Rising Star

A SOUTH AFRICAN ASTRONOMY JOURNEY

ENGLISH SCRIPT

TIME	FIRST SHOT OF SEQUENCE	SCRIPT	SUGGESTED PACING & STYLE
00:00	Group dancing around a fire	Humans have always looked up to the night sky and wondered at the repeating patterns of the celestial bodies. What are they, where are they from and what is their connection to us? To answer these questions, we created stories.	"Humans have…" starts at 00:19
00:41	Open dry landscape	A San legend tells the story of the origins of our galaxy, the Milky Way. A young woman waits for the hunters to return at the end of the day.	

00:57	Animated girl appears at night	As it grows dark she throws ash from the fire into the night sky. This becomes the Milky Way, and guides the hunters safely home after dark.	
01:24	Title		
01:31	Drift in deep space animation	Everything we know about the Universe comes from studying the light emitted or reflected by objects in space. By detecting and analyzing light from an object in space, astronomers can learn about its distance, motion, temperature, density and chemical composition. Initially astronomers detected only one type of light. Visible light - the type we see with our eyes, which is actually a spectrum of wavelengths, that make up the colours of the rainbow.	"Everything we…" starts at 01:38
02:18	Light travelling to Earth animation	Light travels very fast. The speed of light is about 300 thousand kilometres per second. This means that light from the sun which is 150 million kilometres away takes just over 8 minutes to get to us on Earth.	

	Light travelling to Earth animation continues	So when we look at the sun, we are actually seeing it as it was about 8 minutes ago. We are looking back in time. Most objects in the Universe are even further away, and light from the most distant galaxies can take billions of years to reach us.	
03:17	Drone over Mclean telescope, located at the South African Astronomical Observatory (SAAO) in Cape Town, South Africa	The South African Astronomical Observatory, or SAAO's, headquarters are located in the suburb of Observatory, Cape Town, where South Africa's first permanent optical telescopes were located as part of the Royal Observatory, Cape of Good Hope. Some of the historical telescopes in Cape Town are still used for outreach and public events. Every month there are talks on astronomy, guided tours of the site and stargazing. Recently, the International Astronomical Union chose SAAO to host the 'Office of Astronomy for Development' in Cape Town. Its slogan is "Astronomy for a better world" and is in line with SAAO's belief that astronomy occupies a special place among the many efforts to address development challenges. Astronomy has a unique ability to stimulate thoughts of "what is possible". It helps people understand the Universe and our place in it, as well as the fact that we and the Universe are all fundamentally connected.	"Some of the..." starts around 03:58 "Recently, the..." starts around 04:34

05:09	Ecology of area Ecology of area continues	This site is also one of the last remaining places close to the city where the original ecology of the area is preserved. It supports a wide range of plant, bird and animal life, including the endangered Western Leopard Toad. Due to increasing light and air pollution in the city, the Royal Observatory joined with the Republic Observatory in Johannesburg and Pretoria's Radcliffe Observatory and moved to Sutherland in the Karoo in 1972.	"Due to…" starts at 00:37
05:51	View of Sutherland Observatory	In Sutherland the remoteness, altitude and weather enable exceptionally dark skies.	
06:02	Drone flight over Sutherland Observatory	SAAO's main research telescopes are located at the observing site 15 kilometres from Sutherland. On a plateau, 1 800 metres above sea level stand over 20 different telescopes, some owned by South Africa and some hosted for international research institutes.	
06:37	1.9-m telescope sunrise	The oldest operational telescope in Sutherland is the 1.9metre telescope which was built between 1938 and 1948. It was previously at the Radcliffe Observatory in Pretoria where it was the biggest telescope in South Africa at the time. We're now standing inside the 1.9 metre telescope building. This telescope is a real	"We're now standing…" starts at 07:07

	Inside 1.9-m continues	workhorse where astronomers used to spend the night and perform their observations manually. Recently the telescope has undergone upgrades and additions to modernise it and allow for remote operations.	
07:34	Night time lapse over 1.9m		No voice over
07:57	Drone flight to SALT	The Southern African Large Telescope (SALT) is the largest single optical telescope in the southern hemisphere and among the largest in the world. Its sophisticated tracking system allows it to follow objects as they move across the sky, in order to maximise exposure time. The telescope has a spherical primary mirror array 11 metres across, comprising 91 individual 1-metre hexagonal mirrors.	"Its sophisticated…" starts at 08:18 (once inside SALT)
08:47	Outside view of SALT at sunset	SALT is powerful enough to observe distant details of galaxies so far away that they would be a billion times too faint to see with the unaided eye.	
08:57	Night timelapse over SALT		No voice over

09:13	End of SALT timelapse sequence	One of SALT's main functions is to record spectra of distant objects using high and low resolution spectrographs.	
09:22	Prism animation Prism animation continues	These instruments split up incoming light into separate wavelengths which can give us information about the physical attributes of the object, such as it's temperature, composition and the speed at which it travels. Visible light is just part of a broader electromagnetic spectrum. Not all radiation coming from space is just visible light. Many objects emit radiation in other parts of the electromagnetic spectrum, which our eyes cannot see. Different types of telescopes are used to detect the different types of radiation Some celestial objects give off light in a variety of wavelengths allowing astronomers a more detailed understanding of what is happening. The Crab Nebula is 6 000 light years away from Earth and is a remnant of a supernova. An exploding star that was observed in 1054 AD. These images are from X-ray, ultra-violet, optical, infrared and radio wavelengths. These separate images can be combined to give a composite image that can be adjusted to	“The Crab Nebula…” starts at 10:10 with Crab Nebula animation.

		elucidate different aspects of the nebula and how different parts of the nebula interact with each other. This is called multi-wavelength astronomy.	
11:00	Hartebeeshoek Radio Telescope	This is the Hartebeeshoek radio telescope, near Johannesburg, an impressive 26-metre diameter dish that is actively used for research. Together with the MeerKAT telescope in the Northern Cape, they comprise the South African Radio Astronomy Observatory (SARAO) Long wavelength radio waves generated in the Universe are collected with large surface area radio antennae. The MeerKAT telescope near Carnarvon combines 64 radio antennae to create the largest and most sensitive radio telescope in the Southern Hemisphere.	
11:43	Fly through space animation	MeerKAT recently produced the clearest ever view of the region around the black hole at the centre of the Milky Way galaxy. A black hole is an object that contains so much mass in such a small volume that even light cannot escape from it's strong gravitational pull.	“MeerKAT recently…” starts around 12:00

		These images are derived from X-rays while this image is a combination of the X-ray images and radio images produced by MeerKAT.	(From 12:24) Narration timed to: These images *(green/orange images)* are derived from X-rays while this image *(red image)* is a combination of the X-ray images and radio images produced by MeerKAT.
12:50	Outside MeerLICHT Telescope	Another example of multi-wavelength astronomy being conducted right here in South Africa is the combination of visible light images from the MeerLICHT telescope at Sutherland and the radio images from MeerKAT. By exclusively linking MeerLICHT to MeerKAT, we are able to, for the first time ever, provide optical multi-band observations of every night-time observation conducted by a radio telescope, ensuring that every celestial object in the field of view will be simultaneously covered in the radio and the optical. These multiwavelength observations are being used for pioneering research into transient events.	"By exclusively... " starts at 13:28 (with Sutherland landscape when text appears)
14:00	Supernova animation sequence	Transients are astronomical objects or phenomena which produce varying amounts of light, either periodically or as once-off events.	

		Transients are often supernovae, which are exploding stars that temporarily give off large amounts of light. They explode when they have burned up all their fuel and disperse elements created in their core, into the universe.	
14:49	Star nightlapse		No voice over
15:11	SALT view during day	Recently SAAO contributed to the observation of a unique transient event in the Universe.	
15:20	Drift in deep space animation	On Friday 18 August 2017 – The US-based LIGO and European-based Virgo detect gravitational shock waves in the Universe. Within hours, astronomers locate the origin of event and alert telescopes in South Africa and around the world.	Narration is now faster paced and more dramatic
15:39	Inside SALT	SALT decides to drop all other plans and goes for a difficult spectral observation of the object 130 million light-years away. SALT succeeds and produces the first spectrum of the event that shows anomalous behaviour proving that this is no run-of-the-mill transient event.	
16:20	Neutron star merger animation	By analysing the data, astronomers are able to infer that the event was caused by two neutron stars, which are very small and extremely dense,	Narration resumes initial slower pace and tone

	Neutron star merger animation continues	colliding together, creating an explosion of light called a kilonova, visible initially in the form of gamma rays. The collision also created a gravitational shock wave in space/time. This is the first time in history that gravitational waves generated by two merging neutron stars have been detected. The initial explosion of light was then followed by X-rays, ultraviolet, optical, infrared and radio waves which were also observed. The early SALT observations showed that the explosion was relatively bright and blue. Only two or three days later, further observations by SALT, SAAO and other major international telescopes showed that the light was rapidly fading and turning red, due to the dusty debris blocking the bluer light. This was the first time that gravitational and electromagnetic waves were used together to get information about a celestial event. It was like having an extra sense and provided another layer of understanding. This new form of combined observations is called Multi-messenger astronomy.	"The initial…" starts at 16:54 with colour-changing supernova animation sequence.
17:45	Asteroid scene	Events like this neutron star merger also create heavier elements in the Universe, such as gold and platinum as extreme gravity and heat fuse the atoms of lighter elements together.	

		When large stars die and explode they distribute these heavy elements into the Universe. Under the influence of gravity, the ejected matter reforms into stars and planets. This is how our solar system and Earth were formed.	
18:23	Drone flight over Sutherland Observatory	SAAO's strategy for the next decade will move the observatory into the Fourth Industrial Revolution by combining software, artificial intelligence and advanced connectivity into the African Intelligent Observatory. The optical and infrared telescopes at Sutherland will be tied together into a network that can carry out standard observations and can also respond automatically to triggers of transient events. The telescopes will all be connected to a state-of-the-art remote observing station at SAAO's headquarters in Cape Town from where astronomers can observe the Sutherland night sky.	"The optical…" starts at 18:53 with the various telescope footage
19:24	Drone flight over MeerKAT / animation	In building MeerKAT, SARAO is also preparing for one of the biggest scientific undertakings ever - the Square Kilometre Array project.	

19:41	Global SKA map	This massive global project will consist of high-frequency antennas spread out across South Africa and other African countries, and low frequency radio antennae in Australia. Global SKA efforts will be coordinated by headquarters located in Manchester in the United Kingdom. Most of the radio antennas in South Africa will be located in the Karoo outside Carnarvon and will be an extension of the MeerKAT array.	
20:16	SKA video in sky	The SKA will push the limits of engineering and scientific endeavour over the coming decades. Building the SKA will require the development of cutting edge technology and innovation, including the design of the world's fastest supercomputers to process data at rates greater than the current global internet traffic. SKA will enable astronomers to probe the universe in unprecedented detail.	
20:50	Nebula fly-through animation	The SKA will also be able to survey the entire sky much faster than any radio astronomy facility currently in existence. This giant telescope will produce science that has the power to change our understanding of the Universe. . . and our place within it.	

		So that the eternal wonder of looking up at the night sky is magnified by knowledge of its creation, composition and architecture. From its mysterious birth, expansion and fiery evolution over billions of years under the influence of gravity and physics . . .	
21:28	Cave scene	...to the knowledge of where the matter that makes up our bodies comes from. and to answer questions, . . . we haven't yet thought to ask.	
22:04	--End credits--		