1
00:00:11,990 --> 00:00:09,270
however the zero gravity of orbit causes

2
00:00:15,190 --> 00:00:12,000
a number of undesirable physiological

3
00:00:17,910 --> 00:00:15,200
changes and weakening of the bones as

4
00:00:20,070 --> 00:00:17,920
well as creating practical problems with

5
00:00:22,550 --> 00:00:20,080
liquids etc

6
00:00:25,429 --> 00:00:22,560
one would therefore want any long-term

7
00:00:27,189 --> 00:00:25,439
base for human beings to be on a planet

8
00:00:29,830 --> 00:00:27,199
or moon

9
00:00:32,630 --> 00:00:29,840
by digging into the surface one would

10
00:00:35,910 --> 00:00:32,640
get thermal insulation and protection

11
00:00:38,310 --> 00:00:35,920
from meteors and cosmic rays

12
00:00:41,030 --> 00:00:38,320
the planet or moon could also serve as

13
00:00:43,190 --> 00:00:41,040

the source of the raw materials that

14
00:00:46,069 --> 00:00:43,200
would be needed if the extraterrestrial

15
00:00:48,869 --> 00:00:46,079
community was to be self-sustaining

16
00:00:51,350 --> 00:00:48,879
independently of earth

17
00:00:57,029 --> 00:00:51,360
what are the possible sites of the human

18
00:01:02,790 --> 00:00:59,990
the most obvious is the moon

19
00:01:04,469 --> 00:01:02,800
it is closed by and relatively easy to

20
00:01:07,510 --> 00:01:04,479
reach

21
00:01:09,510 --> 00:01:07,520
we have already landed on it and driven

22
00:01:12,789 --> 00:01:09,520
across it in a plaguey

23
00:01:15,510 --> 00:01:12,799
on the other hand the moon is small and

24
00:01:18,870 --> 00:01:15,520
without atmosphere or a magnetic field

25
00:01:20,710 --> 00:01:18,880
to deflect the solar radiation particles

26
00:01:23,510 --> 00:01:20,720
like on earth

27
00:01:26,230 --> 00:01:23,520
there is no liquid water but there may

28
00:01:28,550 --> 00:01:26,240
be ice in the craters at the north and

29
00:01:31,590 --> 00:01:28,560
south poles

30
00:01:34,630 --> 00:01:31,600
a colony on the moon could use this as a

31
00:01:41,350 --> 00:01:34,640
source of oxygen with power provided by

32
00:01:47,190 --> 00:01:43,910
the moon could be a base for travel to

33
00:01:50,710 --> 00:01:47,200
the rest of the solar system

34
00:01:53,030 --> 00:01:50,720
mars is the obvious next target

35
00:01:55,590 --> 00:01:53,040
it is half as far again as the earth

36
00:01:57,990 --> 00:01:55,600
from the sun and so receives half the

37
00:02:00,789 --> 00:01:58,000
warmth

38
00:02:03,749 --> 00:02:00,799

it once had a magnetic field but it

39
00:02:06,149 --> 00:02:03,759
decayed four billion years ago leaving

40
00:02:08,229 --> 00:02:06,159
mars without protection from solar

41
00:02:11,350 --> 00:02:08,239
radiation

42
00:02:13,670 --> 00:02:11,360
the strip mars of most of its atmosphere

43
00:02:17,830 --> 00:02:13,680
leaving it with only one percent of the

44
00:02:23,030 --> 00:02:20,229
however the pressure must have been

45
00:02:25,830 --> 00:02:23,040
higher in the past because we see what

46
00:02:27,750 --> 00:02:25,840
appear to be runoff channels and dried

47
00:02:31,670 --> 00:02:27,760
up lakes

48
00:02:35,110 --> 00:02:31,680
liquid water cannot exist on mars now

49
00:02:37,830 --> 00:02:35,120
it would vaporize in the near vacuum

50
00:02:40,470 --> 00:02:37,840
this suggests that mars had a warm wet

51
00:02:43,589 --> 00:02:40,480
period during which life might have

52
00:02:45,670 --> 00:02:43,599
appeared either spontaneously or through

53
00:02:48,710 --> 00:02:45,680
panspermia

54
00:02:51,350 --> 00:02:48,720
there is no sign of life on mars now but

55
00:02:53,670 --> 00:02:51,360
if we found evidence that life had once

56
00:02:56,150 --> 00:02:53,680
existed it would indicate that the

57
00:03:00,149 --> 00:02:56,160
probability of life developing on a

58
00:03:02,309 --> 00:03:00,159
suitable planet was fairly high

59
00:03:04,710 --> 00:03:02,319
nasa has sent a large number of

60
00:03:08,550 --> 00:03:04,720
spacecraft to mars starting with

61
00:03:10,790 --> 00:03:08,560
mourinho iv in 1964.

62
00:03:13,509 --> 00:03:10,800
it has surveyed a planet with a number

63
00:03:16,070 --> 00:03:13,519

of orbiters the latest being the mars

64
00:03:18,070 --> 00:03:16,080
reconnaissance orbiter

65
00:03:20,790 --> 00:03:18,080
these orbiters have revealed deep

66
00:03:22,869 --> 00:03:20,800
valleys and the highest mountains in the

67
00:03:25,750 --> 00:03:22,879
solar system

68
00:03:29,110 --> 00:03:25,760
nasa has also landed a number of probes

69
00:03:31,270 --> 00:03:29,120
on the surface of mars most recently the

70
00:03:33,910 --> 00:03:31,280
two mars rovers

71
00:03:36,470 --> 00:03:33,920
these have sent back pictures of a dry

72
00:03:38,789 --> 00:03:36,480
desert landscape

73
00:03:41,589 --> 00:03:38,799
however there is a large quantity of

74
00:03:43,430 --> 00:03:41,599
water in the form of ice in the polar

75
00:03:46,309 --> 00:03:43,440
regions

76
00:03:49,350 --> 00:03:46,319
a colony on mars could use this as a

77
00:03:53,589 --> 00:03:49,360
source of oxygen

78
00:03:55,509 --> 00:03:53,599
there has been volcanic activity on mars

79
00:03:58,229 --> 00:03:55,519
this would have brought minerals and

80
00:04:00,710 --> 00:03:58,239
metals to the surface which a colony

81
00:04:03,509 --> 00:04:00,720
could use

82
00:04:06,070 --> 00:04:03,519
the moon and mars are the most suitable

83
00:04:07,830 --> 00:04:06,080
sites for space colonies in the solar

84
00:04:10,630 --> 00:04:07,840
system

85
00:04:13,429 --> 00:04:10,640
mercury and venus are too hot while

86
00:04:18,870 --> 00:04:13,439
jupiter and saturn are gas giants with

87
00:04:25,990 --> 00:04:21,509
the moons of mars are very small and

88
00:04:28,310 --> 00:04:26,000

have no advantages over mars itself

89
00:04:30,870 --> 00:04:28,320
some of the moons of jupiter and saturn

90
00:04:34,790 --> 00:04:30,880
might be possible

91
00:04:37,270 --> 00:04:34,800
in particular titan a moon of saturn is

92
00:04:41,590 --> 00:04:37,280
larger and more massive than our moon

93
00:04:47,909 --> 00:04:44,070
the cassini-huygens mission of nasa and

94
00:04:52,390 --> 00:04:47,919
esa has landed a probe on titan which

95
00:04:55,830 --> 00:04:52,400
has sent back pictures of the surface

96
00:04:58,870 --> 00:04:55,840
however it is very cold being so far

97
00:05:02,870 --> 00:04:58,880
from the sun and i wouldn't fancy living

98
00:05:06,390 --> 00:05:02,880
next to a lake of liquid method

99
00:05:08,550 --> 00:05:06,400
what about beyond the solar system

100
00:05:10,950 --> 00:05:08,560
our observations indicate that a

101
00:05:13,670 --> 00:05:10,960
significant fraction of stars have

102
00:05:17,590 --> 00:05:13,680
planets around them

103
00:05:19,990 --> 00:05:17,600
so far we can detect only giant planets

104
00:05:22,150 --> 00:05:20,000
like jupiter and saturn but it is

105
00:05:24,550 --> 00:05:22,160
reasonable to assume that they will be

106
00:05:27,110 --> 00:05:24,560
accompanied by smaller earth-like

107
00:05:28,870 --> 00:05:27,120
planets

108
00:05:31,510 --> 00:05:28,880
some of these will lie in the gold

109
00:05:33,749 --> 00:05:31,520
deluxe zone where the distance from the

110
00:05:38,710 --> 00:05:33,759
star is in the right range for liquid

111
00:05:43,990 --> 00:05:41,029
there are around a thousand stars within

112
00:05:46,469 --> 00:05:44,000
30 light years of earth

113
00:05:49,430 --> 00:05:46,479

if one percent of these have earth-sized

114
00:05:54,070 --> 00:05:49,440
planets in the gold deluxe zone we have

115
00:05:59,110 --> 00:05:56,390
we can't envisage visiting them with

116
00:06:02,950 --> 00:05:59,120
current technology but we should make

117
00:06:06,790 --> 00:06:02,960
interstellar travel a long term aim

118
00:06:09,510 --> 00:06:06,800
by long term i mean over the next 200 to

119
00:06:12,390 --> 00:06:09,520
500 years

120
00:06:16,710 --> 00:06:12,400
the human race has existed as a separate

121
00:06:19,990 --> 00:06:16,720
species for about 2 million years

122
00:06:22,550 --> 00:06:20,000
civilization began about 10 000 years

123
00:06:25,590 --> 00:06:22,560
ago and the rate of development has been

124
00:06:28,070 --> 00:06:25,600
steadily increasing

125
00:06:30,710 --> 00:06:28,080
if the human race is to continue for

126
00:06:36,309 --> 00:06:30,720
another million years we will have to

127
00:06:36,319 --> 00:07:04,150
thank you for listening

128
00:07:07,589 --> 00:07:06,390
thank you professor hawking

129
00:07:09,510 --> 00:07:07,599
for uh

130
00:07:11,189 --> 00:07:09,520
that series of insights and and a

131
00:07:12,150 --> 00:07:11,199
challenge to us all

132
00:07:13,909 --> 00:07:12,160
uh

133
00:07:16,309 --> 00:07:13,919
i believe now for those of you that

134
00:07:18,550 --> 00:07:16,319
wanted to do flash photography it would

135
00:07:22,150 --> 00:07:18,560
be okay for a few moments

136
00:07:24,550 --> 00:07:22,160
and i invite you all to head upstairs

137
00:07:26,870 --> 00:07:24,560
for a very nice reception courtesy of