STEMonstrations

VESTIBULAR SYSTEM

1
00:00:00,000 --> 00:00:08,870
[Music]

2
00:00:08,880 --> 00:00:12,930
go

3
00:00:12,940 --> 00:00:24,790
[Music]

4
00:00:31,269 --> 00:00:27,830
hello i'm aki hoshide

5
00:00:33,270 --> 00:00:31,279
and i'm megan macarthur

6
00:00:35,670 --> 00:00:33,280
we're astronauts living and working

7
00:00:37,670 --> 00:00:35,680
aboard the international space station

8
00:00:40,150 --> 00:00:37,680
have you ever wondered how astronauts

9
00:00:42,790 --> 00:00:40,160
orient themselves in space when there is

10
00:00:44,389 --> 00:00:42,800
no feeling of up or down

11
00:00:46,389 --> 00:00:44,399
in this episode we'll discuss the

12
00:00:48,950 --> 00:00:46,399
vestibular system and the effects of

13
00:00:51,510 --> 00:00:48,960

free fall on our sense of direction up

14
00:00:53,590 --> 00:00:51,520
here on space station let's go try out

15
00:00:55,590 --> 00:00:53,600
some experiments with spatial

16
00:00:57,590 --> 00:00:55,600
orientation

17
00:00:59,990 --> 00:00:57,600
the vestibular system is the sensory

18
00:01:02,150 --> 00:01:00,000
system our brains use to process

19
00:01:05,270 --> 00:01:02,160
movement using the perceived pull of

20
00:01:07,429 --> 00:01:05,280
gravity structures in our inner ears and

21
00:01:08,469 --> 00:01:07,439
through processing visual cues from our

22
00:01:10,310 --> 00:01:08,479
eyes

23
00:01:13,830 --> 00:01:10,320
this information is necessary for

24
00:01:15,990 --> 00:01:13,840
balance motion and spatial orientation

25
00:01:18,550 --> 00:01:16,000
the vestibular system is made up of

26
00:01:21,670 --> 00:01:18,560
several parts primarily located in the

27
00:01:23,910 --> 00:01:21,680
inner ears in a series of interconnected

28
00:01:26,789 --> 00:01:23,920
chambers called the labyrinth the

29
00:01:29,270 --> 00:01:26,799
labyrinth has three semi-circular canals

30
00:01:31,990 --> 00:01:29,280
each oriented in a different plane to

31
00:01:33,670 --> 00:01:32,000
detect different movements

32
00:01:35,749 --> 00:01:33,680
in the micro-g environment here on the

33
00:01:38,230 --> 00:01:35,759
space station the pull of gravity our

34
00:01:40,310 --> 00:01:38,240
body is accustomed to is different and

35
00:01:43,190 --> 00:01:40,320
the vestibular system receives mixed

36
00:01:45,270 --> 00:01:43,200
messages the semicircular canals sends

37
00:01:47,990 --> 00:01:45,280
head rotation in space just as they do

38
00:01:50,469 --> 00:01:48,000

on earth because the otolith organs rely

39
00:01:52,310 --> 00:01:50,479
on gravity to detect linear motion they

40
00:01:54,870 --> 00:01:52,320
don't function the same way in micro g

41
00:01:56,709 --> 00:01:54,880
as they do on earth you've probably

42
00:01:59,190 --> 00:01:56,719
experienced similar mixed messages on

43
00:02:01,190 --> 00:01:59,200
earth some people feel dizzy when they

44
00:02:03,429 --> 00:02:01,200
read a book in a moving car

45
00:02:06,149 --> 00:02:03,439
the structures in your ear pick up on

46
00:02:08,869 --> 00:02:06,159
the motion of the car but your eyes are

47
00:02:10,949 --> 00:02:08,879
fixed on the motionless book these mixed

48
00:02:13,350 --> 00:02:10,959
messages can cause dizziness as your

49
00:02:15,350 --> 00:02:13,360
brain tries to determine if you're at

50
00:02:17,670 --> 00:02:15,360
rest or in motion

51
00:02:19,190 --> 00:02:17,680
we call that dizzy feeling motion

52
00:02:21,510 --> 00:02:19,200
sickness

53
00:02:23,510 --> 00:02:21,520
docking sequence is complete welcome to

54
00:02:25,510 --> 00:02:23,520
the international space station

55
00:02:27,750 --> 00:02:25,520
endurance copies and backing completes

56
00:02:29,589 --> 00:02:27,760
and happy to be here at the iss

57
00:02:32,070 --> 00:02:29,599
this is similar to the way many

58
00:02:35,270 --> 00:02:32,080
first-time astronauts feel when they

59
00:02:38,309 --> 00:02:35,280
arrive on the space station up here we

60
00:02:40,470 --> 00:02:38,319
call that space adaptation syndrome or

61
00:02:42,470 --> 00:02:40,480
space motion sickness

62
00:02:45,030 --> 00:02:42,480
this is a period where our bodies are

63
00:02:47,030 --> 00:02:45,040

adjusting and orienting to the new

64
00:02:49,430 --> 00:02:47,040
free-fall environment

65
00:02:51,589 --> 00:02:49,440
one way we fight off space motion

66
00:02:54,470 --> 00:02:51,599
sickness is by reducing our body

67
00:02:57,750 --> 00:02:54,480
movements until we are acclimated

68
00:03:01,190 --> 00:02:57,760
we also use labels signs and the design

69
00:03:04,070 --> 00:03:01,200
of the station to help orient ourselves

70
00:03:05,589 --> 00:03:04,080
lights are positioned up along what we

71
00:03:08,309 --> 00:03:05,599
call the overhead

72
00:03:11,030 --> 00:03:08,319
and air intakes are positioned down

73
00:03:13,589 --> 00:03:11,040
towards what we call the deck

74
00:03:16,830 --> 00:03:13,599
when we return to earth our bodies once

75
00:03:19,270 --> 00:03:16,840
again must adapt to perceived change in

76
00:03:21,030 --> 00:03:19,280
gravity close your eyes and think about

77
00:03:22,710 --> 00:03:21,040
where you are right now

78
00:03:24,229 --> 00:03:22,720
can you determine which way is up with

79
00:03:25,910 --> 00:03:24,239
your eyes closed

80
00:03:28,149 --> 00:03:25,920
what about down

81
00:03:29,670 --> 00:03:28,159
now open your eyes and think about what

82
00:03:31,270 --> 00:03:29,680
signals you receive to help you

83
00:03:33,990 --> 00:03:31,280
determine direction

84
00:03:35,270 --> 00:03:34,000
on earth we perceive up or down relative

85
00:03:36,949 --> 00:03:35,280
to gravity

86
00:03:39,110 --> 00:03:36,959
while in orbit on station we're

87
00:03:46,070 --> 00:03:39,120
essentially in free fall there isn't a

88
00:03:51,589 --> 00:03:49,509

welcome to which way are you pointing

89
00:03:53,350 --> 00:03:51,599
where our astronauts try to figure out

90
00:03:55,030 --> 00:03:53,360
their orientation while they're in

91
00:03:57,429 --> 00:03:55,040
micro-g

92
00:03:59,670 --> 00:03:57,439
they'll have eye masks on and earplugs

93
00:04:01,990 --> 00:03:59,680
in to remove those senses

94
00:04:03,830 --> 00:04:02,000
on the space station gravity has mostly

95
00:04:05,509 --> 00:04:03,840
been removed as well

96
00:04:08,869 --> 00:04:05,519
they'll pick an object and see if they

97
00:04:11,509 --> 00:04:08,879
can point to it after being spun around

98
00:04:15,350 --> 00:04:11,519
first some terms you should know

99
00:04:17,509 --> 00:04:15,360
pitch is shown as an exaggerated nod

100
00:04:19,830 --> 00:04:17,519
roll is shown as you move your head from

101
00:04:22,069 --> 00:04:19,840
shoulder to shoulder

102
00:04:24,150 --> 00:04:22,079
and yaw is shown as if you were shaking

103
00:04:26,050 --> 00:04:24,160
your head no

104
00:04:41,350 --> 00:04:26,060
let's play

105
00:04:44,150 --> 00:04:41,360
[Music]

106
00:04:47,030 --> 00:04:44,160
oh sorry mark

107
00:04:51,880 --> 00:04:47,040
let's try again target ease of flag

108
00:04:51,890 --> 00:05:01,110
[Music]

109
00:05:06,130 --> 00:05:03,110
wrong again mark

110
00:05:11,480 --> 00:05:06,140
okay shane let's see how you do

111
00:05:27,189 --> 00:05:22,750
[Music]

112
00:05:29,110 --> 00:05:27,199
there are just too many missing pieces

113
00:05:32,070 --> 00:05:29,120

of their vestibular systems to

114
00:05:33,590 --> 00:05:32,080
accurately orient themselves

115
00:05:35,749 --> 00:05:33,600
i encourage you to think about the way

116
00:05:37,830 --> 00:05:35,759
your vestibular system helps you respond

117
00:05:39,510 --> 00:05:37,840
to information from your environment and

118
00:05:41,830 --> 00:05:39,520
take note of what's happening next time

119
00:05:43,350 --> 00:05:41,840
you feel a little off balance

120
00:05:45,350 --> 00:05:43,360
thanks for exploring the effects of

121
00:05:47,670 --> 00:05:45,360
micro-g on the vestibular system with us

122
00:06:06,070 --> 00:05:47,680
today see you next time