too much light and background noise. This makes it too difficult to study space. Our first stop will be where some astronomers have built telescopes, far from the light pollution of cities and towns.

Sit tight, we are taking off.

Music: *Flight music*

Sound effects: *Spacecraft taking off*

Visuals: Take off from space port, then flying over land/ocean eventually arriving above the Atacama desert.

N.B. Dialogue spoken over flight music when over the Atacama desert.

C10 - Captain:

We are now flying over the Atacama Desert in Chile, high up in the mountains, and well away from towns and cities. It is so dry that hardly any animals or plants can survive. This is one of the best locations in the world to enjoy the night sky and a perfect place for astronomer's telescopes.

C11 - Captain:

Prepare for landing.

Sound Effect: *Spacecraft landing*

Visuals: Landing somewhere in sight of the four main domes of the VLT.

C12 - Captain:

We are now at the European Southern Observatory's Very Large Telescope or VLT. I am hovering the spacecraft so that we get a good view.

Visuals: Begin hover sequence

C13 - Captain:

There are actually four big telescopes here. Each sitting inside a building that looks like a giant drinks can. These buildings are as tall as skyscrapers! At night they open up, allowing the astronomers to investigate space. There are no towns or cities nearby - let's open our windows.

Sound Effect:

Window opening, whilst fade in sounds of desert breeze

Sounds of desert breeze

C14 - Captain:

Just the quiet breeze of the desert.

Sound Effect:

Window closing whilst fade out sounds of desert breeze

C15 - Captain:

Now, I will land the spacecraft because we have someone very special joining us to help out on the rest of our tour.

Visuals: End hover sequence. We should be facing south, with the Sun should be high and slightly off to the left of front (to match the sunset sequence coming up)

C16 - Captain: I will open the flight deck door and let him in.

Sound effect:

Door open

Door close

A1 - Astronomer:

Hello passengers, I'm Dr Nic Bonne and I'm a blind astronomer.

I've been partially-sighted since birth but this does not stop me using telescopes to study distant galaxies. I do not have to rely on my sight to study space, I can use my other senses as well.

First of all, I want to talk to you about the Sun. Remember - it is very dangerous for *any of us* to look directly at the Sun.

C17 - Captain:

That's right Nic! I'm tuning our sonification machine into the Sun's light.

Sound effect:

Re-tuning sonification machine (long)

C18 - Captain:

Okay. The Sun's light will now sound like a steady low drone. Let's take a listen.

Sonification:

Sun-sunset-twilight sequence

N.B. Talk over sun

A2 - Astronomer:

Thanks captain.

We are facing South and it is late morning.

The Sun is up in the sky, slightly to your left towards the East.

In a moment we will speed up time to experience what happens during the day.

The Sun will seem to move in a Westerly direction and then start to get lower until sunset.

This is because our planet Earth is constantly spinning and as we get towards night-time we, here on the ground, are turning away from the Sun.

C19 - Captain:

Okay - speeding up time until sunset

N.B. we hear sun moving

Visuals: Moving to sunset, tracking dialogue/audio track

C20 – Captain

The Sun moves across the sky

Now it is over our heads

Working its way towards the West

Getting lower

and lower.

And now it has gone. The Sun has set.

N.B. we just hear low/quiet hum of twilight

Visuals: Should now be at twilight.

A3 – Astronomer:

Now is the time-of-day astronomers call twilight.

Although the sphere, or ball, of the Sun is hidden from view, some of its light is still in the sky.

The stars are *a/ways* above us but even a little bit of sunlight hides them from us.

We are going to move further into night-time until the Sun's light has completely gone and the stars will be revealed.

C21 - Captain:

Okay Nic, I'm also going to re-tune for the light of the stars.

Sound effect: *Re-tuning sonification machine (short)*

A4 - Astronomer:

The stars are like thousands of pinpricks of light spread across the blackness of the night sky.

Our sonification machine will first detect the very bright stars emerging, followed by the thousands of fainter stars that become noticeable later.

The brighter stars will be louder, and the fainter stars will be quieter.

The bluer stars, which are actually hotter, will sound as high notes and the cooler, red stars as low notes.

Here we go!

N,B. fade out twilight slowly to overlap with start of stars appearing

Sonification: *Stars appearing*

Visuals: Moving later into the night, as we hear a star, have the same star "twinkle"

C22 - Captain:

Wow! The stars are so beautiful flickering above our heads. All night long stars decorate the sky.

A5 - Astronomer:

I agree Captain! It is amazing to think that the stars are actually just other Suns so far away we cannot feel their heat.

C23 - Captain:

Now it is time to leave the Earth!

We will take off and study our planet from above. Hold tight, here we go!

Music: *Flight Music*

Sound effect: *Spacecraft ending in space*

Visuals: Leaving VLT ending up in space, whilst music and next dialogue is playing, gently float into a final position

N.B. Talking over music

C24 - Captain:

Here we are above the Earth - a giant sphere- covered by oceans, lands, towns, and cities. Home for all the people and animals we know and love. The reason everything stays on the Earth's surface is because of an invisible force called gravity. Later, we will encounter gravity in action again in our tour of the solar system.

Nic, could you explain to us why one half of the earth is lit up and the other is dark?

Visuals: Fix ourselves in one position above the Earth where we can see daytime on the left and nighttime on the right.

A6 - Astronomer:

Absolutely, you will hear the Sun is off to our left.

Sonification: *Sun tone - above earth (panned left) -*

N.B. dialogue over sune tone

A7 - Astronomer:

The sun is millions of kilometers away but so bright and hot we can feel its heat.

The half of the Earth pointing towards the Sun is lit up and feeling the daytime heat. From our position this is the left side.

The half of the Earth turned away from the Sun, currently the right side, is in darkness and is feeling the coolness of the nighttime.

The parts of the Earth that are lit up keep changing because the ball of the Earth spins constantly - one full spin each day.

Captain, please could you tune into the Earth *as well* as the Sun?

C25 - Captain:

Okay.

Sound effect: *Re-tuning sonification machine (short)*

C26 - Captain:

Let me know when you are ready.

A8 - Astronomer:

Thank you. We are going to hear sunlight bouncing off the spinning Earth. The oceans are full of reflective water acting like giant mirrors. As they pass into the sunlight you will hear a brighter sound. As the land of the continents, such as Africa and the Americas move into the sunlight you will hear a duller sound. We will also speed up time for two full spins of the Earth - that is two complete days or 48 hours. We will start with the Sun shining over the Pacific Ocean.

Okay Captain, we're ready.

Visuals: Earth spinning in sequence with the audio and dialogue - extra emphasis on the Sun's reflection

Sonification: *Earth rotation (N.B. sun still playing)*

A9 – Astronomer:

Australia and Asia are moving into the sunlight

Now Africa

The Atlantic Ocean

The Americas

And back to the Pacific for the second spin of Earth.

Visuals: Slow back down to 'regular' Earth spin (slower)

C27 - Captain:

Okay passengers, time to move to a new location so we can study our Moon

Visuals: Moving slightly further away but keeping within Earth-Moon orbit. We should end with both the Earth and the Moon in front of us and the Sun off to our left. We will be positioned such that during the sequence below the Moon will orbit behind our heads.

Sound Effect: *Spacecraft taking off*

C28 - Captain:

The Earth is currently in front of us with the Moon beyond. The Sun is still off to our left.

Nic, can you tell us about the Moon?

A10 – Astronomer:

I can! The Moon is a sphere of dry, dusty rock about 5 times smaller than our Earth. The Moon is only visible to us because sunlight bounces off it. Let's select a piccolo to convert this light into sound.

C29 - Captain:

No problem - I'll re-tune.

Sound effect: *Re-tuning sonification machine (short)*

C30 - Captain:

Okay, let's take a quick listen

Sonification: *Moon*

N.B. slightly fade Moon when Astronomer speaks

A11 - Astronomer:

Due to the force of gravity, the Moon does not float off into space, instead travelling around and around the Earth. One complete circle, called an orbit, around the Earth takes about 27 days. Roughly one month.

Captain - Let's listen to the light from both the Earth and the Moon and speed up time for two months.

C31 - Captain:

Okay Nic. We'll use a clarinet sound for the Earth and keep the piccolo sound for the Moon.

Sound effect: *Re-tuning sonification machine (short)*

C32 - Captain:

We will stay facing the Earth and hear the Moon travel behind us as it orbits around the Earth

Sonification: *Moon orbit (with Earth in front)*

Visuals: *Moon orbit sequence in time to music*

N.B. talking over Moon orbit sequence

C33 - Captain:

The Moon is to our left

Behind us

To our right

and now one more orbit.

C34 - Captain:

Time to move on. We have just enough fuel to visit the Sun and learn about the 8 planets of our Solar System. It's a *very* long way to the Sun. 150 million kilometers! If we travelled at the speed

of a jumbo jet it would take about 20 years to reach the Sun. However, we are going to speed up time and arrive there in moments. Here we go!

Music: *Flight music (continues during flight sequence)*

Visuals: *Fly to Sun.*

N.B. fade out music surind this dialogue

A12 - Astronomer:

We've arrived.

The Sun is sooo big! It would actually take one million of our Earths to fill it.

However the Sun is not empty, it is a giant ball of gasses. Mostly a gas called hydrogen, which is extremely hot - 1000s of degrees on the surface and millions of degrees in the middle.

Captain, please tune our sonification machine back into the Sun.

Visuals: *lock into a position with the Sun looking huge in front of us.*

Sound effect: *Re-tuning sonification machine (short)*

C35 - Captain:

Just to prepare you passengers, this one is going to be loud and powerful.

Sonification: *Sun-tone close up*

C36 - Captain:

Let's turn the volume down a bit so we can hear Nic tell us a bit more about the Sun.

N.B. Lower volume of Sun tone but keep playing

A13 - Astronomer:

Just like the Earth and the Moon, the Sun is a sphere. However, the reason the Sun is so hot is because, like all stars, it is a giant nuclear fusion reactor where gas particles come together, releasing extraordinary amounts of energy as light and heat. This energy is what makes the Sun a star. Planets and moons do *not* produce their own light. Let's turn up the volume again so we can appreciate the power of the Sun.

N.B.: Volume up for Sun tone for a few seconds before fading away.

A14 - Astronomer:

The Sun is so powerful that it provides us with the heat and light we need to live on Earth even though it is millions of kilometers away. Of course, the Earth is not the only planet in our Solar System.

C37 - Captain Let's turn around so that we can study the other planets.

Sound effect: *Space-craft taking off*

Visuals: Turning around so that Sun is behind us and planets of the Solar system in distance (assuming all planets are in view and not behind us)

C38 - Captain: Nic, I've kept us quietly tuned in to the Sun and I'll now tune in ready for all eight planets.

Sound effect: Re-tuning sonification machine (short)

Sonification: Sun close-up (quietly in rear speakers only)

A15 – Astronomer:

Thank you captain. The planets are millions and millions of kilometers away from here. From this distance they just seem to be tiny dots of light. However, our sonification machine can detect this light and we can use our on-board camera's hyperzoom for a closer look.

Sound effect: Hyperzoom sound

Okay. We have-tuned to a flute sound for Mercury: the closest planet to the Sun and the first of the four rocky planets.

Sonification: *Mercury*

Visuals: Planets will appear one by one during next sequence

N.B. throughout this sequence will talk over planet sound and then fade out slightly after dialogue

A16 - Astronomer: Mercury is the smallest planet in the Solar System and is a bit like the Moon. The surface is covered in craters where large space rocks have collided with the planet.

Visuals: Fade out Mercury

C39 - Captain: The second planet from the Sun is Venus. We will use an oboe sound.

Sonification: *Venus*

Visuals: Zoom-in on Venus

A17 - Astronomer:

Venus is slightly bigger than Mercury but is *very* different because it is surrounded by an atmosphere of thick clouds. This atmosphere would be very poisonous to humans and traps the Sun's heat through the Greenhouse Effect. This makes Venus the hottest planet in the Solar System. At over 400 degrees Celsius it is twice as hot as a kitchen oven!

Visuals: Fade out Venus

C40 - Captain:

Earth is next. Once again we will use a clarinet sound for our home planet.

Sonification: *Earth*

Visuals: Bring-in Earth

A18 - Astronomer:

Earth is similar in size to Venus so we chose a similar note. Earth is the only place we know where life can survive. The temperature is just right so lots of liquid water can exist - a vital ingredient to support life as we know it. Maintaining these conditions is a very delicate balance. Even slight changes in temperature could make it difficult for life to survive. We must take care of Earth!

Visuals: Fade out Earth

C41 - Captain:

Moving onto the fourth planet from the Sun and the last of the rocky planets. Mars, for which we will use a saxophone sound.

Sonification: *Mars*

Visuals: Bring-in Mars

A19 - Astronomer:

Mars is about half the size of Earth, so we used a higher note. Mars is nicknamed the red planet because of its dusty red surface. It is the only other planet that humans will visit anytime soon. Right at this moment robotic rovers are exploring its surface for signs of current or extinct life. This is a very exciting time for space exploration!

Sound effect: *Rover landing*

Visuals: Fade out Mars

C42 - Captain:

Now we move onto the gas giants! The first of these is Jupiter, we will use a powerful trombone sound.

Sonification: *Jupiter*

Visuals: Bring-in Jupiter

A20 - Astronomer:

Jupiter is by far the biggest planet in our solar system. Like all the four giant planets it is a huge ball of gas, but is still a planet because it is not producing its own light like the Sun does. Jupiter's so large that many flying space rocks are pulled onto it by gravity. These rocks might otherwise collide with Earth. Jupiter helps to protect us!

Visuals: Fade out Jupiter

C43 - Captain:

The fifth planet from the Sun is Saturn. Let's use a Euphonium sound.

Sonification: Saturn

Visuals: Bring-in Saturn

A21 - Astronomer:

Saturn is famous because of the bright rings of small rocks and ice surrounding the large central ball of gas. Like all gas giants, many many moons orbit Saturn - some small and some big. Not just one single moon like our Earth has!

Visuals: Fade out Saturn

C44 - Captain:

And for the seventh planet - Uranus – we will use a trumpet sound.

Sonification: Uranus

Visuals: Fade in Uranus, highlight side-rolling

A22 - Astronomer:

Uranus is famous for spinning on its side. Astronomers think it might have been knocked over billions of years ago due to a collision with a space rock twice the size of Earth!

Visuals: Fade out Uranus

C45 - Captain:

And finally, the eighth planet of our Solar System is Neptune- for which we'll use a french horn sound.

Sonification: Neptune

Visuals: Fade in Neptune

A23 - Astronomer: Neptune is so far away from the Sun, it is very very cold. Two hundred degrees Celsius below zero!

Visuals: Fade out Neptune

C46 - Captain:

So, there we have it! The 4 rocky planets and the 4 gas giant planets. We do not have time to visit them today, but the Solar System also contains many more objects such as asteroids and comets!

We are going to travel to a position between Mars and Jupiter, where we will enjoy all of the

planets together. Hold on tight!

Sound effect: *Space-craft taking off*

Visuals: Change position to more above Solar System so that we get a clearer view of all planet orbits.

C47 - Captain:

Now we are turned towards the Sun. We will show you how the planets orbit around the Sun. Nic, can you tell us more?

A24 - Astronomer:

Yes Captain! Planet Earth does one full orbit of the Sun in a single year, that is 365 days. The planets closer to the Sun go around much faster and the planets further away go much slower. Mercury only takes 88 Earth-days for one orbit but Neptune takes 165 Earth-years!

C48 - Captain:

We will speed up time considerably so that we can listen to all of the planets go around the Sun. After the Sun, we will add one planet at a time until we can hear all of the planets together.

Sonification: *Planet Orbit Sequence*

Visuals: When this sequence starts we want the planets orbiting at the same speed as the audio track.

C49 - Captain:

Starting with the Sun!

Adding Mercury – one orbit in just 88 Earth days

Next, boiling hot Venus

Our home the Earth – 365 days for one orbit

Mars – the red planet

Giant Jupiter

Next, ringed Saturn

Adding the side-spinning Uranus

And finally, freezing cold Neptune

C50 - Captain: Fading out now....

Wow. Our Solar system is an amazing place! But is it the only Solar System, Nic?

Visuals: Fade out down orbits

A25 - Astronomer:

No! We will now start flying, using super-spaced up time, away from the Sun and pass by other stars.

Visuals: Start flying

Sound effect: *Engine sound*

A26 - Astronomer:

Our Sun is just one of billions of stars in what we call the Milky Way galaxy, which is just one of billions of galaxies. Astronomers have already discovered other stars have their own planets orbiting them. Just think, there must be billions of planets out there. Perhaps there are others just like the Earth.

C51 - Captain:

That's amazing Nic! Let's tune our sonification machine back into the stars and appreciate just how many stars there are all around us!

Sonification: *Milky Way*

C52 - Captain:

Nic - our fuel gauges are telling me it is time to head home.

A27 - Astronomer:

Okay Captain.

C53 - Captain:

Let's Go!

Music: Flight music,

Visuals: Fly back towards Earth, on the way go via HST.

Sound effect: Sun flyby

C54 - Captain:

Hey Nic! We are passing the Hubble Space Telescope. It's floating in space!

A28 - Astronomer:

Yes, we've talked about telescopes in the desert. But we can also put telescopes in space. This telescope has been observing some of the most distant parts of the Universe and helping us understand how galaxies like our Milky Way were created!

C55 - Captain:

Okay, everyone prepare to re-enter the Earth's atmosphere. We are about land.

Visuals: Re-enter Earth's atmosphere and land back at spaceport.

Sound effect: Space-craft landing

C56 - Captain:

And we are home! On behalf of myself and Nic I would like to thank you all for joining us on our Audio Universe Tour of the Solar System. Remember, we heard about many amazing planets, but our precious Earth is the only one that we can live on – we must all take great care of it!

A29 - Astronomer:

And thank you Captain Lambert. We hope that you have all had an enjoyable journey where we did not have to rely on sight to explore space. Anybody can be a scientist if they want to be. Goodbye everyone!

C57 - Captain:

Goodbye!

Music: Credits music

Visuals: Credits

Credits (to be read out)

The Audio Universe Tour of the Solar System was brought to you by...

Rachel Lambert as the captain

Nic Bonne as himself

Chris Harrison as director

Theofanis Matsopoulos for planetarium production and 3D visualisation

James Trayford as principle sound designer

Leigh Harrison as musical director and composer

Amrit Singh as chief advisor

Steve Toase as script editor

We are also grateful for the valuable contributions from...

The Institute of Cosmology & Gravitation at the University of Portsmouth

Aishwarya Girdhar

Anita Zanella

Jeff Cooke

Phia Damsma

Garry Foran

Rubén Garcia-Benito

Miranda Jarvis

Liz Milburn

Enrique Pérez Montero

Stefania Varano

Newcastle Children's Vision Team

The VIEWS group Newcastle

and The Great North Museum: Hancock