00:00:13.279 --> 00:00:14.369
>>> WOW.

00:00:14.369 --> 00:00:19.820
I THINK WE GOT SOMETHING.

00:00:19.820 --> 00:00:22.480
I BETTER TALK TO MARK.

00:00:22.480 --> 00:00:24.519
HEY, MARK.

00:00:24.519 --> 00:00:26.559
>> HEY DAVID.

00:00:26.559 --> 00:00:27.910
>> WE HAVE A NEW ASTEROID.

00:00:27.910 --> 00:00:29.368
>> A NEW ASTEROID
>> YEP.

00:00:29.368 --> 00:00:31.980
>> I BETTER GET THE 730 TEAM TOGETHER.

00:00:31.980 --> 00:00:34.960
YOU KNOW THEY SCATTER AFTER THE SHOW SO LET ME SEE IF I CAN GET

00:00:34.960 --> 00:00:40.120
THEM.

00:00:40.119 --> 00:00:50.439
>>> HI, MARK.

00:00:50.439 --> 00:00:56.479
THE WHOLE TEAM IS HERE.

00:00:56.479 --> 00:00:59.058
>> DAVID SAID A NEW ASTEROID HAS JUST BEEN DISCOVERED.
00:00:59.058 --> 00:01:02.128
>> WHEN WILL IT HIT THE EARTH?

00:01:02.128 --> 00:01:03.699
>> IT DOESN'T HIT THE EARTH.

00:01:03.700 --> 00:01:06.469
I THINK WE NEED TO TEACH
STUDENTS ABOUT ASTEROIDS AND

00:01:06.469 --> 00:01:08.298
NASA'S REDIRECT MISSION.

00:01:08.299 --> 00:01:09.700
>> HOW MUCH TIME DO WE HAVE?

00:01:09.700 --> 00:01:10.890
>> 30 MINUTES.

00:01:10.890 --> 00:01:12.099
>> WHEN DO WE START?

00:01:12.099 --> 00:01:23.069
>> RIGHT NOW BECAUSE THIS IS
730.

00:01:23.069 --> 00:01:24.449
\\\\
>>> THIS IS 730.

00:02:00.228 --> 00:02:01.259
>> HI I'M MARTY.

00:02:01.259 --> 00:02:02.259
>> I'M BETH.

00:02:02.259 --> 00:02:05.659
>> WE'RE COMING LIVE TO YOU FROM
THE AIR AND SPACE MUSEUM IN

00:02:05.659 --> 00:02:14.759
WASHINGTON, D.C.
OOH THIS GALLERY IS PHENOMENAL.
ONE OF MY FAVORITE IN THE ENTIRE MUSEUM.

SOME ARTIFACTS IN HERE BILL PLOW AWAY.

YOU'VE CONVINCED ME.

THIS GALLERY IS DEDICATED TO THE SPACE SHUTTLE AND SPACE SHUTTLE ERA.

ON HERE ARE SPACE SUITS WORE BY SALLY RIDE AND THE FIRST AFRICAN-AMERICAN ASTRONAUT.

YOU CAN VISIT THE MID-DECK TO EXPLORE A LOT OF ARTIFACTS.

A CAN OF SODA, BUZZ LIGHT YEAR AND OTHER ITEMS.

WHEN YOU COME TO THIS GALLERY YOU CAN'T HELP NOTICE THE AMAZING MODELS.

HANGING FROM THE CEILING IS A SCALE MODEL OF THE INTERNATIONAL
00:02:57,650 --> 00:03:01,000
SPACE STATION AND ACROSS THE
ROOM IS A SPACE MODEL OF THE

40
00:03:01,000 --> 00:03:04,759
SPACE STATION COLUMBIA.

41
00:03:04,759 --> 00:03:08,628
>> LET'S WELCOME OUR INHOUSE
AUDIENCE, WHITTAKER EDUCATION

42
00:03:08,628 --> 00:03:09,628
CAMPUS.

43
00:03:09,628 --> 00:03:12,959
THANK YOU ALL FOR BEING HERE
TODAY.

44
00:03:12,960 --> 00:03:15,209
>> WE ALSO WANT TO THANK OUR
ONLINE VIEWERS AND THOSE

45
00:03:15,209 --> 00:03:17,030
WATCHING ON NASA TV.

46
00:03:17,030 --> 00:03:20,751
IF YOU GO TO WEBSITE SUBMIT
QUESTIONS THAT WE'LL HAVE A

47
00:03:20,751 --> 00:03:24,340
DOCENT READY TO ANSWER.

48
00:03:24,340 --> 00:03:28,950
>> SO, MARTY, WHY DO WE WANT TO
STUDY ASTEROIDS?

49
00:03:28,949 --> 00:03:30,548
>> THAT'S A GREAT QUESTION.

50
00:03:30,549 --> 00:03:34,000
TO HELP US ANSWER THAT QUESTION
WE HAVE THE PROGRAM MANAGER FROM

51
00:03:34,000 --> 00:03:36,580
NASA'S ASTEROID REDIRECT
I WANT TO GET YOU GUYS INVOLVED REAL QUICK.

THESE GUYS IN THE AUDIENCE HAVE GO AND NO GO SIGNS.

WE'RE GOING TO TALK ABOUT A COUPLE OF DIFFERENT CONCEPTS

THAT WE HAD FOR THE MISSION AT THE OUTSET.

WE'RE GOING TO ASK YOU TO GIVE US A GO OR NO GO FOR THAT

CONCEPT AND WE'LL SEE WHICH ONE THEY CHOOSE.

ONE IDEA IS TO GO OUT IN SPACE, FIND A SMALL ASTEROID AND GRAB IT AND BRING IT BACK TOWARDS EARTH.

THE OTHER IDEA IS TO GO OUT, LAND ON AN ASTEROID, PICK UP A BOWLED FRIRT, BRING THAT BOULDER BACK TOWARDS EARTH.

BOTH OF THESE ARE VERY COMPLEX.
YOU HAVE TO THINK ABOUT THE COST AND SAFETY AND THE DESIGN CHALLENGES.

SO LET’S SEE WHAT YOU GUYS THINK FOR GO OR NO GO.

HOW ABOUT THE FIRST ONE, GOING OUT AND GRABBING A SMALLER ASTEROID, GRABBING IT AND BRINGING IT BACK TO EARTH.

LET’S SEE.

OKAY.

ALL RIGHT HOW ABOUT THE IDEA MUCH GOING OUT, LANDING ON AN DESTROYED, PICKING UP A BOULDER AND BRINGING IT BACK TOWARDS

PRETTY GOOD.

PRETTY GOOD.

SO TELL US WHICH OF THOSE IDEAS
WAS CHOSEN.

WE DID DECIDE TO GO WITH THE OPTION TO TRAVEL TO A LARGE ASTEROID, AND EXTRACT A MULTI-TON BOULDER OR COHESIVE MASS FROM THE SURFACE OF THAT ASTEROID AND THEN ACTUALLY PERFORM A DEMONSTRATION OF A PRECISION DEFLECTION MANEUVER OF A LARGER ASTEROID AND BRING THAT BOULDER BACK TO THE LUNAR VICINITY.

TELL ME WHAT THAT IS.

WHAT WE'LL DO IS UTILIZE THE GRAVITATIONAL FORCE CREATED BY BOTH THE SPACECRAFT AND THE MULTI-TON BOULDER TOGETHER TO SLOWLY AND PRECISELY HOPEFULLY WE'LL MERIT, ALTER THE
00:05:28,168 --> 00:05:31,659
TRAJECTORY OF THE LARGE ASTEROID
WHILE IT'S HURTLING THROUGH

00:05:31,660 --> 00:05:34,760
SPACE.

00:05:34,759 --> 00:05:37,110
>> SO IF THERE'S AN ASTEROID
HEADING TOWARDS EARTH MAYBE WE

00:05:37,110 --> 00:05:41,180
CAN NUDGE IT A LITTLE BIT SO IT
MISSES EARTH?

00:05:41,180 --> 00:05:45,699
>> IT WILL BE A DEMONSTRATION OF
ONE TYPE OF DEFLECTION.

00:05:45,699 --> 00:05:48,430
>> WHAT ARE THE OTHER
CHALLENGES?

00:05:48,430 --> 00:05:53,650
>> SO, THE ROBOTIC SPACECRAFT
WHICH YOU CAN SEE HERE ON THE

00:05:53,649 --> 00:05:58,909
FRONT END OF THIS MODEL IS
POWERED BY ADVANCE SOLAR

00:05:58,910 --> 00:06:01,780
ELECTRICAL PROPULSION WHICH IS A
COMBINATION OF ADVANCED

00:06:01,779 --> 00:06:09,069
TECHNOLOGIES INCLUDING HIGH
POWER SOLAR RAY, LONG LIFE ION

00:06:09,069 --> 00:06:14,360
THRUSTERS AND POWER PROCESSING
AND CONVERSION TECHNOLOGY.

00:06:14,360 --> 00:06:16,410
INTEGRATION OF THESE
TECHNOLOGIES THAT PROVIDES THE

00:06:16.410 --> 00:06:22.319
REAL ENABLING SYSTEM FOR THIS
DEMONSTRATION AS WELL AS THE

00:06:22.319 --> 00:06:30.939
INTEGRATED MOVING MASS.

00:06:23.889 --> 00:06:33.579
>> A LOT
OF THIS IS BRAND NEW

00:06:30.939 --> 00:06:32.259
TECHNOLOGY.

00:06:32.259 --> 00:06:33.579
>> YES.

00:06:33.579 --> 00:06:34.909
FIRST TIME IT'S FLOWN.

00:06:34.910 --> 00:06:36.180
CAPABILITY DEMONSTRATION.

00:06:36.180 --> 00:06:37.840
>> THAT'S AWESOME.

00:06:37.839 --> 00:06:42.549
SO TELL ME SOMETHING ELSE ABOUT
THIS MISSION.

00:06:42.550 --> 00:06:45.978
THE SOLAR PANELS ARE SUPER HIGH
POWERED?

00:06:45.978 --> 00:06:49.550
>> MUCH HIGH POWERED THAN
ANYTHING WE'VE FLOWN BEFORE.

00:06:49.550 --> 00:06:50.550
>> THAT'S AWESOME.
I LOVE THE IDEA YOU GUYS ARE CREATING NEW TECHNOLOGY AND PUTTING THEM TOGETHER IN A WAY WE'RE ABLE TO DO ALL KIND OF DIFFERENT THINGS.

YOU READY TO TAKE SOME QUESTIONS?

>> HI.

MY QUESTION IS WHEN WILL YOU BE ABLE TO GET ASTEROIDS TO EARTH.

>> IN ADDITION TO THE SOLAR ELECTRIC PROPULSION THERE'S A CAPTURE SYSTEM ON THE FRONT END OF THIS MODEL.

AND WILL BE ON THE SPACECRAFT.

A CAPTURE SYSTEM INCLUDES TWO SOPHISTICATED MATURE ROBOTIC ARM

SYSTEM AND A RESTRAINT SYSTEM FROM SENSORS WITH OTHER
APPLICATIONS.

WE'RE TRYING TO INFUSE COMMONALITY AND EFFICIENCY AND OUR BUILD FAST AT NASA.

IT'S THE COMBINATION OF THOSE TECHNOLOGIES THAT ALLOW US TO GRAFT AND ACQUIRE AND BRING IT BACK TO THE AIRCRAFT.

>> HOW LONG WILL IT TAKE TO GET TO THE ASTEROID.

SO CURRENT TRAJECTORY PLAN IS APPROXIMATELY 18 MONTHS.

IT'S NOT A SHORT MISSION.

THAT IS ONE OF THE ADVANTAGES OF UTILIZING SOLAR ELECTRICAL PROPULSION IS IT PROVIDES FLEXIBILITY BY ALLOWING A VERY LOW THRUST WHICH IS A RATHER SLOWER AND MORE FLEXIBLE
THRUSTING TECHNIQUE THAN WE USE WITH OUR BIG ENGINES.

00:08:32,568 --> 00:08:35,129
>> WE HAVE AN ONLINE QUESTION NEXT.

00:08:35,129 --> 00:08:39,208
WHY DOES THE ENGINE ON THE SPACECRAFT GLOW BRIGHT BLUE.

00:08:39,208 --> 00:08:40,799
>> THAT'S INTERESTING.

00:08:40,799 --> 00:08:45,329
SO THE EXHAUST CHEMICALS COMBINED WITH THE ATMOSPHERIC CONSTITUENTS CAUSE COLOR.

00:08:45,330 --> 00:08:48,040
OUR EYES PERCEIVE COLOR.

00:08:48,039 --> 00:08:51,299
>> AWESOME.

00:08:51,299 --> 00:08:52,729
RECENTLY WE HAD AN OPPORTUNITY TO GO TO GODDARD SPACE FLIGHT CENTRE AND BETH TALKED TO ONE OF THE LEADING ENGINEERS.

00:08:52,730 --> 00:08:55,159
CENTRE AND I'M WITH BEAU.

00:08:55,159 --> 00:09:01,750
WE'VE GOT THIS VERY COMPLEX THING HERE.
149
00:09:15,769 --> 00:09:17,860
DO YOU WANT TO TELL ME WHAT THIS IS?

150
00:09:17,860 --> 00:09:18,860
>> SURE.

151
00:09:18,860 --> 00:09:25,409
THIS IS A MICROSPINE TOOL, THE TOOL WE USE TO CAPTURE A BOULDER

152
00:09:25,409 --> 00:09:28,199
OFF THE SURFACE OF AN ASTEROID.

153
00:09:28,200 --> 00:09:34,340
THIS VERSION IT HAS 24 PAWS AND EACH OF THESE PAWS HAVE SEVERAL

154
00:09:34,340 --> 00:09:38,100
FISH HOOKS AT THE END OF IT, SOMETHING LIKE 2,000 FISH HOOKS

155
00:09:38,100 --> 00:09:45,000
TOTAL AND THEY GRAB THE BOULDER TO LIFT IT OFF THE ASTEROID

156
00:09:45,000 --> 00:09:46,000
SURFACE.

157
00:09:46,000 --> 00:09:51,190
>> HOW DO THEY WORK
>> THEY ARE INDIVIDUALLY MOUNTED

158
00:09:51,190 --> 00:09:55,910
ON THE SPRINGS SO THAT THEY CAN MOVE KIND OF LIKE CAT'S PAW,

159
00:09:55,909 --> 00:09:59,939
ALTHOUGH EXCEPT WE'RE NOT TRYING RETRACT THEM SO WE DON'T SCRATCH

160
00:09:59,940 --> 00:10:06,070
OURSELVES, WE MAKE THEM SO WE GET AS MANY OF THEM TO GRASP THE
LITTLE FEATURES OF THE BOULDER AS POSSIBLE.

SO THIS TOOL IS PLACED ON THE BOULDER BY THE ROBOT ARM.

THESE PAWS ARE LOWERED DOWN ON TO THE SURFACE AND RETRACTED AND SO THAT WE GRASP THE ROCK FEATURES.

>> NOW, THIS LOOKS VERY COMPLEX.

SO WHAT ARE SOME OF THE CHALLENGES THAT YOU HAVE TO GO THROUGH TO MAKE SOMETHING LIKE THIS TO JUST LIFT THE BOULDER OFF AN ASTEROID?

THIS IS A VERY COMPLICATED MECHANICAL DEVICE.

A LOT OF WORK HAS TO GO INTO MAKING THE VERY PRECISE MEASUREMENTS AND METAL PIECES INSIDE.

IT HAS SEVEN DIFFERENT FUNCTIONS.
IT PROVIDES.

173
00:10:48.899 --> 00:10:52.879
I TOLD YOU ABOUT 2005 THEM.

174
00:10:52.879 --> 00:10:54.610
ONE IS THE PULL END.

175
00:10:54.610 --> 00:10:56.379
IN THE FLIGHT VERSE IT WILL HAVE
A DRILL.

176
00:10:56.379 --> 00:11:01.279
IT DRILLS INTO THE ROCK FROM
PROVIDE ADDITIONAL ANCHORING.

177
00:11:01.279 --> 00:11:04.679
AFTER IT DRILLS IT ALSO HAMMERS
TO GET DOWN INTO THE ROCK SO IF

178
00:11:04.679 --> 00:11:07.199
YOU EVER TRY TO DRILL INTO
CEMENT YOU KNOW THAT'S

179
00:11:07.200 --> 00:11:08.759
DIFFICULT.

180
00:11:08.759 --> 00:11:12.539
THIS TOOL HAS TO ACCOMMODATE A
WIDE VARIETY OF ROCK SURFACE,

181
00:11:12.539 --> 00:11:15.199
ROCK TYPES.

182
00:11:15.200 --> 00:11:18.940
WE KNOW A GOOD AMOUNT OF
ASTEROIDS BUT ONE THING WE KNOW

183
00:11:18.940 --> 00:11:22.691
IS THERE'S VARIETY AND WE WON'T
KNOW WHAT THIS ROCK WILL LOOK

184
00:11:22.691 --> 00:11:24.170
LIKE UNTIL WE GET THERE.
THAT TOOL HAS TO ACCOMMODATE A WIDE RANGE.

WE'RE 30 MINUTES AWAY ROUND TRIP BY LIGHT FROM EARTH, SO THE ENTIRE SEQUENCE TO DESCEND DOWN TO THE SURFACE IS AUTONOMOUS AND THE SPACECRAFT DOES IT ALL BY ITSELF.

>> THAT IS REALLY COOL.

>> YEAH.

>> THAT INTERVIEW WAS GRIPPING, BUT THAT'S NOT THE ONLY PART OF THE MISSION.

THE NEXT PART OF THE MISSION IS ACTUALLY TO SEND ASTRONAUTS OUT TO THE PIECE OF THE ASTEROID THAT WE BRING BACK AND PUT IT AROUND THE ORBIT OF THE MOON.

TELL US ABOUT THAT.
THE ACTIVE END OF THIS IS THE ORION SPACE CAPSULE AND OUR PLAN.

IS TO -- WE PLAN IT -- IS TO TAKE THE ASTRONAUTS ON THE SPACE CAPSULE APPROXIMATELY 75,000 KILOMETERS FURTHER FROM THE MOON.

WHICH IS ABOUT 45,000 MILES FURTHER THAN WE'VE EVER TAKEN ASTRONAUTS BEFORE.

ROUNDVEOUS WITH THIS VEHICLE TO SELECT SAMPLES, ACQUIRE SAMPLE, CONTAIN SAMPLES AND RETURN THEM TO THE EARTH WITH THE CREW IN THE ORION CAPSULE.

>> WHEN WE LOOK AT THIS MODEL WE'RE LOOKING AT TWO SEPARATE SPACECRAFTS ONE TO THE ASTEROID, THE OTHER TO THE CREW AND DOCK.

WITH IT.

>> IT'S THE ABILITY TO SEPARATE THOSE FUNCTIONS INTO TWO
SEPARATE SPACECRAFTS THAT ALLOW US TO DO A NUMBER OF THINGS.

ONE IS TO LOWER THE RISK TO THE CREW WHILE LOWERING THE COST TO

THE PORTION OF THE MISSION THAT ACTUALLY PERFORMS THE PORTION

THAT IS LESS NECESSARY TO HAVE THE CREW FOR BUT PROVIDE AN INTEGRATED CAPABILITY DEMONSTRATION FOR US TO CONTINUE TO TAKE OUR ASTRONAUTS FURTHER AND FURTHER THAN WE HAVE EVER BEFORE.

RECENTLY I HAD AN OPPORTUNITY TO TALK WITH ASTRONAUT RANDY ABOUT SOME OF THE TRAINING THAT HE'S DONE TO ACTUALLY GO OUT THE AN ASTEROID.

SO LET'S CHECK THAT OUT.

I'M JOINED TODAY BY RANDY.
HE'S A SPACE SHUTTLE ASTRONAUT.

222
00:13:42,610 --> 00:13:46,550
HE DID TWO SPACE WALKS THAT TOTALLED OVER 11 HOURS IN SPACE.

223
00:13:46,549 --> 00:13:48,359
THANK YOU SO MUCH FOR JOINING US TODAY.

224
00:13:48,360 --> 00:13:49,769
>> MY PLEASURE.

225
00:13:49,769 --> 00:13:51,639
>> THERE ARE SOME CHALLENGES WHEN YOU DO A SPACEWALK.

226
00:13:51,639 --> 00:13:53,689
CAN YOU TELL US ABOUT THOSE?

227
00:13:53,690 --> 00:13:58,000
>> FIRST, WE HAVE TO HAVE A SPACESHIP TO GO OUTSIDE.

228
00:13:58,000 --> 00:14:01,409
BREATHABLE ATMOSPHERE, MAINTAIN THE TEMPERATURE BECAUSE AS YOU

229
00:14:01,409 --> 00:14:06,139
KNOW, IT'S PLUS 250 DEGREES IN THE SUN AND MINUS 250 DEGREES IN

230
00:14:06,139 --> 00:14:07,139
THE SHADE.

231
00:14:07,139 --> 00:14:09,819
THAT 500 TEMPERATURE CHANGE IS TOUGH TO OVERCOME MECHANICALLY.

232
00:14:09,820 --> 00:14:14,920
>> WHAT ARE THE CHALLENGES FOR A SPACEWALK THAT'S WAY OUT FROM

233
00:14:14,919 --> 00:14:15,949
EARTH.
WE HAVE RADIATION BELTS TO PROTECT US FROM COSMIC RADIATION.

OUTSIDE OF RADIATION BELTS, LUNAR ORBIT WE DON'T HAVE THAT.

EDUCATION EXPOSURE IN THOSE SUITS WILL BE A LOT MORE.

WE NEED SUITS DESIGNED FOR HIGHER RADIATION ENVIRONMENT.

I THINK PSYCHOLOGICALLY, THE HUMAN PART, THE HARDER PART IS

THE FACT THAT YOU DON'T HAVE EARTH, THIS BIG HUGE BALL RIGHT THERE.

SO EVEN THOUGH YOU'RE 225 MILES UP, YOU HAVE THE FEELING YOU'RE TIED TO EARTH.

THE MOON GUYS, THEY CAN PUT THEIR THUMB UP AND COVER THE

EARTH AND YOU'RE NOT FAR AWAY YOU DON'T HAVE THE EARTH THERE.
THAT MIGHT BE A DIFFERENT SENSATION FROM THE FOLLOWING ONE

US HAVE TO OVERCOME.

>> YOU'VE DONE SOME TRAINING FOR WORKING ON AN ASTEROID,

CORRECT?

>> CORRECT.

WE LIVE IN THE HABITAT OFF THE COAST OF FLORIDA, UNDERSEA

HABITAT IN THE WORLD AND WE LIVE THERE FOR A WEEK UNDER GROUND.

PART OF OUR TIME WAS DEDICATED TO EQUIPMENT EXPLORATION THAT ALLOWS US TO DO WORK ON AN ASTEROID.

ASTEROIDS ARE SMALL.

THEY DON'T HAVE GRAVITY.

IF WE GO UP TO AN ASTEROID AND ONE SMALL ENOUGH WE CAN DO

_REDIRECT MISSION AND BRING IT BACK TO THE EARTH, IF WE GO UP

TO IT WE'LL PUSH IT AND IT MAY PUSH AWAY.

WE'LL BE OPPOSING EACH OTHER.

SO WHAT WE DID, WORKED OUT A SYSTEM WHERE WE CAN BOLT DOWN THE SURFACE OF THE ASTEROID AND USING A TELESCOPING ARM, DRILL AND GET CORE SAMPLES.

>> THAT SEEMS LIKE THAT WILL BE A CHALLENGING MISSION.

WOULD YOU LIKE TO BE ON THAT MISSION?

>> ABSOLUTELY.

ALL THE ASTRONAUTS WANT TO DO THE HARD STUFF YOU HAVEN'T DONE BEFORE.

THAT'S THE FUN THING ABOUT LEARNING IS THE FACT SOMETHING
INTERESTING TO YOU, YOU GO
STUDY, WORK HARD AND THEN

271
00:16:23,240 --> 00:16:26,289
HOPEFULLY IN TEND EITHER FIND
THE ANSWER OR IN THIS CASE WITH

272
00:16:26,289 --> 00:16:30,779
EXPLORATION DEVELOP AN FIGURE
OUT HOW WE GO FURTHER BASED ON

273
00:16:30,779 --> 00:16:31,949
THE ANSWERS WE FIND.

274
00:16:31,950 --> 00:16:34,230
>> THANK YOU SO MUCH FOR TALKING
WITH US TODAY.

275
00:16:34,230 --> 00:16:35,950
>> MY PLEASURE.

276
00:16:35,950 --> 00:16:39,440
>> SO I'M SITTING HERE WITH MY
FRIENDS.

277
00:16:39,440 --> 00:16:44,140
NOW WE JUST HEARD AN ASTRONAUT
TALK ABOUT TRAVELING INTO SPACE.

278
00:16:44,139 --> 00:16:47,580
HOW MANY OF YOU WOULD LIKE TO BE
ON ONE OF THESE MISSIONS?

279
00:16:47,580 --> 00:16:51,879
LET'S SEE GO, NO GO.

280
00:16:51,879 --> 00:16:53,659
I THINK WE HAVE A LOT OF GOS.

281
00:16:53,659 --> 00:16:59,069
WE HAVE A LOT OF PEOPLE WHO DO
WANT TO BE ASTRONAUTS.

282
00:16:59,070 --> 00:17:02,720
YOU ALL HAD A CHANCE TO MEET
WITH MARTY, RIGHT?

HE CAME TO YOUR SCHOOL.

CAN YOU TELL US WHAT HE DID?

>> WELL WE STUDIED MORE WITH METEORITES AND WHERE THEY COME FROM AND WE STOOD ROCKS AND THE TEXTURE OF IT WAS VERY SMOOTH.

WE WERE ABLE TO USE MAGNETS TO ATTRACT THE PIECES OF THE METEORITES.

LET'S LOOK WHAT WE DID.

>> TODAY YOUR GUYS READY TO BECOME GEOLOGISTS?

>> YES.

WE'RE GOING TO CHECK OUT SOME ROCKS BUT THESE AREN'T ORDINARY EVERY DAY ROCKS.
THESE ROCKS ARE FROM OUTER SPACE.

>> OH.

>> THESE ARE ALL METEORITES, CHunks of asteroids at some point fell to the earth's surface and we found them and

NOW WE CAN STUDY THEM TO LEARN ABOUT OUR EARLY SOLAR SYSTEM.

ARE YOU READY TO CHECK THIS OUT?

>> YES.

>> ALL RIGHT.

LET'S DO IT.

SO THIS WAS ORIGINALLY A METEORITE MADE UP OF A WHOLE BUNCH OF FIBERS LIKE THIS AND THEY SLICED IT SO THEY COULD

STUDY THE INSIDE OF IT.

METEORITES ARE MADE OF ALL KINDS OF DIFFERENT THINGS.
THIS ONE IS MOSTLY MADE OF ROCK.

SO WHAT WE KNOW FROM THIS ONE IS, THIS TYPE OF METEORITE WAS PROBABLY FROM THE OUTSIDE LAYER OF AN ASTEROID.

WHERE THIS ONE THAT'S MOSTLY FEEL THAT -- MOSTLY METAL, IRON, VERY HEAVY, IT'S MOST LIKELY FROM THE INSIDE OF AN ASTEROID.

WHAT'S REALLY COOL HERE ON EARTH WE DON'T REALLY HAVE ROCKS FROM THE VERY INSIDE OF THE EARTH, DO WE?

BUT HERE WE HAVE A ROCK FROM THE INSIDE OF AN ASTEROID.

AND WE CAN LEARN A LITTLE BIT ABOUT HOW THAT ASTEROID WAS FORMED OR WHAT THAT'S MADE OUT OF.

>> GUYS, DID YOU THINK IT WAS PRETTY COOL GETTING A CHANCE TO HOLD ROCKS FROM OUTER SPACE
320
00:19:32,750 --> 00:19:35,750
>> THEY WERE A LOT HEAVIER THAN THEY LOOKED, WEREN'T THEY?

321
00:19:35,750 --> 00:19:36,750
>> YES.

322
00:19:36,750 --> 00:19:37,759
>> SO GOOD JOB TODAY.

323
00:19:37,759 --> 00:19:43,808
I GOT TO SAY YOU GUYS AND YOUR OBSERVATIONAL SKILLS, YOU ROCK.

324
00:19:43,808 --> 00:19:47,029
>> THANK YOU.

325
00:19:47,029 --> 00:19:48,029
J OHNSON.

326
00:19:48,029 --> 00:19:49,230
HOW ARE YOU TODAY?

327
00:19:49,230 --> 00:19:50,279
>> GOOD.

328
00:19:50,279 --> 00:19:53,589
>> YOU'RE GOING TO TELL US A LITTLE BIT ABOUT ASTEROIDS.

329
00:19:53,589 --> 00:19:55,259
>> YES.

330
00:19:55,259 --> 00:19:58,109
MI GHT ASK WHY ARE WE INTERESTED IN EXPLORING ASTEROIDS.

331
00:19:58,109 --> 00:20:07,179
ASTEROIDS ARE LITERALLY THE
CONSTRUCTION MATERIALS OF THE SOLAR SYSTEM.

IF YOU GO BY A BUILDING CONSTRUCTION SITE YOU SEE THESE PILES OF SAND AND BRICKS AND ROCKS.

WELL, AN ASTEROID, I THINK WE HAVE AN IMAGE OF AN ASTEROID HERE THAT LOOKS A LOT LIKE CONSTRUCTION MATERIAL.

>> CEMENT.

>> FROM A CONSTRUCTION SITE.

SO THIS IS MATERIAL THAT OVER THE COURSE OF THE SOLAR SYSTEM, BILLIONS OF YEARS IN THE SOLAR SYSTEM COALESCED TOGETHER AND HAS GROWN BIGGER AND BIGGER AND BECOME PLANETS OF THE SOLAR SYSTEM.

SO BY GOING TO AN ASTEROID AND SAMPLING MATERIAL AND BRINGING
IT BACK FOR LABORATORY ANALYSIS
WE CAN LITERALLY DETERMINE WHAT

ELEMENTS BUILT UP THE SOLAR SYSTEM AND BECAME THE PLANETS,

AND MATERIAL THAT POSSIBLY HAS THE ELEMENTS FOR THE CREATION OF LIFE.

NOW, THE ASTEROID THAT'S ON THE IMAGE, THE ONE ASTEROID WE HAD A SPACECRAFT ACTUALLY GO TO IN ORBIT AND COLLECT SAMPLES.

IN REAL LIFE IT'S ABOUT A QUARTER MILE LONG.

AND SO IT'S ABOUT THE SIZE OF A FOOTBALL STADIUM.

AND SO THIS IS A 3-D BOTTLE OF IT.

AS YOU CAN SEE IT HAS BOULDERS ON THE SURFACE THAT MAKES IT A PERFECT KIND OF ASTEROID THAT WE WOULD WANT TO GO WITH THE
ASTEROID REDIRECT MISSION TO COLLECT SAMPLES.

WE HAVE ANOTHER ASTEROID MISSION CALLED CYBER REX.

This is a model of it.

It also is about a quarter of a mile in size.

But it's much, looks much darker and that's a carbonaceous, has carbon and water and those kind of materials possibly even by taking samples and bringing them back to earth we'll discover where the elements, creation of life came from.

>> By studying asteroids we learn more about ourselves?

>> Exactly.

We are the stuff of asteroids.

>> I think we have some questions.
DO WE HAVE A VIDEO QUESTION.

LET'S START THERE.

>> HI.
IS THERE SOME WAY TO FIND OUT WHERE SPACE ASTEROIDS ARE FORMED?

>> IS THERE A WAY TO FIND OUT WHERE ASTEROIDS ARE FORMED IN SPACE?

>> SURE.
THAT'S ONE OF THE PROGRAMS I LEAD AT NASA.

THE OBSERVATION PROGRAM WHERE WE'RE TRYING TO FIND WHERE ALL THE ASTEROIDS ARE IN THE SOLAR SYSTEM.

SO WE TAKE THE OBSERVATIONS.
THEN USING MATH, COMPUTERS, THANKFULLY THE COMPUTERS WE CAN
BACK THOSE ORBITS UP FOR MILLIONS OF YEARS AND DETERMINE
WHERE IN THE SOLAR SYSTEM THESE OBJECTS ORIGINATED.

>> WE GOT AN AUDIENCE QUESTION.

DO YOU HAVE YOUR QUESTION READY?

GOT A QUESTION?

READY?

>> MY QUESTION IS WHY DO ASTRONAUTS EXIST

>> LET'S TRY THE THIS ONE ON METEORS.

>> ARE METEORS VALUABLE.

>> ARE METEORITES VALUE RABL?

>> METEORITES ARE VERY VALUABLE.
00:23:38,000 --> 00:23:43,700
IT’S LIKE A FREE SAMPLE RETURN.

00:23:43,700 --> 00:23:48,230
MATERIAL THAT METEORITES COMES FROM THE ASTEROIDS AND THE

00:23:48,230 --> 00:23:51,700
COMETS IN THE SOLAR SYSTEM WHEN THEY PASS BY THE EARTH THEY

00:23:51,700 --> 00:23:56,049
LEAVE THIS MATERIAL THAT COMES INTO THE EARTH’S ATMOSPHERE, SO

00:23:56,049 --> 00:24:01,180
OUT IN SPACE IT’S AN ASTEROID OR IF IT’S A SMALL ASTEROID WE CALL

00:24:01,180 --> 00:24:02,180
THEM METEORS.

00:24:02,180 --> 00:24:06,710
WHEN IT ENTERS THE EARTH'S ATMOSPHERE IT HAS A BRIGHT TRAIL

00:24:06,710 --> 00:24:09,140
AND CALLED A METEOR.

00:24:09,140 --> 00:24:13,890
WHEN IT HITS THE GROUND AND COLLECTED OFF THE SURFACE,

00:24:13,890 --> 00:24:15,310
THAT’S A METEORITE.

00:24:15,309 --> 00:24:18,099
SO THIS IS MATERIAL THAT’S BEEN DELIVERED TO THE SURFACE OF THE

00:24:18,099 --> 00:24:19,759
EARTH FROM SPACE.

00:24:19,759 --> 00:24:20,759
>> OKAY.
LET'S TAKE AN ONLINE QUESTION.

IS NASA WORRIED IF THESE ASTEROIDS ARE NOT REDIRECTED SOME WILL COLLIDE WITH EARTH?

>> YEAH, THAT'S THE REAL BASIS OF OUR PROGRAM IS TO FIND ANY ASTEROID THAT COULD HIT THE EARTH BEFORE IT FINDS US.

SO OUR PROGRAM, IT'S BEEN OPERATING FOR ABOUT, YOU KNOW, 16 YEARS NOW.

AND WE HAVE FOUND OVER 13,000 ASTEROIDS THAT COME, WHAT WE CALL NEAR EARTH ORBITS AND ABOUT 1600 OF THOSE ARE IN ORBITS THAT COME CLOSE ENOUGH TO EARTH THAT WE CONSIDER THEM HAZARDOUS.

WE CONTINUE TO OBSERVE THOSE AND MAKE SURE WE UNDERSTAND THEIR ORBITS AND FIND ALL THE REST OF THEM OUT THERE.
CURRENTLY WE HAVE FOUND ONLY ABOUT 10% OF THE ASTEROIDS THAT COULD BE HAZARDOUS TO THE EARTH AND CAN DO SOME REAL DAMAGE IF IT HIT THE EARTH.

THIS IS A PROGRAM THAT WILL TAKE MANY YEARS AND LITERALLY DECADES TO CATALOG ALL THOSE OBJECTS.

>> THANK YOU SO MUCH FOR JOINING US TODAY.

WE'RE GOING TO GO BACK TO MARTY AND MICHELE.

>> SO WE TALKED ABOUT THIS MISSION BUT ONE OF THE BIG PARTS OF THIS MISSION IS IT'S A STEPPING STONE TOWARDS EVENTUALLY GOING TOWARDS MARS.

HOW IS THAT?

>> SO, THE APPLICATION OF UTILIZING SOLAR ELECTRIC
PROPULSION TO MOVING MULTI-TON MASSES AND INTERPLANETARY

STAGING ORBIT ALLOWS US TO DEMONSTRATE MOVING MARS CHARGE

THE INTEGRATION OF THE CREW, VEHICLE AND ROBOTIC VEHICLE AND

OPERATION OF THAT COMBINED SYSTEM WHILE WE'RE STILL JUST A FEW DAYS RETURN NOT TOO FAR YET ALLOWS US TO DEMONSTRATE THAT

WHOLE INTEGRATED MISSION OPERATIONS CAPABILITY, SAFETY OF

THE CREW, MAINTAINING RETURN TIMES IF WE NEED TO GET THE CREW BACK AND FINALLY I WOULD SAY THE BEGINNING OF THE EVA OR EXTRA

VEHICULAR ACTIVITY TO TAKE THE ASTRONAUTS OUTSIDE TO DO USEFUL,
MEANINGFUL TASKS.

00:26:38.500 --> 00:26:41.230
PRETTY COMPLICATED TASKS YOU HAVE TO MAKE SURE THE ASTRONAUTS

00:26:41.230 --> 00:26:47.000
HAVE ADEQUATE MOBILITY, ADEQUATE SYSTEMS IN WHICH TO ACCOMPLISH

00:26:47.000 --> 00:26:50.119
THEIR TASKS, CARRY ALONG THEIR LIFE SUPPORT SYSTEMS IN A

00:26:50.119 --> 00:26:54.789
PORTABLE MANNER, TESTING THE ENCASING THAT PROTECTS THE

00:26:54.789 --> 00:26:57.829
HUMANS FROM THE HARSH VACUUM OF DEEP SPACE.

00:26:57.829 --> 00:27:01.199
SO THOSE WILL ALL COMBINE THROUGH DEMONSTRATION ON THIS

00:27:01.200 --> 00:27:05.269
MISSION TO ENABLE US TO TAKE THE NEXT STEP TO MARS.

00:27:05.269 --> 00:27:06.269
>> THAT'S AWESOME.

00:27:06.269 --> 00:27:08.139
THANK YOU SO MUCH FOR TALK WITH US TODAY.

00:27:08.140 --> 00:27:11.790
OUR NEXT SHOW IS ALL ABOUT MARS ON OCTOBER 21st.

00:27:11.789 --> 00:27:16.619
CHECK THIS OUT OUR STEM 2nd.

00:27:16.619 --> 00:27:21.489
HI, I'M BETH WILSON ONE OF THE HOSTS OF STEM 30.

YOU KNOW THERE'S NOTHING MORE I LIKE MORE THAN LOOKING AT A PHOTOGRAPH OF A BEAUTIFUL SUNSET.

>> HEY, THIS DOESN'T LOOK FAMILIAR.

>> WELL IT IS THE SUN AND YOU CAN SEE IT SINKING SLOWLY BEHIND THE HORIZON RIGHT ALONG THESE WONDERFUL MOUNTAINS.

YOU CAN ALMOST SMELL THE FRESH AIR.

HOWEVER, THERE ISN'T ANY AIR.

THIS PHOTOGRAPH WAS TAKEN ON MARS BY ONE OF THE MARS ROVERS.

IF YOU THINK THIS IS COOL CHECK OUT OUR NEXT STEM 30.

>> OCTOBER 21st, ALL ABOUT MARS.

NOVEMBER 18th WE TALK TO THE ASTRONAUTS LIVE ON THE
INTERNATIONAL SPACE STATION.

THANKS TO OUR GUESTS AND TO NASA SPONSORING OUR SHOW.

WE'LL SEE YOU NEXT TIME.