
GH
CANE SUGAR
15

1
00:00:08,690 --> 00:00:06,019
so I just bought myself a 10 gallon

2
00:00:11,120 --> 00:00:08,700
aquarium the reason I've done this is I

3
00:00:14,299 --> 00:00:11,130
spend quite a bit of time online people

4
00:00:16,670 --> 00:00:14,309
who think have some doubts about the

5
00:00:18,769 --> 00:00:16,680
shape of the earth and a lot of the

6
00:00:21,580 --> 00:00:18,779
times they make observations of distant

7
00:00:25,240 --> 00:00:21,590
cities or mountains or things like that

8
00:00:30,169 --> 00:00:25,250
for example or look at a city like

9
00:00:32,420 --> 00:00:30,179
Toronto across the lake and they'll see

10
00:00:33,380 --> 00:00:32,430
perhaps more of it or perhaps less of it

11
00:00:35,979 --> 00:00:33,390
than they expect

12
00:00:38,030 --> 00:00:35,989
now the reason of course is refraction

13
00:00:39,729 --> 00:00:38,040

when light travels through the

14
00:00:42,680 --> 00:00:39,739
atmosphere because the atmosphere is

15
00:00:45,020 --> 00:00:42,690
varying density then the light can get

16
00:00:48,080 --> 00:00:45,030
that down you can get bent up and this

17
00:00:52,610 --> 00:00:48,090
can cause more or less of the distance

18
00:00:55,580 --> 00:00:52,620
seemed to be observe people don't really

19
00:00:58,970 --> 00:00:55,590
like seems a bit like you know hand

20
00:01:01,639 --> 00:00:58,980
waving or refraction so good thing would

21
00:01:04,630 --> 00:01:01,649
be to do practical experiment so I

22
00:01:25,760 --> 00:01:04,640
bought this cheap fish tank

23
00:01:28,219 --> 00:01:25,770
from $20 so when light passes it gets

24
00:01:32,210 --> 00:01:28,229
bent more now what I'm gonna do is take

25
00:01:35,630 --> 00:01:32,220
this picture of Chicago I'm gonna stick

26
00:01:36,830 --> 00:01:35,640
it on this end oh the fish tank I want

27
00:01:39,890 --> 00:01:36,840
to take it there for now

28
00:01:44,420 --> 00:01:39,900
I might have to adjust it later and I'm

29
00:01:46,810 --> 00:01:44,430
gonna take let's see what it looks like

30
00:01:50,270 --> 00:01:46,820
from the other end so I'm gonna be

31
00:01:52,910 --> 00:01:50,280
looking down here and seeing what we can

32
00:01:55,550 --> 00:01:52,920
see Oh Chicago now I've got this bit of

33
00:01:57,440 --> 00:01:55,560
curved metal which I'm going to use to

34
00:01:59,240 --> 00:01:57,450
represent the curve of the earth you

35
00:02:02,740 --> 00:01:59,250
know again we're exaggerating things a

36
00:02:04,969 --> 00:02:02,750
lot more here because we want to

37
00:02:05,340 --> 00:02:04,979
actually be able to see things on the

38
00:02:07,320 --> 00:02:05,350

small

39
00:02:09,930 --> 00:02:07,330
scale which normally only exists on a

40
00:02:12,059 --> 00:02:09,940
large scale now you might also noticed

41
00:02:13,890 --> 00:02:12,069
I've got some sugar I'm going to do with

42
00:02:16,770 --> 00:02:13,900
this is first of all I'm going to fill

43
00:02:18,210 --> 00:02:16,780
in the tank with water and I got to look

44
00:02:22,199 --> 00:02:18,220
through this end and see what we can see

45
00:02:25,280 --> 00:02:22,209
of actually can't go over simulated

46
00:02:28,470 --> 00:02:25,290
ground here I'm also going to take this

47
00:02:31,830 --> 00:02:28,480
laser pointer which I just also just got

48
00:02:34,500 --> 00:02:31,840
and shining that through the tank and

49
00:02:36,420 --> 00:02:34,510
what we have to see the the beam of

50
00:02:37,830 --> 00:02:36,430
light Bend now the bend of the beam of

51
00:02:40,020 --> 00:02:37,840
our laser light is going to be the same

52
00:02:41,460 --> 00:02:40,030
as the bend of visible light go in one

53
00:02:43,559 --> 00:02:41,470
way or the other doesn't matter which

54
00:02:45,210 --> 00:02:43,569
direction it's going you'll get to see

55
00:02:47,250 --> 00:02:45,220
the light Bend and I'm also going to

56
00:02:49,830 --> 00:02:47,260
show you what you can see from this end

57
00:02:52,050 --> 00:02:49,840
so first of all I'm gonna do it without

58
00:02:54,240 --> 00:02:52,060
sugar then I'm gonna add sugar now when

59
00:02:56,400 --> 00:02:54,250
you actually what you do you fill the

60
00:02:58,289 --> 00:02:56,410
tank with water then you pour sugar into

61
00:03:00,270 --> 00:02:58,299
it lays in the bottom the shoe at the

62
00:03:01,770 --> 00:03:00,280
bottom starts to dissolve and that makes

63
00:03:04,170 --> 00:03:01,780

the refractive index the density

64
00:03:06,750 --> 00:03:04,180
essentially the optical density of the

65
00:03:09,979 --> 00:03:06,760
water will be higher lower down and

66
00:03:12,930 --> 00:03:09,989
light bends towards a more dense medium

67
00:03:14,759 --> 00:03:12,940
which is what normally happens in the

68
00:03:17,030 --> 00:03:14,769
atmosphere of the air is denser lower

69
00:03:21,060 --> 00:03:17,040
down so you should see the light curve

70
00:03:27,900 --> 00:03:21,070
downward and we should looking at this

71
00:03:29,610 --> 00:03:27,910
end see more of Chicago from this end so

72
00:03:40,990 --> 00:03:29,620
let's see what happens

73
00:03:52,700 --> 00:03:50,330
we see it is magnified of course but

74
00:03:54,170 --> 00:03:52,710
it's not distorted in any way they the

75
00:04:00,430 --> 00:03:54,180
image is exactly the same it's just

76
00:04:06,290 --> 00:04:03,940
around about five pounds I think sugar

77
00:04:07,940 --> 00:04:06,300
one thing I didn't take into account was

78
00:04:10,040 --> 00:04:07,950
that it was very very cold in my garage

79
00:04:11,510 --> 00:04:10,050
so it took a really really long time for

80
00:04:17,990 --> 00:04:11,520
the sugar to dissolve and I ended up

81
00:04:19,849 --> 00:04:18,000
moving the fish tank inside I swear I

82
00:04:22,280 --> 00:04:19,859
ended up doing was and removing some of

83
00:04:23,690 --> 00:04:22,290
the water and just lowering this curve a

84
00:04:26,360 --> 00:04:23,700
little bit because it was a little bit

85
00:04:30,970 --> 00:04:26,370
too much for my knees yeah but what

86
00:04:35,150 --> 00:04:30,980
nicely happened was it worked the water

87
00:04:38,120 --> 00:04:35,160
dissolved the sugar and we get a bending

88
00:04:40,310 --> 00:04:38,130

lesbian now it's this most obvious if I

89
00:04:42,260 --> 00:04:40,320
kind of pointed this lays of being

90
00:04:43,760 --> 00:04:42,270
upwards a bit and then move to being

91
00:04:45,290 --> 00:04:43,770
down down down down down

92
00:04:49,820 --> 00:04:45,300
you'll see if you get to the bottom here

93
00:04:53,780 --> 00:04:49,830
it bends over at the far right hand side

94
00:04:56,390 --> 00:04:53,790
and that means if we're looking up in

95
00:04:59,300 --> 00:04:56,400
this direction if a camera here which

96
00:05:00,980 --> 00:04:59,310
I'll put in there in a second well the

97
00:05:03,530 --> 00:05:00,990
line of sight from the camera will go up

98
00:05:06,590 --> 00:05:03,540
over and down which means it will go

99
00:05:12,320 --> 00:05:06,600
over this inspection in here if you see

100
00:05:13,700 --> 00:05:12,330
I send this light beam out and actually

101
00:05:15,770 --> 00:05:13,710
bands down

102
00:05:18,140 --> 00:05:15,780
watch out of the other side actually

103
00:05:20,930 --> 00:05:18,150
goes over this little lump of metal I

104
00:05:22,700 --> 00:05:20,940
have here which I used to raise the

105
00:05:25,430 --> 00:05:22,710
obstruction because I flattened it a bit

106
00:05:27,500 --> 00:05:25,440
too much and it comes over the other

107
00:05:31,400 --> 00:05:27,510
side so what can we see the other end

108
00:05:36,050 --> 00:05:31,410
well the other end of the tank I have a

109
00:05:37,490 --> 00:05:36,060
picture of Toronto not Chicago and the

110
00:05:37,940 --> 00:05:37,500
interesting thing that happens is when I

111
00:05:41,120 --> 00:05:37,950
moved

112
00:05:43,520 --> 00:05:41,130
camera down so it would only be obscured

113
00:05:47,210 --> 00:05:43,530

by this curve or this block here instead

114
00:05:48,740 --> 00:05:47,220
of being obscured the distance image of

115
00:05:54,350 --> 00:05:48,750
Toronto actually it seems to get

116
00:05:56,900 --> 00:05:54,360
compressed and rides up in the air all

117
00:06:01,610 --> 00:05:56,910
the way down you can see it's being

118
00:06:05,240 --> 00:06:01,620
compressed up again it's back to not go

119
00:06:10,160 --> 00:06:05,250
down it's compressed so what's happening

120
00:06:13,280 --> 00:06:10,170
is the beams of light are bending over

121
00:06:16,580 --> 00:06:13,290
so the beams from here from the image of

122
00:06:19,070 --> 00:06:16,590
Toronto are bending up and over and back

123
00:06:22,040 --> 00:06:19,080
down into the camera now if you look at

124
00:06:23,980 --> 00:06:22,050
this laser when it's just going all the

125
00:06:26,720 --> 00:06:23,990
way over you'll see at the other end

126
00:06:28,850 --> 00:06:26,730
it's actually if I can hold it steady

127
00:06:30,680 --> 00:06:28,860
it's actually spreading out which going

128
00:06:33,110 --> 00:06:30,690
to indicate what's going on that means a

129
00:06:36,470 --> 00:06:33,120
larger portion of this image comes back

130
00:06:38,600 --> 00:06:36,480
over here into the camera and creates a

131
00:06:41,000 --> 00:06:38,610
smaller version which is why we get this

132
00:06:43,220 --> 00:06:41,010
compression so you can be normal there

133
00:06:45,140 --> 00:06:43,230
and then we come down below it it gets

134
00:06:47,030 --> 00:06:45,150
compressed it's compressed because the

135
00:06:50,570 --> 00:06:47,040
beams are kind of being pulled in

136
00:06:52,010 --> 00:06:50,580
together another thing people often do

137
00:06:53,780 --> 00:06:52,020
is stand on one side of a lake with a

138
00:06:55,670 --> 00:06:53,790

laser beam and change across the lake

139
00:06:57,560 --> 00:06:55,680
then stand on the other side and get all

140
00:06:58,730 --> 00:06:57,570
surprised when they can see it because

141
00:07:01,160 --> 00:06:58,740
they think it would be hidden by the

142
00:07:03,110 --> 00:07:01,170
curve of the lake but of course what's

143
00:07:06,320 --> 00:07:03,120
going on is exactly the same thing as

144
00:07:08,270 --> 00:07:06,330
this image compression the light is

145
00:07:10,940 --> 00:07:08,280
simply being bent around by refraction

146
00:07:12,890 --> 00:07:10,950
here I'm simulating a laser at the shore

147
00:07:14,690 --> 00:07:12,900
line by shining a laser at the image

148
00:07:16,610 --> 00:07:14,700
from behind you can see that even when

149
00:07:18,350 --> 00:07:16,620
we bring the camera all the way down to

150
00:07:20,270 --> 00:07:18,360
the bottom of the tank you can still see

151
00:07:23,720 --> 00:07:20,280
the laser because the light is being

152
00:07:24,830 --> 00:07:23,730
bent around by refraction you can see

153
00:07:26,900 --> 00:07:24,840
what's happening here because of the

154
00:07:28,430 --> 00:07:26,910
image compression which is why it's a

155
00:07:32,810 --> 00:07:28,440
good idea to do this type of test sure

156
00:07:34,580 --> 00:07:32,820
in the day time and not at night so

157
00:07:37,370 --> 00:07:34,590
these physical experiments are great but

158
00:07:39,980 --> 00:07:37,380
another way of looking at this issue is

159
00:07:42,500 --> 00:07:39,990
to use this simulation that I wrote this

160
00:07:46,550 --> 00:07:42,510
is simulating atmospheric refraction

161
00:07:49,670 --> 00:07:46,560
through a range of conditions and you

162
00:07:51,540 --> 00:07:49,680
can see the conditions here which is

163
00:07:54,029 --> 00:07:51,550

basically the temperature gradient

164
00:07:57,089 --> 00:07:54,039
and you can see by moving it around you

165
00:07:59,249 --> 00:07:57,099
can make it hotter or colder higher up

166
00:08:01,260 --> 00:07:59,259
or you can make the lower air colder

167
00:08:04,230 --> 00:08:01,270
with a lower error hotter and you can

168
00:08:05,700 --> 00:08:04,240
see what what effect it has on the the

169
00:08:08,520 --> 00:08:05,710
distance seen here you can see I'm

170
00:08:10,439 --> 00:08:08,530
making the thicker lower lower air

171
00:08:14,129 --> 00:08:10,449
hotter and it's creating this kind of

172
00:08:15,809 --> 00:08:14,139
Mirage like you would see on a road I've

173
00:08:19,020 --> 00:08:15,819
got a number of presets and one of them

174
00:08:20,249 --> 00:08:19,030
is the sugar aquarium free ship preset

175
00:08:22,740 --> 00:08:20,259
and I tried to make it as close as

176
00:08:25,860 --> 00:08:22,750
possible to what we're seeing in the

177
00:08:28,860 --> 00:08:25,870
aquarium this is the temperature curve

178
00:08:32,610 --> 00:08:28,870
it starts out here at 12 and a half

179
00:08:36,810 --> 00:08:32,620
degrees down at water level goes up over

180
00:08:39,930 --> 00:08:36,820
the first 40 feet to around 16 degrees

181
00:08:42,449 --> 00:08:39,940
Celsius and then rises fairly rapidly so

182
00:08:45,030 --> 00:08:42,459
this is this is a fairly big kind of

183
00:08:47,190 --> 00:08:45,040
temperature inversion the water is very

184
00:08:49,560 --> 00:08:47,200
very cold and then we have warmer air

185
00:08:52,370 --> 00:08:49,570
above it and then it gets progressively

186
00:08:55,470 --> 00:08:52,380
less warm until it starts cooling down

187
00:08:57,510 --> 00:08:55,480
and this view here at the top is very

188
00:09:00,690 --> 00:08:57,520

similar to our side view from the tank

189
00:09:02,160 --> 00:09:00,700
with the the laser beams you see the the

190
00:09:03,269 --> 00:09:02,170
source here which is the camera or the

191
00:09:05,310 --> 00:09:03,279
laser depending on which way you're

192
00:09:07,470 --> 00:09:05,320
thinking of it and these beams coming

193
00:09:10,290 --> 00:09:07,480
out and you see the ones that are lower

194
00:09:11,730 --> 00:09:10,300
down are bent ever so slightly it's kind

195
00:09:13,860 --> 00:09:11,740
of difficult to see in this tippy

196
00:09:15,480 --> 00:09:13,870
stretch it this way you can see it a

197
00:09:17,730 --> 00:09:15,490
little bit better that they are actually

198
00:09:19,680 --> 00:09:17,740
bending down this is the curve of the

199
00:09:22,910 --> 00:09:19,690
earth it's obviously greatly exaggerated

200
00:09:25,470 --> 00:09:22,920
here because this is over about

201
00:09:29,010 --> 00:09:25,480
30-something miles I believe let's say

202
00:09:31,920 --> 00:09:29,020
32 miles yeah okay so what we can do now

203
00:09:34,560 --> 00:09:31,930
is we can move our viewpoint down this

204
00:09:37,829 --> 00:09:34,570
is a viewpoint here we are at 80 feet

205
00:09:42,030 --> 00:09:37,839
above the ground right here and this is

206
00:09:44,760 --> 00:09:42,040
the CN tower over here at 1,800 feet to

207
00:09:49,199 --> 00:09:44,770
the top and if I move the viewpoint down

208
00:09:51,120 --> 00:09:49,209
you will see that the scene changes in a

209
00:09:53,850 --> 00:09:51,130
very similar way to how it changes in

210
00:09:55,710 --> 00:09:53,860
our aquarium so we're starting up at 80

211
00:09:58,620 --> 00:09:55,720
feet and the city looks more or less

212
00:10:01,769 --> 00:09:58,630
normal and then we go down to all the

213
00:10:04,110 --> 00:10:01,779

way down to 0.1 feet so we're actually

214
00:10:05,370 --> 00:10:04,120
nearly nearly at sea level and yet we

215
00:10:07,470 --> 00:10:05,380
can still see

216
00:10:09,900 --> 00:10:07,480
things right at the bottom and what's

217
00:10:12,690 --> 00:10:09,910
happened again is everything is being

218
00:10:15,810 --> 00:10:12,700
compressed together here and the curve

219
00:10:17,760 --> 00:10:15,820
is actually curving around the curve the

220
00:10:21,030 --> 00:10:17,770
light is curving around the earth and we

221
00:10:25,110 --> 00:10:21,040
can see this reflected in the image now

222
00:10:27,810 --> 00:10:25,120
we can go back up to 80 feet and then go

223
00:10:30,570 --> 00:10:27,820
back down again and see the exact same

224
00:10:32,460 --> 00:10:30,580
effect we can go even higher things will

225
00:10:34,410 --> 00:10:32,470
look even more normal this is actually

226
00:10:37,050 --> 00:10:34,420
what the shape of the buildings in

227
00:10:38,340 --> 00:10:37,060
Toronto actually is from 80 feet it's

228
00:10:39,330 --> 00:10:38,350
actually a little bit compressed but it

229
00:10:42,360 --> 00:10:39,340
when you go all the way down it's

230
00:10:43,710 --> 00:10:42,370
obviously very very very compressed so

231
00:10:45,540 --> 00:10:43,720
you can play around with this this is

232
00:10:47,760 --> 00:10:45,550
the meta Bank refraction simulator

233
00:10:49,710 --> 00:10:47,770
meadow Banga org slash refraction and

234
00:10:52,050 --> 00:10:49,720
there's a bunch of other things that you

235
00:10:54,630 --> 00:10:52,060
can look at a bunch of presets there's

236
00:10:57,540 --> 00:10:54,640
things like mirages there's various

237
00:11:00,150 --> 00:10:57,550
different cities this is Chicago we can

238
00:11:03,410 --> 00:11:00,160

see what effect temperature has on

239
00:11:07,560 --> 00:11:03,420
whether we see Chicago over the lake

240
00:11:10,380 --> 00:11:07,570
there here's Chicago from different

241
00:11:13,560 --> 00:11:10,390
positions Chicago showing showing me

242
00:11:15,950 --> 00:11:13,570
Rogers views of Brighton let's use of

243
00:11:21,390 --> 00:11:15,960
Blackpool from various locations and

244
00:11:25,830 --> 00:11:21,400
there's some classic experiments for old

245
00:11:27,570 --> 00:11:25,840
refraction simulations and it's very

246
00:11:30,600 --> 00:11:27,580
configurable I have a read of the thread

247
00:11:35,620 --> 00:11:30,610
which you can find by clicking this this

248
00:11:40,059 --> 00:11:38,319
hi I'm Mick West and if you liked that

249
00:11:42,490 --> 00:11:40,069
video you might also like my book

250
00:11:44,680 --> 00:11:42,500
escaping the rabbit hole how to debunk

251
00:11:47,470 --> 00:11:44,690
conspiracy theories using facts logic

252
00:11:49,449 --> 00:11:47,480
and respect escaping the rabbit hole as

253
00:11:50,860 --> 00:11:49,459
a guide to helping friends family and

254
00:11:52,960 --> 00:11:50,870
loved ones who have been sucked into

255
00:11:55,360 --> 00:11:52,970
conspiracy theories like 9/11 or

256
00:11:56,590 --> 00:11:55,370
chemtrails I explained why people fall

257
00:11:58,059 --> 00:11:56,600
for these theories and how I can

258
00:12:00,579 --> 00:11:58,069
understand them and how you can help