**01 Motion (MMXX — I) [feat. Diplo]**

Welcome to *Under Ancient Skies*, with words by the Smithsonian's National Air and Space Museum and music by Diplo. I'm Hriskikesh Hirway.

In this program, we're going to explore the universe, and our human experience in it, around the world, throughout history, into the future, and across space and time. We'll learn about cosmological knowledge from different cultures, and how it grows and evolves. Because our understanding of the universe, like the universe itself, is always changing.

Sit back, or lie back, and consider these perspectives over the next twelve chapters.

Let's begin with the stars themselves. Consider the constellations above us—steady, seemingly unchanged, always rising to meet your gaze—like an old friend as reliable as the tides.

People in every land saw shapes in the stars and gave names to patterns overhead. They shared their stories of the sky beside the fire, around the world, and across the centuries.

But the stars, like everything in the cosmos from the subatomic to the pangalactic, are in constant motion. The stars move in relation to each other, and *we* move in relation to the stars. The Earth is spinning beneath you at a thousand miles per hour, and our solar system moves through the galaxy at hundreds of miles per second. Sit still for a moment and try to feel your world in motion.

The constellations we see evolved over eons, as we evolved alongside them. We've watched over hundreds of thousands of years, until the stars took their familiar shapes and we saw ourselves and our histories and traditions reflected in starshine. And as we move far into the future, the constellations will change with us. New shapes, new stories—for as long as we are here to see them.

**02 Distance (MMXX — II) [feat. Diplo]**

Space is vast.

Incomprehensibly vast.

There are hundreds of billions of stars in our galaxy, and trillions more galaxies across the cosmos. Each one farther than the last.

Imagining this expanse feels impossible. Our understanding is limited by the physics of spacetime, but the universe itself is limitless.

Even in the darkness between the stars, there are oceans of stars that we cannot see, each one farther than the next. Distances we cannot traverse, even in our minds.

Light itself takes millions or billions of years to travel this void. And what reaches us is a glimpse of the past.

All the way back to the beginning, when hydrogen swirled, heated, and fused, when the universe first expanded, evolved, changed, continued on. Each moment, farther than the last. All the way through time and space to where we are now, and continuing on, passed us.

Though we may only dream of traversing this distance, we are travelers within it just the same. Travelers of this unfathomable expanse. Travelers through time and space. Together in our journey through the universe. Moving forward. Never backward.

Looking up from Earth, space is vast and ancient. And the light we shine back into the void will travel for millions and billions of years, as vast and ancient to the cosmos as the cosmos is to us.

**I.**

**03 Eclipse (MMXX — III) [feat. Diplo & Mikky Ekko]**

Each day, the sun rises and sets, transitioning us between day and night. This cycle is constant, a familiarity that our bodies and our societies depend on to work, sleep, and live our lives.

But, every year or two, somewhere on Earth, the Moon blocks out the Sun, creating a few moments of near-night in the daytime.

For a few minutes during a solar eclipse, you can look at the Sun with your naked eyes and see only a wispy corona, or crown, of sunlight peeking from behind the Moon.

The Moon is 400 times closer to us than the Sun. But, by cosmic coincidence, it's also 400 times smaller. When the Moon passes between the Earth and Sun and its orbit is *just right*, the disc of the sun and the disc of the Moon align perfectly, if fleetingly--eclipse totality lasting a few minutes at most.

Total solar eclipses, while foreseeable, are rare and special--and shocking to be seen firsthand. Cultures have long created stories to explain the jarring phenomenon of the Sun's daytime disappearance.

Many of these stories are about animals or demons trying to eat the Sun. The earliest word for an eclipse in ancient China literally meant "to eat."

In West Africa, the Batammaliba people of Togo and Benin explain the phenomenon differently. They say that human anger and fighting occasionally spreads to the heavens-- and the eclipse is a fight between the Sun and the Moon. To set an example and encourage amends, people give gifts to each other and seek resolution to disputes.

To the Batammaliba, an eclipse is an opportunity for communities to come together and encourage peace--and anyone who has seen a total solar eclipse will tell you that as they occur, the world seems to stop for a moment—unified in full presence and wonder.

**04 Wanderers (MMXX — IV) [feat. Diplo]**

Look above you. Stars fill the night sky. Stretching further and further, beyond what the eye can see.  And surrounding many of those stars are planets. More than we can count. More than we'll ever know.

But there was a time, not that long ago, that we knew even less.

Stars were just stars — bright spots in the darkness, our stories and legends and ancestors mapped in shapes across the sky.

We didn't always know that beyond our home here on Earth, more and more planets spanned the universe, warmed by the light of other stars.

Ancient civilizations looked up at the sky and saw the Sun, the Moon, and five planets that at first glance seemed like stars.

But these starlike lights moved.

They seemed to be wandering across the night sky. The Greeks named them planetes — wanderers.

Ancient peoples constructed elaborate world systems to explain the planets and the stars. The Romans named these unknowable worlds for their gods and goddesses—reflections of their human experience on Earth. Jupiter, the king of the gods—steady and immense. Mercury, the god of travelers, swift and fleeting. Mars, the blood-red god of war. Golden Venus, the goddess of love and beauty. And Saturn, the titanic god of wealth and plenty.

After centuries of watching these wanderers, from towers and mountaintops, with the naked eye and eventually telescopes, we found that these planets were worlds of their own. They danced across our sky because they orbit the Sun—which helped us understand Earth's place in the solar system and our station in the heavens.

Although we were no longer the center of our little universe, our wandering neighbors—out of reach for now but so much closer than the stars around them—gave us something new. No longer the most mysterious lights in the sky, projections of our earthly human experience—now real places in the cosmos—tantalizingly close for future humans to experience.

**05 Higher (MMXX — V) [feat. Diplo]**

I breathe harder as I rise higher. The higher I go the faster I breathe.

Upward, toward the sky. Mountains surround me, neighbors now, no longer skybound. For I'm *in* the sky, halfway above what keeps us below. The air around me is thinner--and so I breathe harder. This place is high in the Atacama, chosen because it stretches into the sky. And I have chosen to climb higher.

As I climb, my breath begins to steady. The people of this place — the Atacameños, the Likan Antai — know what it is to be high. They call this the "take off place." And I do feel I have taken off. Into the deep blue of the sky, exploring worlds we couldn't see from further down. Being up so high, we connect with the sky in ways we only dreamt of before. The Plateau, Llano de Chajnantor, where people have stood and watched the sky for centuries. Getting ready to take off.

I see it now, the colors my eyes never evolved to learn. Shining down from the far reaches of space. And we are here to catch them. I breathe easier, now acclimated, and I see distant worlds being born in swirling cocoons of dust….centers of mighty galaxies, hidden from view.

I see spectrums that never reached the ground, but here I am, in a place where the Earth brought the ground to the sky.

An ancient place, a future place, a take off place.

**06 Aurora (MMXX — VI) [feat. Diplo]**

What could prepare you for seeing the colorful ribbons of the northern or southern lights glowing high in the sky above? Nothing else on Earth.

Even today, auroras seem otherworldly--impossibly ethereal in an age of satellites and space stations. But how would you react, under this sheet of dancing lights, if you had no context or explanation? With wonder? With fear? Maybe both.

Nearly all people and cultures that experienced auroras have their own stories to interpret them.

In Australia, Aboriginal peoples see the lights as fires set by ancestors or gods. The Gunai nation in southern Australia see these fires as omens of catastrophe.

In some Algonquin traditions, the northern lights are an eternal flame set by Nanahbozho, the creator of Earth, to serve as a reminder that he is always thinking of his people.

The Cree people believe that auroras--called Wawatay--were the spirits of the departed — celebrating life and communicating with the loved ones that they left behind.

The Iñupiat also see their ancestors in the dancing lights, this time playing kickball in the sky.

And in Norse traditions, the lights of the aurora are reflections from the armor of the Valkyrie, flashing in combat, or the shimmering, pulsating “Bifrost Bridge” that led fallen warriors to Valhalla.

Today we have another explanation for the sparkling light shows that draw people from around the world to gaze in wonder: solar wind crashing against Earth’s magnetosphere in a riot of color and motion.

Storms on the Sun blast particles and light into space, streaming towards Earth at high speeds. The particles create shimmering and glowing shapes as they collide with our magnetic field and then the air of the ionosphere.

This unparalleled display of cosmic color, that inspires songs and poetry, is actually the result of a violent collision of our planet and it’s cosmic environment---a reminder of the protection our home here on Earth provides, and the strange, terrible beauty of the space beyond.

**07 Entropy (MMXX — VII) [feat. Diplo]**

The stages of our lives here on Earth—birth, life, death—have informed the way we've looked at the universe over the centuries. And just as communities throughout history have their own stories for how the cosmos came to be born—most also have a concept for how it will end.

Many are cyclical—in these stories, as in our lives, the universe begins, it grows up and grows old, and it dies, making way for new life from the dust of the old. The destruction and resurrection of Earth is a recurring motif—often with flood waters that surge and recede.

The Norse foretold of an end of days called Ragnarök—where disorder and disruption consume the Earth, while a pair of wolves devour the Sun and the Moon. The stars wink out, and our now-desolate planet is subsumed by the original, primeval chaos from which it emerged at the dawn of time.

Our current scientific origin story—the Big Bang—also suggests a number of different endings. Will the big bang rebound in a big crunch?  Will the imperfect vacuum of spacetime hiccup out of existence on its way to a lower energy state?

Thermodynamics presents one possibility —  a slow, cold return to darkness over trillions of years. As the universe expands faster and faster, all of the stars will burn out, black holes will consume whatever matter remains and then evaporate over eons. And eventually the thin ether of stray particles and dim radiation will grow too cold, too dark, and too sparse for any interaction at all and the uniform temperature of the universe will approach absolute zero.

But thankfully, we won't have to worry about any of these grim scenarios. The Earth will have long since been consumed by the sun as it expands into a red giant a few billion years from now.

**08 Messengers (MMXX — VIII) [feat. Diplo & Lunice]**

Are you there?

Humans have long sought connectedness. The ability to communicate and create understanding is a core value of who we are.

The Inca believe that in the beginning, Inti, the sun god, sent Manco Capac and Mama Ocllo to Earth. Rising from the icy waters of Lake Titicaca, they founded the city of Cusco, their center of the universe.

And from that center, the Inca expanded.

They built a network of roads that stretched outward like the cosmos overhead, always growing, but always connecting back to Cusco. The Inca messengers, the chasqui, traveled these roads like streaks of light across the sky – swift and steady— message always in hand—carrying it forth, carrying it home.

When crossing a desert landscape, or traversing seemingly endless jungle. When the path is steep and the air is thinning. When it feels like we're moving in slow motion. We are still going. The Inca roads last to this day, tracing a line along the spine of the great Andes and beyond.

Centuries later, we remember the messengers that came before us. And we continue our work to connect the far corners of our universe—no matter how big it’s grown. We gild our spacecraft emissaries with sounds of Earth and maps leading back home—for whom, we don’t know. Perhaps only for ourselves. We broadcast into space that which defines us, as a species, and as a planet.

And we hope that maybe, someday, a message might find its way back to us across the icy cosmos - From centuries ago, with centuries to go.

Is there anybody out there?

We keep waiting, and we keep going.

**09 Family (MMXX — IX) [feat. Diplo & Mikky Ekko]**

The Pleiades star cluster is visible from nearly every part of the world. One of the closest star clusters to Earth, the Seven Sisters, as they're called, can be easily spotted with the naked eye, as long as you know where — and when — to look.

The night sky is incredibly important to the peoples of Aboriginal Australia, woven into the fabric of their daily life. And so, just as different communities developed their own languages and customs, they also developed astronomies and cosmologies — passed on from generation to generation.

Across the continent, it is believed that the sky above is a vast and lively dwelling place for their heroes and ancestral spirits. There are enormous variations in Aboriginal Australian cosmologies — with different parts of the night sky holding significance for different communities.

But they nearly all agree on the Seven Sisters.

People hundreds or thousands of miles apart looked up at the curious cluster of stars, some shining brighter than the rest, and told stories to explain the phenomenon. Many of these narratives, developed separately, are rooted in the same idea:

Seven sisters, traveling together, avoiding the unwanted advances of a man.

The Pleiades are almost always viewed as a group of related ancestral women. Sometimes seven running together, or six protecting a younger sibling. The celestial objects representing the man in pursuit of the Seven Sisters varies across Aboriginal cultures — Orion, the Moon, the bright star Canopus, Venus.

But it is striking that these peoples, living their own lives in their own communities, looked to the same patch of night sky, and told nearly the same story.

It's almost as if you can tell just by looking that this grouping of stars are gravitationally bound to one another in such a way that could only make them, family.

**10 Falling (MMXX — X) [feat. Diplo & Good Times Ahead]**

Late on a dark night, if you look long enough, you might see a flash of light *streak* across the starry sky. These meteors are often no bigger than a grain of sand--and the journey to Earth may take eons.

Scale often tricks us in space. A meteoroid can travel for millions of years and millions of miles without anything disrupting its path. In the vastness of space, speed and distance are almost imperceptible.

Gradually and then suddenly -- everything changes.

Slamming into the atmosphere at a velocity magnitudes faster than anything on Earth, this metallic meteor is overwhelmed by gravity. Falling, burning, melting, overcome with heat and pressure, our extraterrestrial object streaks the night sky and continues to fall until it finds the ground in shifting desert sands near a sea later called the Mediterranean--its cosmic journey at an end, a terrestrial journey just beginning.

To the ancient Egyptians, meteoritic iron was more precious than gold — most weapons in the Nile Valley were made from copper or bronze. Meteorites like the one found west of Alexandria were fashioned into prized pieces, suitable for Kings.

Nineteen iron objects were found in the tomb of King Tutankhamun, most of them small and crudely worked--but one, the largest and most finely made, was found on the King's person inside his funerary wrappings--a dagger, perhaps passed down from his father and grandfather as a symbol of kingship and kinship. It had a gold and crystal handle and a blade made of "Bia-n-pet," "iron from the sky."

**11 Elemental (MMXX — XI) [feat. Diplo]**

It's been said that "we are all made of star stuff"--and that's true. Almost all of the chemical elements in the universe were created in stellar crucibles of nuclear fusion and gravitational pressure. Lighter elements like primordial hydrogen and helium fuse into heavier, more complex elements as a star ages and dies.

For stars like our sun, elements like carbon and oxygen form after billions of years, making their way out into the universe as the star ejects its outer layers until only a celestial cinder remains.

For stars larger than our sun, the nucleosynthesis continues until iron and nickel are created—followed by the cataclysm of a supernova.

That's the same oxygen you're breathing right now. Produced in the furnace of faraway suns billions of years ago, oxygen is the catalyst *you* use to burn fuel and produce energy. And that oxygen is being carried through your body right now by iron forged in the death throes of other ancient suns.

From the heat and haze of the Big Bang, to billions of years of stellar and biological evolution, the universe has developed increasingly elegant and complex processes leading to…you.

We are made of star stuff, but it's not just your constituent atoms—it's your breath and your blood.

**12 Gravity (MMXX — XII) [feat. Diplo & Rhye]**

We live in a gravity well. Feel the weight pulling on your limbs –-that's something special. That's the sensation of the entire Earth warping spacetime around you.

*Oh you're moving inside me so softly*
*Oh you're dancing inside me so softly*
*Feel all this warmth come into me*
*So many ways reframe*

*Rain in my house you follow*
*Give me yours, give me some*

*Faith in something new*
*Ohh Faith in something new*
*Ohh Faith in something new*
*Ohh Faith in something new*

Gravity is the exception and the rule, giving order and substance to everywhere that's somewhere in the universe, islands of stability in an ink-black ocean

*Don't look away so fragile*
*Come into me*
*So many ways you're fragile*
*Come into me*
*Give that space shadow and haze*
*Fill up these days so softly*
*Send me your breath so slowly*
*Give me love, give me yours, give me warmth*

*Faith in something new*
*Ohh Faith in something new*
*Ohh Faith in something new*
*Ohh Faith in something new*

Gravity defines the ground beneath from the sky above. It gives us a place to make our stand in a wild and wonderous universe that dances and turns in every direction.

Gravity keeps us grounded and centered, and invites our gaze up to dream and find faith…in ancient skies.