



1
00:00:06,960 --> 00:00:10,410
>> WE ARE GOING TO DO OUR FIRST
SHOW ON HELICOPTERS?

2
00:00:10,410 --> 00:00:11,950
>> THAT IS SO COOL.

3
00:00:11,950 --> 00:00:14,650
ALL OF MY FAVORITE SHOWS HAD
HELICOPTERS.

4
00:00:14,650 --> 00:00:42,370
THERE WAS A TEAM, MAGNUM P.I.,
AIR WOLF AND CHIPPS.

5
00:00:44,370 --> 00:00:43,370
∂
∂

6
00:00:44,370 --> 00:00:50,610
>> MARTY.

7
00:01:07,110 --> 00:00:58,859
MARTY.

8
00:01:07,110 --> 00:01:15,350
>> WHAT?

9
00:01:15,350 --> 00:01:33,689
>> CHIPPS WAS MORE ON
MOTORCYCLES THAN IT WAS ABOUT

10
00:01:33,689 --> 00:01:34,689
HELICOPTERS.

11
00:01:34,689 --> 00:01:35,869
THIS IS NOT AN ACTION.

12

00:01:35,869 --> 00:01:37,280
THIS IS SIM IN 30.

13
00:01:37,280 --> 00:02:08,910
THIS IS STEM IN 30.

14
00:02:08,910 --> 00:02:19,800
>> HI, I'M MARTY.

15
00:02:19,800 --> 00:02:20,800
>> I'M BETH.

16
00:02:20,800 --> 00:02:25,700
>> TODAY WE ARE COMING TO YOU
FROM VIRGINIA.

17
00:02:25,700 --> 00:02:29,390
THIS PLACE IS AMAZINGLY COOL.

18
00:02:29,390 --> 00:02:32,780
NEAR US TODAY WE HAVE A HUEY AND
COBRA HELICOPTER.

19
00:02:32,780 --> 00:02:37,170
AND THERE IS AN AIRPLANE THAT
CAN TAKE OFF VERTICALLY.

20
00:02:37,170 --> 00:02:39,470
TODAY'S SHOW IS ABOUT
HELICOPTER.

21
00:02:39,470 --> 00:02:46,080
WE'LL TALK ABOUT THIS ORANGE AND
WHITE COAST GUARD HELICOPTER

22
00:02:46,080 --> 00:02:47,920
HANGING IN THE AIR.

23
00:02:47,920 --> 00:02:50,111

>> WE WOULD LIKE TO WELCOME OUR
IN-HOUSE AUDIENCE, THE

24

00:02:50,111 --> 00:03:01,670
J.LUNDFORD MIDDLE SCHOOL.

25

00:03:01,670 --> 00:03:05,140
>> WE HAVE AN EXPERT STANDING BY
READY TO ANSWER THOSE QUESTIONS.

26

00:03:05,140 --> 00:03:07,680
THOSE AT HOME, SUBMIT THOSE
QUESTIONS.

27

00:03:07,680 --> 00:03:13,680
ANYTHING YOU WANTED TO KNOW
ABOUT HELICOPTERS IS FAIR GAME.

28

00:03:13,680 --> 00:03:15,640
WE MIGHT USE SOME OF THEM ON THE
SHOW TODAY.

29

00:03:15,640 --> 00:03:18,450
>> FOR SOME REASON, FOR THE
HELICOPTER SHOW, MARTY THOUGHT

30

00:03:18,450 --> 00:03:23,350
IT WOULD BE A GREAT IDEA TO TAKE
A RIDE IN A HELICOPTER.

31

00:03:23,350 --> 00:03:31,150
>> THERE WERE A COUPLE OF
DECISIONS WE HAD TO MAKE.

32

00:03:31,150 --> 00:03:34,550
>> I SUGGESTED THAT WE RIDE WITH
THE DOORS OFF AND NOT ON.

33

00:03:34,550 --> 00:03:37,069
DO YOU WANT TO TAKE A LOOK AT

OUR RIDE?

34

00:03:37,069 --> 00:03:58,340

>> LET'S CHECK IT OUT.

35

00:03:58,340 --> 00:03:59,340

∂

∂

36

00:03:59,340 --> 00:04:23,319

>> RIGHT FOR ON LEFT.

37

00:04:23,319 --> 00:04:25,060

ACTIVITY IN AND AROUND THE
AIRPORT.

38

00:04:25,060 --> 00:04:27,479

ADVICE ON INITIAL CONTACT.

39

00:04:27,479 --> 00:04:28,479

YOU HAVE INFORMATION, DELTA.

40

00:04:28,479 --> 00:04:29,479

>> THAT'S HELICOPTER 92335.

41

00:04:29,479 --> 00:04:30,479

READY FOR DEPARTURE.

42

00:04:30,479 --> 00:04:31,479

WE ARE HEADING NORTH.

43

00:04:31,479 --> 00:04:32,479

∂

>> HI, GUYS, WHAT DO YOU THINK?

44

00:04:32,479 --> 00:04:33,479

YOU ARE FLYING.

45

00:04:33,479 --> 00:04:34,479
>> THIS IS GREAT.

46
00:04:34,479 --> 00:04:35,479
IT'S GREAT.

47
00:04:35,479 --> 00:04:36,479
>> THIS IS PRETTY AMAZING.

48
00:04:36,479 --> 00:04:38,180
I WAS NOT EXPECTING TO GO
BACKWARDS TO START, BUT WOULD

49
00:04:38,180 --> 00:04:39,180
YOU.

50
00:04:39,180 --> 00:04:40,910
>> ALL RIGHT.

51
00:04:40,910 --> 00:04:43,650
LET'S GO FLYING.

52
00:04:43,650 --> 00:04:44,650
>> OKAY.

53
00:04:44,650 --> 00:04:48,210
>> GOOD AFTERNOON, HELICOPTER
92335.

54
00:04:48,210 --> 00:04:50,030
HEADING NORTH.

55
00:04:50,030 --> 00:04:52,699
>> THANK YOU FOR GIVING US A
RIDE TODAY.

56
00:04:52,699 --> 00:04:53,810
>> MY PLEASURE.

57
00:04:53,810 --> 00:05:01,030
YOU PICKED A GOOD DAY FOR IT.

58
00:05:01,030 --> 00:05:20,610
RIGHT NOW WE ARE ABOUT 800 FEET,
ABOUT 70 KNOTS, ABOUT 80 MILES

59
00:05:20,610 --> 00:05:23,950
PER HOUR.

60
00:05:23,950 --> 00:05:35,610
>> TELL ME HOW FAR THIS CAN FLY?

61
00:05:35,610 --> 00:05:37,250
>> WE BURN 64-GALLONS OF FUEL.

62
00:05:37,250 --> 00:05:39,500
IT'S RIGHT BELOW BETH AND JOHN.

63
00:05:39,500 --> 00:05:40,500
AS WE BURN OFF FUEL, IT DOESN'T
CHANGE OUR CENTER OF GRAVITY.

64
00:05:40,500 --> 00:05:42,349
ON A GOOD DAY WITH ZERO WIND, WE
CAN GET FROM HERE TO NEW YORK ON

65
00:05:42,349 --> 00:05:46,599
A FULL TANK OF GAS, ABOUT TWO
HOURS, ABOUT IS HUNDRED KNOTS.

66
00:05:46,599 --> 00:05:48,399
>> YOU HAVE TO DRIVE THIS WITH
YOUR HAND AND FEET?

67
00:05:48,399 --> 00:05:49,399
>> AT ALL TIMES.

68

00:05:49,399 --> 00:05:50,439
THERE IS NO AUTO PILOT ON THIS
MACHINE.

69
00:05:50,439 --> 00:05:54,419
BOTH HAND, BOTH FEET ARE WORKING
THE ENTIRE TIME.

70
00:05:54,419 --> 00:06:17,340
IF I HAVE TO MAKE A RADIO CHANGE
WHERE I NEED TO USE MY RIGHT

71
00:06:17,340 --> 00:06:24,870
HAND, I HAVE TO MOVE MY LEFT
HAND AND USE MY RIGHT HAND TO

72
00:06:24,870 --> 00:06:27,099
MAKE THE ADJUSTMENT, MOVE MY
RIGHT HAND BACK.

73
00:06:27,099 --> 00:06:30,219
THAT'S WHY THE MILITARY WILL PUT
COMMAND SEAT IN THE LEFT.

74
00:06:30,219 --> 00:06:33,539
THAT WAY YOUR RIGHT HAND ALWAYS
STAYS ON THE CYCLING.

75
00:06:33,539 --> 00:06:43,120
>> BETH, WHAT DO YOU THINK OF
YOUR FIRST HELICOPTER RIDE?

76
00:06:43,120 --> 00:06:44,270
>> WELL?

77
00:06:44,270 --> 00:06:47,489
>> A LITTLE HESITATION.

78
00:06:47,489 --> 00:06:52,319
>> I'M HAVING FUN.

79
00:06:52,319 --> 00:06:57,139
>> THERE YOU GO.

80
00:06:57,139 --> 00:07:01,289
>> SOMETIMES YOU HAVE TO DO
THINGS THAT SCARE YOU.

81
00:07:01,289 --> 00:07:03,069
>> THIS IS WAY OUT OF MY COMFORT
ZONE, BUT IT'S INCREDIBLY COOL.

82
00:07:03,069 --> 00:07:04,409
THE VIEW IS JUST STUNNING.

83
00:07:04,409 --> 00:07:11,060
THERE WAS A LARGE DEBATE WHETHER
WE SHOULD HAVE DOORS OR NOT.

84
00:07:11,060 --> 00:07:13,689
PROBABLY NO DOORS WAS THE RIGHT
CALL.

85
00:07:13,689 --> 00:07:15,580
SCARY, BUT THE RIGHT CALL.

86
00:07:15,580 --> 00:07:17,460
>> I'M JOINED BY ROGER HERE.

87
00:07:17,460 --> 00:07:20,789
HE'S A LICENSED AIRPLANE PILOT
AND ALMOST A CERTIFIED

88
00:07:20,789 --> 00:07:21,910
HELICOPTER PILOT.

89
00:07:21,910 --> 00:07:23,030
THANKS FOR TALKS WITH US.

90
00:07:23,030 --> 00:07:24,030
>> THANK YOU.

91
00:07:24,030 --> 00:07:25,580
>> WE HAVE GREAT HELICOPTERS.

92
00:07:25,580 --> 00:07:32,699
THE FIRST ONE THAT JUMPS OUT IS
THE FROG.

93
00:07:32,699 --> 00:07:37,820
>> IT'S BIG AND GREEN, SITS WAY
BACK ON THOSE WIDE LANDING GEAR

94
00:07:37,820 --> 00:07:38,900
BACK THERE.

95
00:07:38,900 --> 00:07:42,340
MARINES KNOW THIS AS A CH-46.

96
00:07:42,340 --> 00:07:46,900
THIS PROVIDED THE BULK OF THEIR
HEAVY CARGO AND TRANSPORT

97
00:07:46,900 --> 00:07:47,900
CAPABILITY.

98
00:07:47,900 --> 00:07:51,680
>> THE NEXT ONE IS THE COAST
GUARD HELICOPTER HANGING IN THE

99
00:07:51,680 --> 00:07:53,530
AIR.

100
00:07:53,530 --> 00:07:56,999
>> WE HAVE THE SEA GUARD WHICH
WE JUST INSTALLED IN THE MUSEUM.

101

00:07:56,999 --> 00:08:02,349
IT'S A SINGLE ROTOR HELICOPTER.

102
00:08:02,349 --> 00:08:05,709
>> THIS HAS AN INTERESTING
HISTORY.

103
00:08:05,709 --> 00:08:09,680
>> THE HH 52 WAS ONE THAT SAVED
A LOT OF PEOPLE OVER SEVERAL

104
00:08:09,680 --> 00:08:10,680
DECADES.

105
00:08:10,680 --> 00:08:15,719
IT DID THAT BY BEING AMPHIBIOUS,
HALF BOAT, HALF HELICOPTER.

106
00:08:15,719 --> 00:08:20,599
IN 1979 IT RESCUED A LOT OF
PEOPLE FROM A BURNING WRECK.

107
00:08:20,599 --> 00:08:31,929
AN OIL TANKER HIT.

108
00:08:31,929 --> 00:08:34,800
>> I WANT TO KNOW HOW DO THOSE
HELICOPTERS ACTUALLY GET UP OFF

109
00:08:34,800 --> 00:08:40,110
THE GROUND.

110
00:08:40,110 --> 00:08:42,540
>> I AM HERE WITH A COUPLE OF
FRIENDS FROM OUR MIDDLE SCHOOL

111
00:08:42,540 --> 00:08:43,540
THAT ARE VISITING.

112

00:08:43,540 --> 00:08:47,080
WE ARE GOING TO TALK A LITTLE
BIT ABOUT HOW HELICOPTERS AND

113
00:08:47,080 --> 00:08:48,450
AIRPLANES GET OFF THE GROUND.

114
00:08:48,450 --> 00:08:50,180
FIRST THING, WE'LL TALK ABOUT
AIR.

115
00:08:50,180 --> 00:08:52,350
SO, I HAVE GOT YOU AS MY
VOLUNTEER.

116
00:08:52,350 --> 00:08:56,940
WHAT YOU ARE GOING TO DO, YOU
ARE GOING TO BACK UP, TAKE THIS

117
00:08:56,940 --> 00:08:59,440
WITH YOU, HOLD IT LIKE THAT.

118
00:08:59,440 --> 00:09:03,900
YOU ARE GOING TO PUT THREE,
OKAY, YOU ARE GOING TO PUT THREE

119
00:09:03,900 --> 00:09:07,420
BIG BREATHS IN THERE AND SEE HOW
FAR YOU BLOW IT UP.

120
00:09:07,420 --> 00:09:08,770
TWO, THREE.

121
00:09:08,770 --> 00:09:10,120
ALL RIGHT.

122
00:09:10,120 --> 00:09:12,140
THAT'S NOT BAD.

123

00:09:12,140 --> 00:09:13,480
ALL RIGHT.

124
00:09:13,480 --> 00:09:14,480
SHALL I TRY?

125
00:09:14,480 --> 00:09:19,580
HOW MANY DO YOU THINK I WILL DO?

126
00:09:19,580 --> 00:09:21,080
>> FOUR.

127
00:09:21,080 --> 00:09:22,570
>> FOUR?

128
00:09:22,570 --> 00:09:23,930
LET'S BACK IT UP.

129
00:09:23,930 --> 00:09:25,650
KEEP GOING.

130
00:09:25,650 --> 00:09:28,230
THERE WE GO.

131
00:09:28,230 --> 00:09:30,810
ARE WE READY?

132
00:09:30,810 --> 00:09:32,530
ALL RIGHT.

133
00:09:32,530 --> 00:09:35,720
HOW DID I DO?

134
00:09:35,720 --> 00:09:39,490
I DID A LITTLE BIT BETTER THAN
YOU DID.

135
00:09:39,490 --> 00:09:41,040

HERE'S THE THING.

136

00:09:41,040 --> 00:09:43,900

THIS IS KIND OF A PARTY TRICK.

137

00:09:43,900 --> 00:09:54,500

THIS SCIENTIST SAID FASTER
MOVING AIR CREATE AS LOWER

138

00:09:54,500 --> 00:09:55,770

PRESSURE.

139

00:09:55,770 --> 00:10:01,880

YOU WERE TAKING ALL OF THE AIR
OUT OF YOUR LUNGS, I BLEW INTO

140

00:10:01,880 --> 00:10:06,270

IT, MADE THE AIR MOVE FASTER,
THAT CREATED A LOWER PRESSURE.

141

00:10:06,270 --> 00:10:10,370

WHAT ABOUT THE PRESSURE OUTSIDE
THE BAG, IS IT HIGH OR LOW?

142

00:10:10,370 --> 00:10:13,410

WHAT DO YOU THINK?

143

00:10:13,410 --> 00:10:15,810

IT'S LOW IN THE BAG.

144

00:10:15,810 --> 00:10:17,610

WITH HIGH PRESSURE OUTSIDE.

145

00:10:17,610 --> 00:10:21,990

AIR TRIES TO LIKE BE ALL AT ONE
PRESSURE.

146

00:10:21,990 --> 00:10:25,000

THE HIGH PRESSURE RUSHED IN

THERE AND THAT'S HOW I FILLED

147

00:10:25,000 --> 00:10:26,690

THE BAG.

148

00:10:26,690 --> 00:10:28,290

WHAT DOES THIS HAVE TO DO WITH
FLYING.

149

00:10:28,290 --> 00:10:30,780

I KNOW THAT'S WHAT YOU ARE
ASKING.

150

00:10:30,780 --> 00:10:32,870

LET'S TAKE A LOOK AT THIS.

151

00:10:32,870 --> 00:10:34,690

THIS IS AN AIR FOIL.

152

00:10:34,690 --> 00:10:39,120

THIS IS WHAT WE HAVE DONE, WE
HAVE CUT UP AN AIRPLANE WING.

153

00:10:39,120 --> 00:10:40,840

LIKE A LOAF OF BREAD.

154

00:10:40,840 --> 00:10:44,150

IF IT WERE FLYING, THIS WOULD BE
THE LEADING EDGE.

155

00:10:44,150 --> 00:10:47,990

SO AIR HITS THIS FRONT EDGE, CAN
AIR GO THROUGH THIS?

156

00:10:47,990 --> 00:10:49,010

NO.

157

00:10:49,010 --> 00:10:53,380

OF SOME HAS TO GO OVER TOP, SOME

ON THE BOTTOM.

158

00:10:53,380 --> 00:11:01,400

THE AIR ON TOP MOVES FASTER, SO
CREATING WHAT KIND OF PRESSURE?

159

00:11:01,400 --> 00:11:03,060

LOW PRESSURE.

160

00:11:03,060 --> 00:11:05,230

BENEATH IS HIGH PRESSURE.

161

00:11:05,230 --> 00:11:09,200

THAT'S WHAT GETS AN AIRPLANE
INTO THE AIR.

162

00:11:09,200 --> 00:11:12,050

I KNOW THIS IS HARD TO
UNDERSTAND.

163

00:11:12,050 --> 00:11:15,790

YOU ALL PICK UP YOUR PIECES OF
PAPER.

164

00:11:15,790 --> 00:11:16,950

HOLD THEM LIKE THIS.

165

00:11:16,950 --> 00:11:18,530

PINCH THEM.

166

00:11:18,530 --> 00:11:23,000

WE ARE GOING TO PUT IT ON OUR
TOP LIP AND BLOW.

167

00:11:23,000 --> 00:11:25,790

WHICH WAY IS IT GOING TO GO?

168

00:11:25,790 --> 00:11:26,790

LET'S TRY.

169

00:11:26,790 --> 00:11:29,890

ONE, TWO, THREE, GO.

170

00:11:29,890 --> 00:11:31,520

ALL RIGHT.

171

00:11:31,520 --> 00:11:35,140

SO AGAIN, YOU GOT JUST LIKE WHEN
YOU FILL THE BAG, YOU ARE TAKING

172

00:11:35,140 --> 00:11:37,710

THE AIR OUT OF YOUR LUNGS AND
BLOW.

173

00:11:37,710 --> 00:11:40,420

NOW BOTTOM LIP.

174

00:11:40,420 --> 00:11:42,520

WHICH WAY WILL IT GO?

175

00:11:42,520 --> 00:11:44,300

DOWN.

176

00:11:44,300 --> 00:11:49,910

LET'S TRY.

177

00:11:49,910 --> 00:11:51,810

WHICH WAY IS IT GOING?

178

00:11:51,810 --> 00:11:52,810

IT'S GOING UP.

179

00:11:52,810 --> 00:11:57,280

BECAUSE YOU GOT FASTER MOVING
AIR ON TOP, CREATES A LOWER

180

00:11:57,280 --> 00:11:59,760

PRESSURE.

181

00:11:59,760 --> 00:12:03,350

THAT CREATES LIFT AND THAT'S
WHAT LIFTS THE PIECE OF PAPER IN

182

00:12:03,350 --> 00:12:04,800

THE AIR.

183

00:12:04,800 --> 00:12:08,590

SOMEONE ASKS YOU WHAT YOU
LEARNED, YOU SAY COULD I HAVE A

184

00:12:08,590 --> 00:12:11,980

\$20 BILL AND I WILL SHOW YOU.

185

00:12:11,980 --> 00:12:14,310

PUT THE MONEY IN YOUR POCKET AND
YOU WILL HAVE GOTTEN PAID FOR

186

00:12:14,310 --> 00:12:15,970

WHAT YOU LEARNED TODAY.

187

00:12:15,970 --> 00:12:17,880

DON'T TELL ANYBODY.

188

00:12:17,880 --> 00:12:20,550

HOW DO HELICOPTERS WORK?

189

00:12:20,550 --> 00:12:23,440

DO THEY HAVE WINGS?

190

00:12:23,440 --> 00:12:25,560

>> THEY HAVE A PROPELLER.

191

00:12:25,560 --> 00:12:30,800

>> THE ROTOR ON TOP, BLADES ON
TOP HAVE A SIGNIFICANT SHAPE.

192

00:12:30,800 --> 00:12:32,480

LET'S LOOK AT THAT SHAPE.

193

00:12:32,480 --> 00:12:37,620

WHAT DOES THAT LOOK LIKE?

194

00:12:37,620 --> 00:12:39,610

IT KIND OF LOOKS LIKE THIS
SHAPE.

195

00:12:39,610 --> 00:12:40,610

YEAH.

196

00:12:40,610 --> 00:12:44,430

AIR FOILS ARE ALSO ON HELICOPTER
BLADES.

197

00:12:44,430 --> 00:12:47,370

THOSE START SPINNING, THAT
CREATES LIFT AND THAT'S HOW THE

198

00:12:47,370 --> 00:12:50,450

HELICOPTER GETS OFF THE GROUND.

199

00:12:50,450 --> 00:12:52,590

THERE IS AN ISSUE.

200

00:12:52,590 --> 00:12:55,120

ONCE THAT TOP BLADE STARTS
SPINNING, THERE IS SOMETHING

201

00:12:55,120 --> 00:12:56,120

CALLED TORQUE.

202

00:12:56,120 --> 00:12:59,779

I WILL LET MARTY AND ROGER TALK
ABOUT THAT.

203

00:12:59,779 --> 00:13:01,200

>> THANKS, BETH.

204

00:13:01,200 --> 00:13:04,300

ONE OF THE FORCES IS TORQUE.

205

00:13:04,300 --> 00:13:06,780

IT'S AN INTERESTING WAY YOU
SOLVE FOR TORQUE ON A

206

00:13:06,780 --> 00:13:09,480

HELICOPTER.

207

00:13:09,480 --> 00:13:11,680

>> TORQUE IS THE EQUAL AND
OPPOSITE REACTION TO THE

208

00:13:11,680 --> 00:13:15,930

SPINNING FORCE OF THE ENGINE
TURNING THAT ROTOR.

209

00:13:15,930 --> 00:13:17,610

IT'S A LOT OF FORCE.

210

00:13:17,610 --> 00:13:20,910

YOU COULD HAVE A HELICOPTER THAT
DOESN'T HAVE THIS LONG TAIL BOOM

211

00:13:20,910 --> 00:13:24,120

AND HAVE A POWERFUL ENFINISH TO
FIGHT THAT TORQUE.

212

00:13:24,120 --> 00:13:29,890

WHAT WE DO, WE HAVE A LONG TAIL
BOOM WHICH IS A LEVER.

213

00:13:29,890 --> 00:13:34,100

IT'S A SMALLER FORCE OVER A
LONGER DISTANCE.

214

00:13:34,100 --> 00:13:38,540

WHAT WE HAVE IS A SMALL
PROPELLER THAT WILL PUSH AIR,

215

00:13:38,540 --> 00:13:41,310

THAT'S THE FORCE THAT GETS
APPLIED BY THE REFER.

216

00:13:41,310 --> 00:13:48,120

>> IF YOU DIDN'T HAVE THIS, IT
WILL SPIN AROUND AND AROUND.

217

00:13:48,120 --> 00:13:51,280

SOMETHING HAPPENS TO YOUR TAIL
ROTOR AND YOU START WINDING UP

218

00:13:51,280 --> 00:13:52,360

REALLY FAST.

219

00:13:52,360 --> 00:13:57,230

>> ARE YOU READY TO TAKE
QUESTIONS?

220

00:13:57,230 --> 00:14:06,070

LET'S START WITH A VIDEO
QUESTION.

221

00:14:06,070 --> 00:14:07,270

>> BOTH USE WINGS.

222

00:14:07,270 --> 00:14:11,570

IN A HELICOPTER, THE WINGS ARE
JUST A LOT LONGER AND NARROWER.

223

00:14:11,570 --> 00:14:13,890

THE BIG DIFFERENCE IS HOW THE
WINGS ARE PUSHED THROUGH THE

224

00:14:13,890 --> 00:14:14,890

AIR.

225

00:14:14,890 --> 00:14:19,640
WITH AIRPLANE YOU ARE USING
PROPELLER OR JET ENFINISH TO

226

00:14:19,640 --> 00:14:22,750
MOVE THE AIR OVER THE TOP OF IT.

227

00:14:22,750 --> 00:14:26,810
THE HELICOPTER, WHAT WE ARE
DOING IS USING THE ENGINE TO

228

00:14:26,810 --> 00:14:30,540
TURN THE WING AND THAT ALLOWS US
THE ADVANTAGE OF TAKING OFF

229

00:14:30,540 --> 00:14:35,230
VERTICALLY.

230

00:14:35,230 --> 00:14:37,230
>> WHAT DOES THE WORD HELICOPTER
MEAN?

231

00:14:37,230 --> 00:14:43,870
>> IT'S FROM TWO GREEK WORDS,
SPIRAL AND WING.

232

00:14:43,870 --> 00:14:46,390
AND IT GOES BACK ABOUT 150
YEARS.

233

00:14:46,390 --> 00:14:48,570
THE TERM WAS INVENTED IN FRANCE.

234

00:14:48,570 --> 00:14:49,610
>> LET'S GO TO AN AUDIENCE
QUESTION.

235

00:14:49,610 --> 00:14:51,100
WE HAVE OUR FIRST QUESTION.

236
00:14:51,100 --> 00:14:54,740
COME ON UP.

237
00:14:54,740 --> 00:15:01,270
>> ABOUT HOW FAST DO THE
HELICOPTER BLADES GO?

238
00:15:01,270 --> 00:15:03,840
>> ONE THING TO BE AWARE OF,
THEY ARE TURNING IN A CIRCLE.

239
00:15:03,840 --> 00:15:08,310
SO THE PARTS NEAREST THE MAST
ARE TURNING SLOWER THAN THE

240
00:15:08,310 --> 00:15:13,200
PARTS OUT TOWARD THE TIP.

241
00:15:13,200 --> 00:15:15,900
IT CAN BE CLOSE TO THE SPEED OF
SOUND, IF YOU GET UP TO THE

242
00:15:15,900 --> 00:15:19,510
SPEED OF SOUND, BAD THINGS START
TO HAPPEN.

243
00:15:19,510 --> 00:15:23,190
A LOT OF FORCES START TO PILE UP
ON THE BLADE.

244
00:15:23,190 --> 00:15:27,350
TIP, NEAR THE SPEED OF SOUND, A
LOT SLOWER AS YOU GET NEAR THE

245
00:15:27,350 --> 00:15:32,069
MAST.

246

00:15:32,069 --> 00:15:34,680

>> HOW HIGH IS A HELICOPTER ABLE
TO FLY.

247

00:15:34,680 --> 00:15:38,820

>> ABOUT THE HIGHEST EVERYBODY
HAS LANDED A HELICOPTER WAS ON

248

00:15:38,820 --> 00:15:39,820

TOP OF MOUNT EVEREST.

249

00:15:39,820 --> 00:15:42,120

THAT WAS RECENTLY.

250

00:15:42,120 --> 00:15:45,040

THAT WAS PUSHING THINGS.

251

00:15:45,040 --> 00:15:48,190

YOU CAN ACTUALLY GET ABOVE THAT
IF YOU ARE FLYING FORWARD.

252

00:15:48,190 --> 00:15:51,090

IF YOU ARE NOT TRYING TO HOVER,
YOU CAN GO HIGHER.

253

00:15:51,090 --> 00:15:55,980

SO THEY HAVE DONE ALMOST
45,000 FEET IN A HELICOPTER.

254

00:15:55,980 --> 00:15:57,840

SO PRETTY HIGH.

255

00:15:57,840 --> 00:16:00,690

>> HIGHER THAN 800 FEET WE WERE
FLYING AT EARLIER.

256

00:16:00,690 --> 00:16:02,050

>> OH, YEAH.

257

00:16:02,050 --> 00:16:04,780

>> LIKE WE TALKED ABOUT EARLIER,
YOU ARE CLOSE TO HAVING YOUR

258

00:16:04,780 --> 00:16:06,300

HELICOPTER PILOTS LICENSE.

259

00:16:06,300 --> 00:16:12,790

WE THOUGHT WE WOULD GIVE YOU A
FLIGHT TEST.

260

00:16:12,790 --> 00:16:13,790

WE ARE GOING TO HAVE THREE
QUESTIONS.

261

00:16:13,790 --> 00:16:17,240

WE'LL SHOW YOU A SPLIT SCREEN OF
THE COCKPIT CONTROLS AND WHAT'S

262

00:16:17,240 --> 00:16:21,230

HAPPENING ON THE OUTSIDE OF THE
HELICOPTER AND EXPLAIN TO US HOW

263

00:16:21,230 --> 00:16:23,140

THAT AFFECTS THE MOVEMENTS OF
THE HELICOPTER.

264

00:16:23,140 --> 00:16:28,320

LET'S GO TO THE FIRST QUESTION
ON TAIL ROTOR PEDALS.

265

00:16:28,320 --> 00:16:33,870

>> A TAIL ROTOR, THAT'S THE
ANTI-TORQUE DEVICE.

266

00:16:33,870 --> 00:16:38,551

WE CHANGE THE PITCH OF THE
BLADES AND THAT MAKES OUR RIGHT,

267

00:16:38,551 --> 00:16:39,551
LEFT MOVEMENT.

268
00:16:39,551 --> 00:16:46,170
>> WE ARE TALKING ABOUT KIND OF
SPINNING, ONLY IN A CONTROLLED

269
00:16:46,170 --> 00:16:47,170
WAY.

270
00:16:47,170 --> 00:16:48,170
>> RIGHT.

271
00:16:48,170 --> 00:16:49,930
>> LOOKS LIKE YOU GOT THAT ONE
RIGHT.

272
00:16:49,930 --> 00:16:55,170
LET'S GO ON TO OUR NEXT QUESTION
WHICH IS THE COLLECTIVE.

273
00:16:55,170 --> 00:16:56,750
>> WITH THE COLLECTIVE, WHAT WE
ARE DOING, WE ARE GOING TO

274
00:16:56,750 --> 00:17:00,690
CHANGE THE PITCH OF THE BLADES
ALL TOGETHER, ALL AT ONCE.

275
00:17:00,690 --> 00:17:03,490
THAT'S WHAT COLLECTIVE MEANS.

276
00:17:03,490 --> 00:17:06,990
IF WE INCREASE THE PITCH OF THE
BLADES, WHAT WE ARE DOING IS

277
00:17:06,990 --> 00:17:12,939
HAVING THEM CREATE MORE LIFT,
GETTING MORE BITE OF THE AIR,

278

00:17:12,939 --> 00:17:16,350

THAT'S CAUSING US TO RISE.

279

00:17:16,350 --> 00:17:17,650

>> OUTSTANDING.

280

00:17:17,650 --> 00:17:24,139

WE SEE ON THE SCREEN YOU ARE
EXACTLY RIGHT ON THAT ONE.

281

00:17:24,139 --> 00:17:25,949

I THINK YOU HAVE DONE THIS
BEFORE.

282

00:17:25,949 --> 00:17:30,929

AND LET'S HEAD OVER TO OUR NEXT
QUESTION WHICH IS THE STICK, IN

283

00:17:30,929 --> 00:17:31,929

THE COCKPIT.

284

00:17:31,929 --> 00:17:33,859

TALK ABOUT THAT.

285

00:17:33,859 --> 00:17:38,429

>> THAT'S THE CONTROL, IT'S THE
STICK, WHAT THE PILOT IS USING

286

00:17:38,429 --> 00:17:42,990

TO CHANGE THE DIRECTION OF THE
AIRCRAFT, ITS MOVEMENT.

287

00:17:42,990 --> 00:17:48,420

FORWARD TO FLY FORWARD, BACK,
SIDE TO SIDE.

288

00:17:48,420 --> 00:17:52,490

IT'S A MAGIC THAT'S HAPPENING IN
THAT ROTOR HUB.

289

00:17:52,490 --> 00:17:53,490

SO IT'S THE TRICKIEST PART.

290

00:17:53,490 --> 00:17:58,289

WE ARE CHANGING EACH BLADE
INDIVIDUALLY, NOT ALL AT ONCE,

291

00:17:58,289 --> 00:18:04,860

BUT EACH BLADE'S PITCH AS IT
MOVES AROUND THE ROTOR HUB.

292

00:18:04,860 --> 00:18:11,470

IT'S GOING TO CAUSE THE BLADES
TO RISE OR DESCEND AND THAT

293

00:18:11,470 --> 00:18:16,230

CREATES A CHANGE OF THE PATH OF
THOSE BLADES.

294

00:18:16,230 --> 00:18:19,720

AND THAT'S GOING TO CREATE A
CHANGE IN THE DIRECTIONAL FORCE

295

00:18:19,720 --> 00:18:20,720

OF THE HELICOPTER.

296

00:18:20,720 --> 00:18:23,049

IT'S GOING TO ANGLE LEFT TO
RIGHT, FORWARD, BACK.

297

00:18:23,049 --> 00:18:27,779

>> I WAS AMAZED HOW MUCH STEVE
WAS ON THAT STICK BECAUSE IT WAS

298

00:18:27,779 --> 00:18:28,779

CONSTANT.

299

00:18:28,779 --> 00:18:30,679

THERE WAS NO BREAK IN IT.

300

00:18:30,679 --> 00:18:33,870

>> HELICOPTERS HAVE CONTROLS
THAT ARE MORE INTERCONNECTED.

301

00:18:33,870 --> 00:18:38,620

AN AIRPLANE YOU CAN SIT BACK AND
DO ONE THING AT A TIME.

302

00:18:38,620 --> 00:18:43,179

HELICOPTER, ANY MOVEMENT IN THE
COLLECTIVE OR TORQUE PEDALS, YOU

303

00:18:43,179 --> 00:18:45,740

HAVE TO COMPENSATE.

304

00:18:45,740 --> 00:18:49,190

BOTH HANDS AND FEET ARE MOVING.

305

00:18:49,190 --> 00:18:52,490

>> ON OUR FLIGHT WE HAD
SOMETHING INTEREST AND SCARY

306

00:18:52,490 --> 00:18:53,490

HAPPEN.

307

00:18:53,490 --> 00:18:56,590

BETH IS GOING TO TELL US MORE
ABOUT THAT.

308

00:18:56,590 --> 00:18:57,590

>> OKAY.

309

00:18:57,590 --> 00:19:00,100

YES, SOMETHING DID HAPPEN.

310

00:19:00,100 --> 00:19:02,889

WHAT WE ARE GOING TO DO, I'M

GOING TO PLAY YOU A CLIP OF OUR

311

00:19:02,889 --> 00:19:03,889

FLIGHT.

312

00:19:03,889 --> 00:19:07,509

I WANT YOU TO LISTEN REALLY

CAREFULLY TO THE SOUND THAT THE

313

00:19:07,509 --> 00:19:08,509

HELICOPTER IS MAKING.

314

00:19:08,509 --> 00:19:14,870

LET'S PLAY THIS.

315

00:19:14,870 --> 00:19:21,049

OKAY.

316

00:19:21,049 --> 00:19:23,929

DID YOU HEAR ANYTHING DIFFERENT?

317

00:19:23,929 --> 00:19:25,119

ANYTHING?

318

00:19:25,119 --> 00:19:29,400

>> LIKE SORT OF LIKE SOMETHING

SOUND.

319

00:19:29,400 --> 00:19:30,400

>> WHAT DID YOU HEAR?

320

00:19:30,400 --> 00:19:31,700

>> I HEARD A LOT OF MOVEMENT.

321

00:19:31,700 --> 00:19:33,990

IT WAS DIFFERENT THAN THE

SMOOTH.

322

00:19:33,990 --> 00:19:34,990
>> OKAY.

323
00:19:34,990 --> 00:19:35,990
WHAT DID YOU HEAR?

324
00:19:35,990 --> 00:19:39,240
>> IT WAS LIKE LOUD.

325
00:19:39,240 --> 00:19:40,240
>> IT WAS VERY LOUD.

326
00:19:40,240 --> 00:19:41,320
WHAT DID YOU HEAR?

327
00:19:41,320 --> 00:19:43,480
>> SOUNDED LIKE A LOT OF WIND.

328
00:19:43,480 --> 00:19:44,860
>> LIKE A LOT OF WIND.

329
00:19:44,860 --> 00:19:47,230
LET'S LISTEN TO THIS.

330
00:19:47,230 --> 00:19:49,400
LET'S LISTEN TO IT AGAIN.

331
00:19:49,400 --> 00:20:04,920
DID YOU HEAR HOW IT SORT OF WENT
QUIET?

332
00:20:04,920 --> 00:20:10,410
WHAT HAPPENED WAS WE WERE IN THE
HELICOPTER AND WE ASKED THE 11

333
00:20:10,410 --> 00:20:12,789
PILOT TO DISENGAGE THE ROTORS.

334

00:20:12,789 --> 00:20:15,799
SO THE ROTORS ARE THE THINGS
THAT ARE SPINNING THAT CREATES

335
00:20:15,799 --> 00:20:16,809
THE LIFT.

336
00:20:16,809 --> 00:20:19,869
WHAT DO YOU THINK HAPPENED?

337
00:20:19,869 --> 00:20:21,350
DID WE CRASH?

338
00:20:21,350 --> 00:20:22,350
>> GLIDED.

339
00:20:22,350 --> 00:20:24,070
>> WHAT DO YOU THINK?

340
00:20:24,070 --> 00:20:28,349
>> I THINK YOU GLIDED.

341
00:20:28,349 --> 00:20:29,840
>> HOVERING.

342
00:20:29,840 --> 00:20:31,700
>> I THINK YOU GLIDED.

343
00:20:31,700 --> 00:20:49,460
>> LET'S TAKE A LOOK AT WHAT
HAPPENED.

344
00:20:49,460 --> 00:21:06,429
>> OKAY.

345
00:21:06,429 --> 00:21:08,210
WE DIDN'T QUITE LAND.

346

00:21:08,210 --> 00:21:12,019
BUT THE BLADES CONTINUED TO
SPIN.

347
00:21:12,019 --> 00:21:17,289
YOU ARE RIGHT, WE SORT OF GLIDED
DOWN OR AUTO ROTATED.

348
00:21:17,289 --> 00:21:22,549
WHAT HAPPENED WAS AS WE GOT TO
THE RUNWAY, THE PILOT,

349
00:21:22,549 --> 00:21:26,500
THANKFULLY, ENGAGED THE ROTORS
AGAIN, SO WE WERE ABLE TO TAKE

350
00:21:26,500 --> 00:21:27,500
OFF.

351
00:21:27,500 --> 00:21:30,049
YOU HAVE TINY LITTLE
HELICOPTERS.

352
00:21:30,049 --> 00:21:31,799
WE ARE GOING TO AUTO ROTATE
THEM.

353
00:21:31,799 --> 00:21:33,740
EVERYBODY HOLD THEM UP.

354
00:21:33,740 --> 00:21:36,350
ON THE COUNT OF THREE, DROP
THEM.

355
00:21:36,350 --> 00:21:39,369
ARE THEY GOING TO DROP OR SPIN?

356
00:21:39,369 --> 00:21:41,220
READY, ONE, TWO, THREE.

357

00:21:41,220 --> 00:21:45,179

LET'S SEE WHAT HAPPENS.

358

00:21:45,179 --> 00:21:46,440

YOU ALL LANDED SAFELY.

359

00:21:46,440 --> 00:21:47,639

NO ONE GOT HURT.

360

00:21:47,639 --> 00:21:50,220

MARTY, ROGER, BACK TO YOU.

361

00:21:50,220 --> 00:21:54,900

>> I HAVE TO TELL YOU ONE HIDDEN

SECRET ABOUT THAT VIDEO.

362

00:21:54,900 --> 00:21:56,830

BETH AND I WEREN'T IN THE
HELICOPTER WHEN THAT HAPPENED.

363

00:21:56,830 --> 00:22:06,299

WE TOOK THE CREW AND LET THEM GO
IN THERE.

364

00:22:06,299 --> 00:22:08,780

AS A PILOT, IT'S QUITE A BIT OF
FUN.

365

00:22:08,780 --> 00:22:11,470

>> IT'S A BLAST.

366

00:22:11,470 --> 00:22:13,700

>> ONE OF THE THINGS THAT'S
HAPPENING WITH HELICOPTERS,

367

00:22:13,700 --> 00:22:17,880

THERE IS A NEW AGE OF
HELICOPTERS WITH DRONES. 12

368

00:22:17,880 --> 00:22:18,880

TELL US ABOUT THAT.

369

00:22:18,880 --> 00:22:26,100

>> A LOT OF YOU HAVE SEEN THE
QUAD COPTERS.

370

00:22:26,100 --> 00:22:31,520

THEY ARE SIMPLER IN THE TERMS OF
THE WAY THEY ARE CONTROLLED.

371

00:22:31,520 --> 00:22:36,129

THEY ARE CONTROLLING THE SPEED
OF ELECTRIC MOTORS AND THAT'S

372

00:22:36,129 --> 00:22:38,799

JUST DRIVING A FIXED PITCH
PROPELLER.

373

00:22:38,799 --> 00:22:42,649

THERE IS NO COLLECTIVE CONTROL
ON THOSE.

374

00:22:42,649 --> 00:22:45,639

IF YOU SCALE THIS UP AND PUT A
PERSON IN IT AND SOME PEOPLE ARE

375

00:22:45,639 --> 00:22:48,970

STARTING TO DO THIS NOW, IT GETS
KIND OF TRICKY.

376

00:22:48,970 --> 00:22:51,960

YOU CAN GET SICK RIDING ONE OF
THOSE.

377

00:22:51,960 --> 00:22:55,080

ANY LITTLE MOVEMENT TO CONTROL
THE THING, YOU ARE GOING TO FEEL

378

00:22:55,080 --> 00:22:56,440
STRONGLY.

379
00:22:56,440 --> 00:23:00,419
HELICOPTER, IT'S NICE AND STABLE
IN THE CABIN AND THE ROTOR IS

380
00:23:00,419 --> 00:23:02,299
DOING ALL THE MOVING PART.

381
00:23:02,299 --> 00:23:05,659
IN THE DRONE, THE WHOLE THING IS
PITCHING AROUND.

382
00:23:05,659 --> 00:23:06,990
>> DRONES DON'T AUTO ROTATE.

383
00:23:06,990 --> 00:23:12,809
>> NO, IF YOU LOSE THE POWER, IT
WILL COME DOWN.

384
00:23:12,809 --> 00:23:16,710
YOU WILL NEED A PARACHUTE.

385
00:23:16,710 --> 00:23:22,059
>> WE COLLECTED THE FIRST
DELIVERY DRONE.

386
00:23:22,059 --> 00:23:28,789
>> IT MADE A DELIVERY OF
MEDICINE.

387
00:23:28,789 --> 00:23:32,350
>> THAT IS INTERESTING.

388
00:23:32,350 --> 00:23:37,149
TELL ME ABOUT THE OFFSPRING.

389
00:23:37,149 --> 00:23:43,760

>> THE ADVANTAGE, IT CAN TAKE
OFF VERTICALLY.

390

00:23:43,760 --> 00:23:45,860
YOU HAVE TO CARRY THE EXTRA
PARTS WITH YOU.

391

00:23:45,860 --> 00:23:47,889
PART AIRPLANE, PART HELICOPTER.

392

00:23:47,889 --> 00:23:51,549
IT'S NOT DOING EITHER ONE OF
THOSE THINGS AS GOOD AS A PURE

393

00:23:51,549 --> 00:23:55,960
AIRPLANE OR AS A HELICOPTER IN
HOVERING.

394

00:23:55,960 --> 00:24:00,259
>> THERE IS A NEW DESIGN THAT
HAS TWO ROTORS STACKED.

395

00:24:00,259 --> 00:24:03,309
>> ONE REASON YOU MIGHT DO THAT,
THEY HAVE TWO ROTORS ON TOP OF

396

00:24:03,309 --> 00:24:09,779
EACH OTHER, YOU NEED A NARROWER
HELICOPTER, LET'S SAY YOU ARE ON 13

397

00:24:09,779 --> 00:24:14,369
A SHIP, YOU DON'T HAVE ENOUGH
ROOM FOR THAT FULL ROTOR SPAN.

398

00:24:14,369 --> 00:24:15,539
YOU MIGHT DO THAT.

399

00:24:15,539 --> 00:24:19,649
OR IF YOU ARE TRYING TO GO
FASTER, IF YOU STACK THE ROTORS

400

00:24:19,649 --> 00:24:23,639

ON TOP OF EACH OTHER, THEY WILL
REACH THEIR SPEED LIMIT WHICH IS

401

00:24:23,639 --> 00:24:27,320

CALLED RETREATING BLADE.

402

00:24:27,320 --> 00:24:28,809

THEY COUNTER ACT THAT EFFECT.

403

00:24:28,809 --> 00:24:32,299

YOU CAN PUSH INTO THAT REGIME OF
FLIGHT WHICH A SINGLE ROTOR

404

00:24:32,299 --> 00:24:33,829

HELICOPTER CANNOT DO.

405

00:24:33,829 --> 00:24:39,489

>> BUT THE FROG BEHIND US, THEY
DON'T HAVE TO DEAL WITH THE SPIN

406

00:24:39,489 --> 00:24:40,489

OF TORQUE.

407

00:24:40,489 --> 00:24:42,549

>> THEY DON'T HAVE THE TORQUE
PROBLEM.

408

00:24:42,549 --> 00:24:45,229

>> READY TO GIVE QUESTIONS A
WHIRL?

409

00:24:45,229 --> 00:24:46,229

>> SURE.

410

00:24:46,229 --> 00:24:50,140

>> WOULD A HELICOPTER BE ABLE TO
LAND ON MARS?

411

00:24:50,140 --> 00:24:54,369

>> THIS IS ACTUALLY NOT AS CRAZY
A QUESTION AS YOU MIGHT THINK.

412

00:24:54,369 --> 00:24:58,450

AT THIS MOMENT, ENGINEERS AT THE
JET PROPULSION LABORATORY ARE

413

00:24:58,450 --> 00:25:02,929

DEVELOPING A HELICOPTER TO FLY
ON MARS AS PART OF THEIR MARS

414

00:25:02,929 --> 00:25:04,580

SAMPLING ROVER.

415

00:25:04,580 --> 00:25:09,190

THEY ARE LOOKING AT FOR
DIFFERENT WAYS TO GO OUT AND GET

416

00:25:09,190 --> 00:25:10,190

SAMPLES.

417

00:25:10,190 --> 00:25:13,970

THE ONE PROBLEM WITH THE MARS
ROVERS THAT THEY HAVE HAD, THEY

418

00:25:13,970 --> 00:25:19,039

GET BOGGED DOWN AND THE LOOSE
SOIL ON MARS.

419

00:25:19,039 --> 00:25:22,840

IF YOU CAN FLY AROUND AND GET
SAMPLES, IT WOULD BE EASIER.

420

00:25:22,840 --> 00:25:24,850

FLYING ON MARS IS NOT A SIMPLE
THING.

421

00:25:24,850 --> 00:25:27,009
THE AIR IS VERY THIN.

422
00:25:27,009 --> 00:25:31,720
YOU NEED A LOT BIGGER ROTORS TO
MAKE THAT WORK OR MAYBE MORE

423
00:25:31,720 --> 00:25:32,760
POWER.

424
00:25:32,760 --> 00:25:35,769
IT'S A REALLY BIG ENGINEERING
CHALLENGE.

425
00:25:35,769 --> 00:25:38,570
BUT ESSENTIALLY WHAT THEY ARE
DOING IS MAKING A FANCY DRONE TO

426
00:25:38,570 --> 00:25:39,570
FLY ON MARS.

427
00:25:39,570 --> 00:25:41,640
>> OKAY. 14
WE HAVE AN AUDIENCE QUESTION

428
00:25:41,640 --> 00:25:42,640
NEXT.

429
00:25:42,640 --> 00:25:45,720
COME ON UP.

430
00:25:45,720 --> 00:25:50,779
>> HOW DOES A HELICOPTER STAY
BALANCED WHEN THERE IS UNEVEN

431
00:25:50,779 --> 00:25:51,779
WEIGHT?

432
00:25:51,779 --> 00:25:55,600

>> HOW DOES A HELICOPTER FLY IF
IT'S UNBALANCED.

433

00:25:55,600 --> 00:25:59,169
AND THIS IS A VERY TRICKY PART
WITH HELICOPTERS.

434

00:25:59,169 --> 00:26:03,619
HELICOPTERS ARE USUALLY MORE
DIFFICULT TO HANDLE WITH WAIT

435

00:26:03,619 --> 00:26:05,419
THAT'S NOT PERFECTLY BALANCED.

436

00:26:05,419 --> 00:26:09,490
AIRPLANES, THEY ARE EASIER TO
TRIM OUT.

437

00:26:09,490 --> 00:26:11,619
HELICOPTERS, IT'S NARROW.

438

00:26:11,619 --> 00:26:14,559
WHEN YOU LOOK AT HOW A
HELICOPTER IS BUILT, THERE IS A

439

00:26:14,559 --> 00:26:18,130
LOT OF THOUGHT GOING TO WHERE
YOU PUT THE ENGINES, THE GAS

440

00:26:18,130 --> 00:26:19,130
TANK.

441

00:26:19,130 --> 00:26:22,619
YOU HAVE TO HAVE MOST OF YOUR
WEIGHT HAS TO BE RIGHT UNDER THE

442

00:26:22,619 --> 00:26:24,190
CENTER OF THE ROTOR.

443

00:26:24,190 --> 00:26:27,881
SO YOU HAVE TO DESIGN THE
HELICOPTER, ANYTHING THAT IS

444

00:26:27,881 --> 00:26:32,490
GOING TO CHANGE IN WEIGHT, THE
GAS, PEOPLE YOU PICK UP OR CARGO

445

00:26:32,490 --> 00:26:37,350
YOU LOAD ON, THAT SHOULD BE
BALANCED, CENTERED ON THAT ROTOR

446

00:26:37,350 --> 00:26:38,350
SYSTEM.

447

00:26:38,350 --> 00:26:41,940
IF YOU HAVE A FROG, IT'S EASIER.

448

00:26:41,940 --> 00:26:46,259
IT'S LIKE A BOARD BEING HELD UP
AT BOTH ENDS RATHER THAN A

449

00:26:46,259 --> 00:26:49,539
SEESAW, IT'S GOING TO BE MORE
STABLE.

450

00:26:49,539 --> 00:26:53,799
THAT'S THE BEST WAY TO DEAL WITH
CARGO THAT'S OUT OF WHACK.

451

00:26:53,799 --> 00:26:57,820
SINGLE ROTOR HELICOPTER, YOU
HAVE TO DESIGN CAREFULLY.

452

00:26:57,820 --> 00:27:00,999
>> THANK YOU FOR TALKING WITH
US.

453

00:27:00,999 --> 00:27:05,190
WE LIKE TO THANK OUR SPONSORS

AND IN TWO WEEKS WE'LL HAVE A

454

00:27:05,190 --> 00:27:07,549

SHOW THAT IS GOING TO ROCK.

455

00:27:07,549 --> 00:27:10,600

HI, I'M MARTY.

456

00:27:10,600 --> 00:27:14,450

CHECK THIS OUT.

457

00:27:14,450 --> 00:27:18,720

IN THIS CASE ARE ROCKS FROM THE
SURFACE OF THE MOON.

458

00:27:18,720 --> 00:27:24,299

THE MOON. 15

THESE ROCKS WERE PICKED UP BY

459

00:27:24,299 --> 00:27:29,710

THE ASTRONAUTS ON APOLLO'S 15,
16, 17.

460

00:27:29,710 --> 00:27:34,019

ASTRONAUTS LOOK DOWN, THERE IS A
COOL ROCK, THEY PICKED IT UP AND

461

00:27:34,019 --> 00:27:37,179

RIGHT NOW THEY ARE IN MY HAND.

462

00:27:37,179 --> 00:27:42,830

IF YOU THINK THIS IS COOL, BE
SURE TO TUNE IN TO STEM IN 30.

463

00:27:42,830 --> 00:27:45,649

IF YOU WANT TO KNOW WHAT IT'S
LIKE TO FLY IN A HELICOPTER, WE

464

00:27:45,649 --> 00:27:52,820

POSTED ON THE WEBSITE A VIDEO OF
US FLYING.