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Destiny In Space

By Toni Myers

In the Milky Way galaxy,
circling a star called the Sun ...
is a small planet inhabited
by intelligent life.
Earthlings have always been
curious creatures.
Even as we discovered our own world,
we dreamed of exploring others.
Perhaps other beings inhabit
planets around distant stars.
If they are sending signals ...
we could detect them with this
powerful radio telescope ...
and maybe send a signal
back across the cosmos.
But might we ourselves
leave our home on Earth ...
to explore new worlds?
We have already taken the first
small steps outside our planet.
We designed this shuttlecraft to
carry people and cargo up into orbit.
Here, far above the
Earth's atmosphere ...
we're learning how to
live and work in space.
You've got a go to
maneuver the orbiter.
It's doing nose sweep, going
towards the starboard side.
The exterior shows just a little
of the expected wear and tear ...
of many trips back and forth.
The shuttle is equipped
with a robotic arm ...
to move large payloads
ferried up from Earth.
Houston, do we have
a go for maneuver?
It has lifted from the cargo bay ...
a spacecraft which carries
a German telescope named ORFEUS ...
and a remotely operated
IMAX camera.

Through its lens, we are
seeing as never before ...
the exterior of the shuttle
as it orbits the Earth.
Discovery, Houston.
You have a go for release.
Copy that.
Now the ORFEUS telescope
has been released into orbit.
We are riding with it,
floating free in space.
Beneath us the shuttle pulls
away, its cargo bay empty.
ORFEUS will spend several days ...
observing the hottest and
coldest gases in our galaxy.
Then the shuttle will
take it back to Earth.
Over three decades, we've learned how
to travel back and forth to space ...
and live in low Earth orbit.
Now that we have taken these
first steps, are we ready ...
to cross the great black void to explore
the other worlds in our solar system?
The journey will be hundreds of times
farther than any we have ever undertaken.
First, we need to understand
how we adapt to weightlessness.
The nine hours of work
scheduled for the blue shift ...
one and a half hour for green.
Connected by tunnel to the crew cabin,
a laboratory known as Spacelab ...
is carried in the cargo bay
on certain flights.
Inside it, scientists are
performing experiments ...
developed by 13 different countries.
Two medical doctors, Norm Thagard
and Roberta Bondar, a Canadian ...
are studying how our
sensory systems behave ...
when introduced to microgravity.

More than half the astronauts
experience space motion sickness ...
the first day or two.
We're getting one
last calibration, Dave.
German payload specialist Ulf Merbold
is conducting an experiment ...
to find out more
about how it happens.
I've got vection.
The subject sees one thing,
but he feels another.
His brain is confused by
these conflicting messages ...
and he becomes disoriented.
Is the spacecraft rotating ...
or are we?
While Roberta spins, a tiny
camera inside her helmet ...
is recording the movements of her
eye as it reacts to the motion.
Data are collected at mid-flight,
then again near its end.
When the results are compared ...
it becomes clear that the more
time people spend in space ...
the more they rely on the visual
sense alone for orientation.
But these results tell us only about
how we adapt in the short term.
Spores three goes to centrifuge 204.
Make sure it says spore 31G.
Spores Which one?
To find out how we're
affected by longer stays ...
people must live continuously
in a space station.
There, we could learn how to maintain
a closed life-support system ...
for months or years at a time.
One more. Interesting.
Recycling is a must.
Future astronauts will be
accomplished gardeners.

They will tend
small farms in space ...
like this hydroponic garden
at the Kennedy Space Center ...
that uses recycled water
and oxygen to grow food.
The plants must be kept
free of contamination.
Halfway to another planet,
a crop failure would be a disaster.
A hundred and eighty reps left.
Keeping fit is another challenge.
With no body weight to support,
our muscles get weaker.
Bones become brittle.
The longer we stay,
the worse the problems become.
Hey, Bobby! Come on up here.
We're going by Canada.
People traveling to other planets ...
will spend years living
in a very confined space.
What kinds of emotional
stress will we face?
Will we get homesick, so far
from everything we know ...
isolated from family and friends
and the familiar comforts of home?
There she is, John.
Don't run into our home.
Our first journeys to another
world were to our nearby Moon.
Tranquility Base, Houston.
You are cleared for takeoff.
But those round trips
took barely a week.
Today, on the Mir station ...
Russian cosmonauts live
in space for many months.
From time to time, new crews arrive
from Earth in the Soyuz craft.
Now, after almost a year in orbit ...
the cosmonauts will
return home in Soyuz.

And even though they've spent up
to six hours exercising each day ...
when re-exposed to Earth's gravity,
they are temporarily unable to stand up.
Imagine arriving on an alien
planet in this condition.
But what if we could produce
an artificial gravity ...
as we travel to our destination?
In 1968, Stanley Kubrick's
classic film ...
featured spaceship designs
which would allow us to do this.
As the ship spins around,
anyone inside ...
feels an outward, or centrifugal,
force that acts like gravity.
In another design, parts of the
ship spin around a stationary hub.
But the rotation of
a small spacecraft ...
could make the occupants
disoriented or sick.
We could avoid this ...
if we built a spacecraft large
enough and with a slower spin.
But it would have to be about as
long as the Golden Gate Bridge.
How could we build such
a large ship in space?
To get to Mars, for instance ...
we might design a spacecraft
with two modules ...
one attached to each end of
a very long cable, or tether.
Once underway, the tether would be
extended to separate the two modules.
The whole assembly, rotating
about once per minute ...
could provide the
synthetic gravity needed.
But until recently, tethers
were merely an elegant idea.
The concept would have to be tested.

So far we have good
satellite stability.
So an experiment was flown
on the space shuttle.
An Italian satellite was deployed
on a very long tether.
The crew was then to retrieve it.
Let's do it like we simmed it.
You're gonna keep the tether
under control, right? Okay.
At first, the tether behaved
exactly as predicted.
- You don't want to yank on the
satellite. - You've got good tension.
And the Rdot is just oscillating
a little bit, but it's based at zero.
- Slack tether.
- Wait a minute.
But then the reel jammed
and the tether went slack.
Houston, we have slack tether.
Ldot has stopped.
By firing jets on both the
orbiter and the satellite ...
the crew learned that they
could tighten it once again ...
showing that we can
control tethers in space.
Tether's under control.
Unexpected snags
are bound to arise.
But we learn from them
and keep moving forward.
To build more reliable spacecraft,
we need light but tough materials.
To test them, in 1984
we launched a satellite ...
with dozens of materials
attached to its surface ...
exposing them to the
wear and tear of space.
Columbia, Houston.
We have a tally-ho on LDEF.
We left it in orbit for six years,

long enough for an interplanetary trip.
Ready to go get it?
Then the shuttle retrieved it
and took it back to Earth.
We found a wealth of information
embedded in these panels.
Splatters.
As the microscopes reveal ...
the vacuum of space
is anything but empty.
This pattern, I don't
know what this is.
A continuous bombardment
of micrometeorites ...
pitted the surfaces with craters.
But the most serious hazard
in space is radiation.
As the shuttle hangs suspended
above the Earth's horizon ...
we see only the lights of
its cargo bay in the darkness.
But we can't see the harmful cosmic
radiation that is everywhere here.
High-energy charged particles ...
are streaming out from
the Sun and other stars.
On Earth, we are protected
by the atmosphere ...
and the surrounding
magnetic field.
In space, the radiation can
penetrate the walls of our craft.
A Japanese x-ray satellite reveals
vast clouds of radiation ...
erupting from the Sun.
On interplanetary trips ...
we'll have to retreat to
heavily shielded onboard shelters ...
whenever solar storms are sighted.
Most of the planets are too
hostile for people to visit.
But that doesn't stop us
from exploring them.
Okay, understand. We have a go

for deploy, so we're starting out.
Five, four, three ...
two, one, mark.
- Do we have motion?
- I see motion.
It's stable? It's clear of the ASE.
Where humans cannot safely go ...
we send remotely controlled
robot explorers.
Commanding them from Earth ...
we use their electronic eyes and sensors
to explore the alien landscape.
In 1989, the Galileo spacecraft ...
began a five-year journey to Jupiter ...
the largest planet
in our solar system.
Galileo just kind of dissolves
out into nothingness ...
as it goes into the
darkness of space.
And that's the last we saw of it.
Early images of Jupiter were
sent back to Earth in 1979 ...
by two robot probes named Voyager.
This was our first opportunity
to marvel at its Great Red Spot ...
three times the size of Earth.
The molecular building
blocks for life ...
may be swirling within Jupiter's
turbulent atmosphere.
If Galileo's probe confirms this ...
we should gain new insights
into the origins of life.
Though it is our nearest planetary
neighbor, Venus was always a mystery.
Thick cloud layers blocked
our view of its surface.
Then we sent a spacecraft
named Magellan to orbit the planet.
Its radar eyes could see
through the clouds.
Magellan collected so much data ...
that we can now explore the surface

as if we were actually there.
We begin 60,000 feet up.
To help scientists
recognize its features ...
a computer has exaggerated the
height of the terrain 10 times.
Perhaps these pancake domes ...
were caused by lava pushing through
weak spots in the surface.
These craters, some the
size of Connecticut ...
were made by collisions
with comets and asteroids.
On Earth, ancient craters like these
have been eroded by wind and water.
But there is little
wind and no water here.
Venus swelters beneath a thick
atmosphere of carbon dioxide ...
which acts like a greenhouse:
It allows sunlight to filter in,
but then traps the heat inside.
The surface temperature
is hot enough to melt lead.
In the distance, the great
Gula Mons volcano.
We are now soaring more than
The long, smooth strips
that now and then cross our path ...
are small portions of the surface
that Magellan's radar did not scan.
The Magellan craft has shown us the
fantastic surface of an alien planet ...
where no human could
ever hope to land.
But there is another world in our
solar system that people can visit.
Future generations of explorers
will walk upon Mars.
Do you know what that is?
To prepare the way for them,
we could send a robot like this ...
to scout a landing site.
We might dispatch a whole flock of

these helpers to explore the terrain.
Unlike us, they are almost
immune to radiation ...
and need no air or water.
And they never get homesick.
Robots like this
Russian Mars rover ...
being tested in
Death Valley, California ...
have already been programmed
for difficult tasks ...
like negotiating rugged terrain.
More elaborate versions could
help us construct a Mars base.
But operating them
will be a challenge.
At the speed of light,
a single command ...
takes up to 20 minutes to
travel from Earth to Mars.
If there is or ever has been life
somewhere else in the solar system ...
Mars is a good place
to look for traces.
A great rift valley splits
open the Martian plain.
It is as long as the
entire United States.
We are now descending
from 40,000 feet ...
into a part of the valley
known as Candor Chasma.
It is five times deeper than
the Earth's Grand Canyon.
The height of the terrain
has not been exaggerated.
This is how it really looks.
Life as we know it must
have liquid water to develop.
Water may have flowed
through these canyons long ago.
Perhaps it nourished life.
Fossil life forms may lie exposed
on the floor of these canyons.

If we find any, it would
be our first proof ...
that life has existed beyond Earth.
It would mean that life
probably is abundant in our galaxy ...
and awaiting discovery
in the universe beyond.
Today, Mars is a frozen world.
The average temperature here is
lower than at the Earth's South Pole.
But long ago, when water
may have flowed here ...
it must have been warmer.
We don't know
why Mars turned so cold ...
but perhaps it could be made
to change once again.
Could future generations
somehow transform Mars ...
into an Earth-like world
where people could live?
To do it, we might imagine some-
how raising the temperature ...
to build up the atmosphere
and melt the ice caps.
This would create
lakes and rivers.
Then we could introduce plants
to fill the air with oxygen.
Animals and people
could now breathe the air.
A new world might be ready
for us to colonize.
What would life be like on Mars?
Perhaps we could
build farms and cities.
Or perhaps we will leave
Mars as we found it.
Those decisions will be
made by our descendants.
If terraforming is even possible,
it would take thousands of years.
By then, we may have
left our solar system ...

to explore the stars beyond.
Though it would take about 100,000 years
to reach them with present technology ...
future generations
may travel faster.
For the present, we must use
telescopes to explore the stars.
Now, we are about to
launch into space ...
an instrument that will allow us to look
to the farthest reaches of the universe ...
and back in time almost to its birth.
One more foot.
This is the Hubble Space Telescope.
Keep coming.
Once in orbit above the
shimmer of Earth's atmosphere ...
it will see 10 times farther
than telescopes on the ground.
And down.
Astronauts Kathy Sullivan,
Loren Shriver and Bruce McCandless ...
have come here to the Lockheed
Vehicle Assembly facility ...
for a final inspection.
That's the socket in the MLI
that you put the pre-load tool in ...
once you've got the door open ...
and just crank it over center
so it'll stay open.
Hello, hello, hello. Howdy.
Morning.
Family and friends gather for the
launch at the Kennedy Space Center.
Among them is Dr. Lyman Spitzer ...
who first proposed the idea
for a space telescope in 1946.
This is a tremendous
milestone today for me.
Very exciting, very exciting.
I suggested a telescope of this general
nature would be very helpful to astronomy.
And the idea finally took
hold among astronomers ...

and then among other people
and finally, even in Congress.
And off it goes.
T-minus 10, go for main engine start.
We are go for main engine start.
Five, four, three, two, one ....
And lift-off of the
space shuttle Discovery.
Once Hubble is deployed ...
astronomers on the ground
will be able to direct its eye ...
to any region of the universe
they wish to observe.
- Give you a payload ID of one.
- Discovery, we'd like you to go free drift.
While pilot Charlie Bolden, on the left,
maintains the shuttle's precise position ...
astronomer Steve Hawley
prepares to perform the deployment.
Discovery, go for Hubble release.
Hawley releases the telescope.
Then, very slowly and carefully ...
retracts the arm.
The sky and sea of Earth,
reflected in its door ...
the Hubble Space Telescope ...
the creation of 10,000 people,
is launched at last.
It will remain here for many years,
sending images back to Earth.
Shuttle crews will visit Hubble
on regular service calls ...
to replace and upgrade its parts.
Yeah, it looks good.
I don't see any
motion at all in there.
Hubble is open for business.
I wish you guys had been here to see
it, because you'll never believe it.
Well, superb is an understatement.
Residuals were at .02 and .01.
The telescope would reveal
objects in detail ...
never before seen.

But there was a problem:
A flaw was found in the shape
of the telescope's primary mirror.
A repair would be necessary.
As part of the
regular service call ...
another crew would make
the repairs three years later.
Endeavour, you've got
a go for capture.
First, the crew would have
to recapture the telescope.
Houston, Endeavour, the right-hand
solar array, as we can see it, is ....
One side of it is bent way over,
so clearly we have a dynamic situation.
There's a problem with one
of the solar panels ...
that provide electrical
power to the telescope.
Looks like the outer bi-stem
has a kink in it and is twisted ...
there at the kink.
Once the telescope is
secured in the cargo bay ...
the astronauts will move outside
for a closer inspection.
So begins the most ambitious
and difficult service mission ...
ever attempted.
Payload commander Story Musgrave
and astronomer Jeff Hoffman ...
are both veteran spacewalkers.
Story is not built
like the rest of us.
Most of us just float under the hut,
and Story has to screw himself in.
If you're a person that gets claustrophobia,
this is not the business you wanna get into.
They'll depressurize
here in the airlock ...
then go to work.
It had been planned that the
crew replace the solar panels ...

as part of the regular service.
But now, the twisted panel cannot
be safely stowed in the cargo bay.
They have no choice but
to throw it overboard.
Mission Specialist
Kathy Thornton will do it.
- Okay, they say you've got a
go for release. - Okay, no hands.
Such a large object floating in space
can pose a hazard to other spacecraft.
So bursts from the
shuttle jets are fired ...
directly at the solar panel
to make it spin.
The motion will speed up its descent
to the Earth's atmosphere ...
where it will burn up.
There it goes.
Almost like a bird. Look at it.
It's quite a sight.
Now, work on the
telescope can resume.
Okay, coming straight on up.
Looking real good. I'm gonna let go.
Okay, take me away.
Just come right up easy,
just like you're doing.
Bring the forward up a little more.
It's difficult to maneuver bodies
and equipment unassisted.
The repair of the telescope
would be almost impossible ...
without the help
of the shuttle's arm.
It is controlled from inside by
Swiss astronaut Claude Nicollier ...
while Ken Bowersox,
the pilot, acts as lookout.
Just keep coming up, Claude.
- Stop. Stop.
- Brake's on.
I'm not even pulling it, I'm just
coaxing it with my fingertips.

The new wide-field planetary camera
will tell us more about the size ...
of the universe and how
rapidly it is expanding.
Here we go.
The crew lifts it
up with great care.
The tiniest bump could
damage its delicate parts.
The astronaut teams
alternate each day ...
spending up to six hours
in the cold vacuum outside.
Okay, I'm gonna slip over. You've
got another foot to keep coming up.
Keep coming up.
Coming up. Coming up.
All of their tools must be
tethered to the workstation ...
to keep them from floating
off into space.
Endeavour, Houston for Story.
You've got a go to open the doors.
Okay. Swing it.
After five days of intensive work
and many dazzling accomplishments ...
the astronauts are now ready to install
the critical corrective-optics package.
It's a kind of contact lens ...
designed to bring Hubble's
giant eye into focus.
Pitch up a little.
If it succeeds ...
we will be able to look
back to the edge of time.
Good work, guys.
The service and repair
are now complete.
The mission drew upon
every skill we have learned ...
throughout three decades
of work in space.
Whether repairing a telescope,
assembling a space station ...

or building a base
on a distant planet ...
we must rely upon the teamwork
of humans and machines ...
if we are to succeed in this challenging
new environment away from Earth.
Endeavour, you've
got a go for release.
The Cape of Good Hope beneath it ...
the space telescope is now poised
to begin a new era of exploration.
One of the astonishing discoveries ...
is a first close look at an
enormous and very unstable star ...
we call Eta Carinae.
Four million times more
luminous than our Sun ...
its last outburst was seen in 1841.
And now Hubble reveals that it has
blown two massive clouds into space.
The clouds contain the heavy elements
essential for the creation of life.
Now, in the heart
of the Orion Nebula ...
Hubble reveals a stellar nursery.
Gas and dust are condensing
here to create new stars.
And even more astounding ...
new planets are being born.
Never before seen, the dark material
appears to be a new solar system ...
forming around a young sun.
Hubble has now provided evidence
that planets are common in the universe.
Life may be widespread among them.
Perhaps we will hear a signal.
Our curiosity and
our need to progress ...
compel us to move outward ...
to explore the worlds
of our solar system ...
our galaxy, and the
universe beyond.
The distances are vast,

the voyage hazardous ...
the destination daunting.
Still, we choose to explore.
What we discover ...
will shape our destiny in space.