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PASSPORT TO THE UNIVERSE

By Ann Druyan and Steven Soter, 15 February 2000

MAIN SHOW

1. PRE-FLIGHT CHECK-LIST

"This is Tom Hanks. Welcome."

"There are times in each of our lives when it first dawns on us that we are not the center of the universe; That we are part of something larger than ourselves. We are living in the golden age of astronomy. We are mapping the grand structure of the universe; finding our place in its great story. We are becoming citizens of the cosmos."

"What you are about to see is not an artist's fantasy, but a three-dimensional map of the *real* universe."

"Before we begin our journey, I need to run through a pre-flight checklist."

"Planet program: Solar system orbits, planets, moons and rings, check."

"Star program: Local star positions, colors and magnitudes, check."

"Galaxy program: Milky Way and galactic coordinates, gas and dust nebulas, check."

"Universe program: Local Group of galaxies, Virgo Supercluster, check."

"Late breaking astronomical images, check."

"OK, we're ready to roll."

2. THE ZEISS SKY

"In the time before electricity, in a world lit only by fire, *this* was the sky that everyone knew. Back then, on a clear moonless night, it was *always* dark enough to see the faint band of the Milky Way arcing across the sky."

"For a thousand generations, our ancestors looked at the night sky and wondered what it was. The sky *looked* like the inside of an enormous bowl, slowly turning around an Earth believed to be at its center. The stars were like tiny points of light stuck to the inside of the bowl, and not so very far away. The ancient sky seemed *two dimensional*.

"Our ancestors imagined that the stars formed pictures in the sky. They named these constellations after mythical creatures and heros."

"But what *were* the stars, really? What was the Milky Way? For that matter, what was the *Earth*? And *where* was it? We had no way to know, until we devised the methods and tools of science."

3. TELESCOPES

"Because our eyes are very small and the stars are far away, at best we can only see a few thousand of them, even on the darkest night."

"But for every star we *can* see with the unaided eye, the night hides fifty million others, in our Milky Way Galaxy alone.

"Using telescopes, we discovered that the sky has a *third* dimension – depth – and that the universe is far grander than *anyone* could have imagined."

4. THE COSMIC ADDRESS

"During the last four hundred years, in a series of astonishing discoveries, we filled out our Cosmic Address. We learned that, far from being the center of the universe, the Earth is actually but one of the planets, moving in orbit around the Sun. Our Sun in turn is just an ordinary star. It is one of over a hundred billion stars in our Milky Way Galaxy. And our Milky Way Galaxy is one of several thousand galaxies in the Virgo Supercluster. Finally, this vast supercluster of galaxies is but a tiny part of the Observable Universe."

5. FROM EARTH TO SATURN

"Using telescopes and the laws of physics, we are mapping the universe in three dimensions. And once you have a map . . ."

". . . you can know where you are . . ."

". . . and, where you're going."

"That's Mars -- after the Earth, the next planet out from the Sun."

"The gas giant planet Jupiter is heavier than all the other planets put together. Its Great Red Spot is a storm that has raged for centuries. Each of its big moons is an unexplored world in its own right. One of them, Io, has volcanic eruptions at all times. Another, Europa, has a deep ocean of water hidden beneath an icy crust."

"The planet Saturn has hundreds of thin rings made of countless orbiting snowballs."

"With our computer on interplanetary drive, we've come this far in only a minute. Our fastest spacecraft actually take years."

6. PALE BLUE DOT

"We've come a long way." "Can you find the Earth?"

"It's so small we can hardly see it from here."

"It's that one -- the pale blue dot. That's *home*. Everyone you ever knew -- or ever heard of -- came from that tiny spot . . ."

"Seeing it like that always gets to me."

"The planets of the solar system are huddled close to the Sun, like campers around a fire in a vast cold and dark plain."

"From out here, it's obvious that our mighty Sun is just another star. But the familiar constellations still look the same . . . because even at this distance from Earth, the stars are still *enormously* far away."

7. SET-UP INTERSTELLAR FLIGHT

"Connect the dots and there's Orion the Hunter. The three stars in the belt make this constellation easy to find in the winter sky. Below Orion's belt you can see a faint wispy cloud."

"It doesn't look like much because it's so far away, but just wait."

"The stars are *millions* of times farther away than the planets. To move among the stars, we'll have to shift to the *interstellar* drive."

8. FLIGHT TO ORION

"As we move out into our Galaxy, the old two-dimensional patterns vanish, because the starry sky is *three* dimensional."

"We're heading for the Orion Nebula, about fifteen hundred light years from the Earth."

9. ORION NEBULA TOUR

"The Orion Nebula is a recycling center for the stars of the Milky Way, a vast interstellar cloud of gas and dust, a place where stars are born. We're entering a virtual landscape of the nebula, assembled from observations with the Hubble Space Telescope. No one has ever seen the Orion Nebula like *this* before."

"The brightest stars illuminate the surface of the nebula from which they were born."

"Our solar system was made in a place like this -- a stellar nursery. That was a long time ago, of course, nearly five billion years, but it must have looked pretty much the same."

"Each of these teardrop-shaped clouds is a blanket of gas and dust swaddling a newborn star and perhaps a family of growing planets."

"And what does all this have to do with us?"

"Take a deep breath . . . No, I'm serious. Really, everybody, do it."

"Every atom of oxygen you just inhaled was made deep inside a star. The carbon in our muscles, the calcium in our bones, the iron in our blood -- in fact all the heavy elements -- were cooked in the hearts of stars. As Carl Sagan said, we are starstuff."

10. PULL OUT FROM GALAXY

"Stars are born in batches -- with dozens in every litter. The sibling stars of our Sun are now spread throughout the spiral arms of the Milky Way galaxy."

"As we leave our Galaxy, the individual stars appear to blend together."

11. LOOK BACK AT OUR GALAXY

"Our Milky Way is really a vast spiral galaxy -- a congregation of hundreds of billions of suns. But you have to get out *here*, outside the galaxy, to see the whole thing. We've never had this view before."

"Remember back on Earth, where we could only see a few thousand stars?"

"Well, *all* of them lie within that tiny part of the Galaxy."

12. THE VIRGO SUPERCLUSTER

"Every one of those spots isn't a star, but a whole *galaxy* with billions of stars."

"We're now in *intergalactic* drive, moving through virtual space at *millions* of light-years per second.

"That's the Andromeda Galaxy, our nearest neighboring spiral galaxy. It's the largest member of the so-called Local Group -- a collection of a few dozen galaxies."

"Our Local Group is a small part of the Virgo Supercluster -- a vast gathering of several *thousand* galaxies."

"From out here, it's hard to spot our own Milky Way Galaxy".

"Well, it's *that* one. That's home."

13. LARGE SCALE STRUCTURE

"Our supercluster of galaxies is only a tiny part of the Observable Universe. On the largest scale we can see, the superclusters form the knots of a tangled network or web. The brightest knots are entire superclusters of thousands of galaxies, with each galaxy containing billions of suns."

"This is the last line of our Cosmic Address . . . for now, anyway . . ."

"We may be just little guys, living on a speck of dust. But we don't think small. We managed to figure this much out."

"And we're still figuring . . . there are about a hundred billion galaxies in the universe we can see. But there are parts we *can't* see."

"And -- who knows? -- it may be that *all this*, the entire *observable* universe, is one tiny bubble in an *infinite* universe hidden beyond our cosmic horizon."

"It's time to be heading back. Let's see if we can find a black hole around here somewhere . . ."

14. BLACK HOLE PLUNGE

"Black holes are places where gravity is so strong that not even light can get out. Some theories imagine that they provide short-cuts to connect distant parts of the universe. No one knows what it might look like inside, so we're free to imagine it."

15. RETURN TO EARTH

"Well, we got off in the right neighborhood."

16. CONCLUSION

"Welcome home, fellow citizens of the cosmos."

"Your passports are now good *everywhere* in the universe . . . among the planets of our solar system, the stars of our Milky Way galaxy, the other galaxies of our Supercluster, and on out to our cosmic horizon."

"Next time you look up at the clear night sky, remember . . ."

". . . you, me, and everybody -- we are starstuff. We are in the universe, and the universe is *in us*."

"In the deepest sense, we are citizens of the cosmos."

THE END