THIS IS A PAYLOAD THAT'S GONNA BE ON THE JEM XPOSED MODULE, SO IT'S HANGIN' ON THE OUTSIDE OF THE ISS LOOKIN' DOWN AT THE EARTH.

AND WHAT ARE WE DOING? WE'RE TRYING TO MEASURE ATMOSPHERIC CARBON DIOXIDE.

PLANTS ARE ACTUALLY DOING US A HUGE FAVOR.

THOSE PLANTS IN THE OCEAN TAKE ABOUT HALF OF
THE ATMOSPHERIC CARBON DIOXIDE THAT HUMANS EMIT OUT EVERY YEAR.

BUT SOME YEARS IT'S 20%.

SOME YEARS IT'S 80%, AND WE'VE GOTTA FIGURE OUT WHY THAT IS.

SO OCO-2 HAS STARTED COLLECTING ATMOSPHERIC CARBON DIOXIDE DATA.

WE'VE BEEN DOING THAT SINCE 2014.

OCO-3 IS MEANT TO CONTINUE THAT RECORD OF CARBON DIOXIDE, AND BUILD ONTO WHAT OCO-2 STARTED.
BUT BEING ON THE SPACE STATION
IS A LITTLE BIT DIFFERENT.
YOU KNOW IT’S IN
THIS PRECESSING ORBIT.
EVERY DAY IT GOES OVER YOUR HEAD
A LITTLE BIT EARLIER IN THE DAY.
WE’LL HAVE THESE DETAILED
LITTLE SNAPSHOT MAPS
OF CARBON DIOXIDE AND SIF
THAT ARE UNLIKE DATA
WE’VE COLLECTED BEFORE.
LET US SEE NEW THINGS
ABOUT FORESTS, CROP AREAS,
AND OF COURSE THERE’S FOLKS
WANNA LOOK AT CITIES

AND POWER PLANTS.

SO THE SNAPSHOT MAP'S

GONNA BE A GREAT NEW WAY

TO GET A DETAILED PICTURE

OF CARBON DIOXIDE.

>> WE'RE INTERESTED IN

STUDYING PLANETARY BODIES.

SO IN PARTICULAR,

MY RESEARCH OF FOCUS IS ON

STUDYING ASTEROIDS.

THE GOAL OF HERMES IS

TO STUDY THE SURFACE MATERIAL

OF ASTEROIDS, AND THIS IS

SOMETHING THAT WE CALL REGOLITH,
THIS FINE PARTICLE, FINE DUST

THAT COVERS THE ENTIRE SURFACE.

THERE'S A LOT OF INTEREST

IN ONE DAY SENDING ASTRONAUTS

TO ASTEROIDS, FOR INSTANCE,

AND WE HAVE ALREADY

SENT A LOT OF ROBOTIC MISSIONS

TO ASTEROIDS,

AND PLAN TO SEND MORE.

AND SO WE WOULD NEED TO

UNDERSTAND HOW TO INTERACT

WITH THE ASTEROID SURFACE.

SO IF YOU WERE GOING TO ANCHOR

to the surface of the asteroid,
FOR INSTANCE, UM, YOU NEED TO UNDERSTAND HOW TO INTERACT WITH THE REGOLITH.

WHY DO WE WANNA STUDY THIS ON THE ISS?

SO IT'S NOT JUST THE LONG DURATION EXPOSURE MICROGRAVITY.

UM, IT'S ALSO-- SOMETHING THAT WE HAVE ON ASTEROIDS IS VACUUM, RIGHT?

SO WE WANNA EXPOSE OUR EXPERIMENTS TO THE VACUUM OF SPACE, SO WE ACTUALLY HAVE OUR FACILITY HOOKED UP
ESSENTIALLY TO A PORT TO SPACE.

SO THIS WILL BE A PERMANENT FACILITY ON THE SPACE STATION.

AND THE IDEA IS THAT WE'LL SEND DIFFERENT SCIENCE PACKAGES THAT ARE CALLED CASSETTES THAT WILL GO INSIDE THE FACILITY.

UM, SO WE DID CASSETTE-1, BUT THE IDEA IS THAT HERMES WILL BE OPEN TO OTHER INVESTIGATORS,

SO CASSETTE-2, CASSETTE-3, CASSETTE-7, THESE WILL BE
OTHER RESEARCHERS THAT WILL

APPLY TO USE HERMES TO DO

RESEARCH ON ASTEROID REGOLITH AND GRANULAR MATERIAL

> THIS IS A TINY BIOENGINEERED DEVICE THAT CONTAINS LIVING HUMAN CELLS THAT ARE DESIGNED TO RECREATE THE STRUCTURE AND FUNCTION OF YOUR TISSUES IN YOUR BODY.

SO WE SEE TISSUE CHIPS AS A TOOL TO HELP UNDERSTAND DISEASES AND SPEED THE PROCESS OF DRUG DISCOVERY,
WHICH DOWN HERE ON EARTH RIGHT NOW IS EXTREMELY EXPENSIVE

AND TAKES A REALLY, REALLY LONG TIME.

WE'RE USING MICROGRAVITY ALSO AS A TOOL, BECAUSE AS YOU KNOW,

MICROGRAVITY CAUSES CHANGES IN PHYSIOLOGY IN ASTRONAUTS THAT OFTEN SEEM TO MIMIC WHAT'S QUITE SIMILAR TO SOME DISEASE STATES OR AGING HERE ON EARTH.

THAT HAPPENS ON A REALLY SHORT TIME SCALE, SO WE'RE
ESSENTIALLY ABLE TO SPEED UP THE WHOLE PROCESS OF DISEASE MODELING AND TESTING OF DRUGS BY USING THESE TISSUE CHIPS UP ON THE SPACE STATION. SO THAT'S A BIG WIN DOWN FOR US HERE ON EARTH. ALL OF THESE TECHNOLOGICAL ADVANCES AND THE PROBLEMS THAT THE TEAMS HAVE HAD TO ENCOUNTER TO SHRINK THEIR TECHNOLOGY AND MAKE IT REALLY ROBUST IS GONNA BE
TRANSFORMATIONAL FOR THE TECHNOLOGY BACK DOWN HERE ON EARTH, BECAUSE IT'S GONNA MAKE THIS TECHNOLOGY MUCH MORE BROADLY ACCESSIBLE TO A WIDER AUDIENCE WHO CAN USE IT DOWN HERE ON EARTH.

SO WE HAVE FOUR PROJECTS THAT ARE LAUNCHING.

WE HAVE A TEAM FROM THE UNIVERSITY OF WASHINGTON, WHO IS GOING TO BE SENDING UP A KIDNEY CHIP. WE'RE ACTUALLY SENDING UP
24 of these chips to

00:03:37,683 --> 00:03:39,252
The International Space Station,

00:03:39,252 --> 00:03:41,688
so that's 72 individual tubules.

00:03:41,687 --> 00:03:42,821
not only is a kidney

00:03:42,822 --> 00:03:44,424
very important for filtering

00:03:44,424 --> 00:03:45,692
our blood and removing

00:03:45,692 --> 00:03:47,126
waste products via urine,

00:03:47,126 --> 00:03:48,394
but it's also a key organ

00:03:48,394 --> 00:03:49,528
involved in the synthesis

00:03:49,528 --> 00:03:50,629
of a number of different

00:03:50,629 --> 00:03:51,965
hormones and vitamins.

00:03:51,965 --> 00:03:52,966
one of those vitamins

00:03:52,966 --> 00:03:54,099
is vitamin D.

00:03:54,099 --> 00:03:54,967
and so we actually hope

00:03:54,967 --> 00:03:55,901
to learn in a matter of
A COURSE OF WEEKS IS

HOW DOES OSTEOPOROSIS, VI-VITAMIN D METABOLISM OCCUR

IN A DISEASE WHICH TYPICALLY TAKES PLACE OVER THE COURSE

OF YEARS IF NOT DECADES.

>> WE ARE THE 2018 GENES IN SPACE WINNING TEAM.

SO IF YOU'RE UNFAMILIAR WITH GENES IN SPACE, UM,

IT'S A 7TH TO 12TH GRADE DNA COMPETITION WHERE YOU

DESIGN AN EXPERIMENT TO TAKE PLACE ON
THE INTERNATIONAL SPACE STATION.

>> DNA IS THE BLUEPRINT OF LIFE, RIGHT?

SO IT ENCODES ALL OUR GENETIC INFORMATION, UM,

AND IT GETS TRANSCRIPTION TO RNA,

WHICH IS TRANSLATED TO PROTEINS,

WHICH OF COURSE HELP ALL OF OUR CELLS FUNCTION.

ASTRONAUTS UNDERGO HIGH RADIATION FROM HZE IONS OR GALACTIC COSMIC RAYS,

WHICH CAN LEAD TO THESE DOUBLE STRANDED BREAKS.
SO OUR OBJECTIVE IN THIS,

UH, EXPERIMENT WAS TO EXAMINE

HOW REPAIR PATHWAY FREQUENCIES

AND DOUBLE STRANDED BREAK REPAIR

AS A WHOLE ARE AFFECTED

BY MICROGRAVITY.

SO TO-TO TEST OUR HYPOTHESIS,

WE'RE GONNA BE USING

THE CRISPR-CAS9 SYSTEM.

WE WANT TO VERIFY THAT

CAS9 CAN CUT IN SPACE,

AND THAT WE CAN DEDUCE

REPAIR PATHWAY FREQUENCIES BASED

ON THE RESULTING SEQUENCES.
SO THE RESULTS OF

00:04:53,225 --> 00:04:54,860
THESE EXPERIMENTS COULD HELP

00:04:54,860 --> 00:04:55,827
SET THE STAGE FOR

00:04:55,827 --> 00:04:57,129
GENOMIC EDITING IN SPACE

00:04:57,129 --> 00:04:58,197
AND PROTECT ASTRONAUTS

00:04:58,197 --> 00:04:59,432
FROM INTENSE RADIATION

00:04:59,432 --> 00:05:00,967
EXPERIENCED IN FLIGHT.

00:05:02,134 --> 00:05:13,379
[ MUSIC ]