Message in a string

- Messenger RNA, the ultimate code, is translated into catalytic, structural, and informational products…
  - **PROTEINS!**
    - The work horses of the cell. Doing most of the things.

1
00:00:12,209 --> 00:00:10,619
yay okay sorry I can't be there I am a

2
00:00:15,150 --> 00:00:12,219
postdoc at Georgia Tech and I have

3
00:00:16,620 --> 00:00:15,160
research obligations um but I was able

4
00:00:19,800 --> 00:00:16,630
to pry myself away from my busy schedule

5
00:00:23,489 --> 00:00:19,810
for 15 minute warm-up talk which

6
00:00:25,560 --> 00:00:23,499
probably won't take 15 minutes um son

7
00:00:28,019 --> 00:00:25,570
Samantha for those of you who don't know

8
00:00:29,579 --> 00:00:28,029
me and I am predominantly a

9
00:00:33,240 --> 00:00:29,589
microbiologist but today I'm going to be

10
00:00:35,960 --> 00:00:33,250
trying to describe to you a very basic

11
00:00:39,540 --> 00:00:35,970
general concepts and molecular biology

12
00:00:41,599 --> 00:00:39,550
which lead up to understanding some of

13
00:00:45,209 --> 00:00:41,609

the researchers that are talking about

14
00:00:48,270 --> 00:00:45,219
prebiotic chemistry so for all you non

15
00:00:52,200 --> 00:00:48,280
biologists this one is for you and I

16
00:00:55,049 --> 00:00:52,210
will try to keep it simple so life what

17
00:00:57,090 --> 00:00:55,059
is it all about on this planet well from

18
00:01:00,180 --> 00:00:57,100
a bacteriologist point of view such as

19
00:01:03,270 --> 00:01:00,190
myself focusing on there for bacterial

20
00:01:05,760 --> 00:01:03,280
life produces a number of things for us

21
00:01:07,800 --> 00:01:05,770
such as oxygen I like to breathe you

22
00:01:11,580 --> 00:01:07,810
like to breathe and we breathe oxygen

23
00:01:13,679 --> 00:01:11,590
due to bacteria bacteria also are

24
00:01:15,719 --> 00:01:13,689
involved in all of the major nutrient

25
00:01:18,840 --> 00:01:15,729
cycles on the planet including the

26
00:01:20,190 --> 00:01:18,850
nitrogen cycle they make complex carbon

27
00:01:24,030 --> 00:01:20,200
structures which allow for higher

28
00:01:26,700 --> 00:01:24,040
organisms to exist such as plants and

29
00:01:31,499 --> 00:01:26,710
animals and in general they are just

30
00:01:33,990 --> 00:01:31,509
amazing little bugs but how do they do

31
00:01:38,550 --> 00:01:34,000
all this how do they do all of these

32
00:01:40,649 --> 00:01:38,560
mechanisms and pathways well they have

33
00:01:42,810 --> 00:01:40,659
this informational code which is

34
00:01:45,330 --> 00:01:42,820
hundreds of millions of years old and

35
00:01:49,740 --> 00:01:45,340
it's been passed down from one cell to

36
00:01:53,520 --> 00:01:49,750
another and this code is DNA and I'm

37
00:01:55,580 --> 00:01:53,530
sure most of you have heard of DNA but

38
00:01:58,830 --> 00:01:55,590

it's the informational string of life

39
00:02:01,279 --> 00:01:58,840
and I like to kind of convey it to you

40
00:02:03,599 --> 00:02:01,289
as a string especially for those non

41
00:02:06,660 --> 00:02:03,609
biochemist and non biologists in the

42
00:02:09,240 --> 00:02:06,670
room so there's a string and it has four

43
00:02:11,220 --> 00:02:09,250
bases I mean by mean cytosine and

44
00:02:14,250 --> 00:02:11,230
guanine don't worry i will go to much

45
00:02:18,330 --> 00:02:14,260
more into them other than that but these

46
00:02:19,200 --> 00:02:18,340
strings are bonded in a ribose sugar

47
00:02:22,380 --> 00:02:19,210
backbone

48
00:02:25,020 --> 00:02:22,390
and two units of a phospho sugar

49
00:02:27,060 --> 00:02:25,030
backbone with their little basis come

50
00:02:29,850 --> 00:02:27,070
together and they form a secondary

51
00:02:32,100 --> 00:02:29,860
structure the double helix and I'm sure

52
00:02:36,270 --> 00:02:32,110
everybody knows the story of the double

53
00:02:38,610 --> 00:02:36,280
helix so from the double helix which is

54
00:02:41,400 --> 00:02:38,620
the secondary structure of DNA can come

55
00:02:43,200 --> 00:02:41,410
and form tertiary structures and

56
00:02:46,050 --> 00:02:43,210
quaternary structures and all these very

57
00:02:49,470 --> 00:02:46,060
complicated things but essentially all

58
00:02:52,470 --> 00:02:49,480
this is is a way to compact the large

59
00:02:54,420 --> 00:02:52,480
and oftentimes read its code into a

60
00:02:58,740 --> 00:02:54,430
smaller structure but I'm not going to

61
00:03:00,480 --> 00:02:58,750
go further into detail than that so how

62
00:03:03,330 --> 00:03:00,490
does this information become functional

63
00:03:04,920 --> 00:03:03,340

in the cell if it's in this code and you

64
00:03:07,500 --> 00:03:04,930
don't want to really perturb this code

65
00:03:09,990 --> 00:03:07,510
too much how does the cell know what to

66
00:03:11,580 --> 00:03:10,000
do how do things happen inside the cell

67
00:03:14,880 --> 00:03:11,590
and outside of the cell well this

68
00:03:17,790 --> 00:03:14,890
information is transcribed in a process

69
00:03:21,030 --> 00:03:17,800
called transcription very simple to

70
00:03:22,590 --> 00:03:21,040
understand so you want to transcribe

71
00:03:24,840 --> 00:03:22,600
because you want to maintain the

72
00:03:28,020 --> 00:03:24,850
integrity of the main informational book

73
00:03:29,520 --> 00:03:28,030
the DNA but you also want promiscuity in

74
00:03:32,700 --> 00:03:29,530
the message you want the message to be

75
00:03:37,010 --> 00:03:32,710
able to do things and these messages

76
00:03:40,500 --> 00:03:37,020
that are transcribed are known as RNA

77
00:03:42,030 --> 00:03:40,510
RNA sequences or RNA strings and they

78
00:03:45,480 --> 00:03:42,040
are comprised of our three familiar

79
00:03:49,520 --> 00:03:45,490
adenine cytosine guanine but also now

80
00:03:52,350 --> 00:03:49,530
introducing carousel now you have T RNA

81
00:03:54,630 --> 00:03:52,360
mRNA which stirs messenger RNA and RNA

82
00:03:58,410 --> 00:03:54,640
ribosomal RNA and those are the three

83
00:04:00,450 --> 00:03:58,420
main gene products of RNA but you also

84
00:04:05,280 --> 00:04:00,460
have other forms of RNA such as small

85
00:04:06,600 --> 00:04:05,290
interfering RNA and a small subunit RNA

86
00:04:09,570 --> 00:04:06,610
but I'm not going to talk about any of

87
00:04:11,430 --> 00:04:09,580
those they do other things now when

88
00:04:14,450 --> 00:04:11,440

you're talking about coding you're

89
00:04:18,120 --> 00:04:14,460
mainly talking about messenger RNA and

90
00:04:21,360 --> 00:04:18,130
these are genes so these are messages in

91
00:04:24,000 --> 00:04:21,370
a string that get translated into the

92
00:04:25,770 --> 00:04:24,010
catalytic catalytic structural and

93
00:04:28,770 --> 00:04:25,780
informational products inside the cell

94
00:04:30,080 --> 00:04:28,780
and these are known as proteins I'm sure

95
00:04:32,950 --> 00:04:30,090
you've all heard this word before

96
00:04:34,960 --> 00:04:32,960
proteins do all of the work in

97
00:04:37,749 --> 00:04:34,970
most of all of the work inside of the

98
00:04:39,670 --> 00:04:37,759
cell they allow they form you know

99
00:04:42,610 --> 00:04:39,680
porins or channels in the membrane that

100
00:04:44,650 --> 00:04:42,620
allow molecules to flow inside and

101
00:04:46,270 --> 00:04:44,660
outside of the cell they allow for

102
00:04:47,589 --> 00:04:46,280
structural integrity of the cell so the

103
00:04:49,659 --> 00:04:47,599
soul just doesn't collapse on itself

104
00:04:53,740 --> 00:04:49,669
especially in the case of eukaryotic

105
00:04:56,980 --> 00:04:53,750
cells and they do the transformations of

106
00:05:00,790 --> 00:04:56,990
molecules inside that cell so catalysis

107
00:05:04,740 --> 00:05:00,800
and metabolisms you know breaking down

108
00:05:07,659 --> 00:05:04,750
sugar and forming complicated sugars and

109
00:05:10,029 --> 00:05:07,669
these proteins are comprised of amino

110
00:05:11,770 --> 00:05:10,039
acids surprise we're going to talk only

111
00:05:13,450 --> 00:05:11,780
about amino acids no I'm not going to go

112
00:05:15,520 --> 00:05:13,460
through all of these because it would

113
00:05:17,469 --> 00:05:15,530

take too long and nobody wants to say

114
00:05:21,070 --> 00:05:17,479
here through that but it's important to

115
00:05:24,930 --> 00:05:21,080
know that the basis code for these amino

116
00:05:27,999 --> 00:05:24,940
acids when you're talking about proteins

117
00:05:30,969 --> 00:05:28,009
but how does this translation happen who

118
00:05:35,499 --> 00:05:30,979
is the monk sitting there going from

119
00:05:37,960 --> 00:05:35,509
ancient Latin into Old English well that

120
00:05:39,909 --> 00:05:37,970
is the job of the ribosome it is the

121
00:05:42,610 --> 00:05:39,919
major hinge of information inside the

122
00:05:48,659 --> 00:05:42,620
cell so the ribosome is composed of that

123
00:05:52,450 --> 00:05:48,669
ribosomal RNA so the ribosome is

124
00:05:55,779 --> 00:05:52,460
actually a complex super structure that

125
00:05:58,089 --> 00:05:55,789
has some small subunits of proximal RNA

126
00:06:00,640 --> 00:05:58,099
and some large subunits of ribosomal RNA

127
00:06:04,450 --> 00:06:00,650
I'm sure you've heard the terms 16s

128
00:06:06,189 --> 00:06:04,460
maybe before or 30s um that's confusing

129
00:06:07,870 --> 00:06:06,199
and I'm not going to describe them in

130
00:06:09,459 --> 00:06:07,880
that way I'm just going to say there's a

131
00:06:13,149 --> 00:06:09,469
small subunit there's a large subunit

132
00:06:16,089 --> 00:06:13,159
and they come together and for some of

133
00:06:18,670 --> 00:06:16,099
us microbiologists out there we also not

134
00:06:22,330 --> 00:06:18,680
only care about the structural and

135
00:06:24,129 --> 00:06:22,340
catalytic part of the ribosome but also

136
00:06:26,770 --> 00:06:24,139
the taxonomic information that it codes

137
00:06:31,959 --> 00:06:26,780
because if you ever look in taxonomy

138
00:06:35,350 --> 00:06:31,969

oftentimes species are defined by their

139
00:06:37,959 --> 00:06:35,360
16s which is one of my favorite

140
00:06:41,079 --> 00:06:37,969
structures so I have that pictured here

141
00:06:41,590 --> 00:06:41,089
and induce equalise 16s gene and it's a

142
00:06:44,650 --> 00:06:41,600
pretty rare

143
00:06:47,680 --> 00:06:44,660
of secondary structure loops and so you

144
00:06:49,780 --> 00:06:47,690
can see just like DNA RNA forms these

145
00:06:51,880 --> 00:06:49,790
secondary structures and it's easy to

146
00:06:53,740 --> 00:06:51,890
imagine how these loops and turns can

147
00:06:56,530 --> 00:06:53,750
all fold in on themselves and for

148
00:07:00,070 --> 00:06:56,540
tertiary structures and then when those

149
00:07:04,690 --> 00:07:00,080
subunits come together they like any a

150
00:07:07,330 --> 00:07:04,700
list star get adorned into the fake

151
00:07:09,610 --> 00:07:07,340
complex with accessory proteins and

152
00:07:15,850 --> 00:07:09,620
that's what all those chain bows are on

153
00:07:18,460 --> 00:07:15,860
top of the sprawled core of the ribosome

154
00:07:20,260 --> 00:07:18,470
so you have your small subunit a large

155
00:07:22,000 --> 00:07:20,270
subunit and then these accessory

156
00:07:24,820 --> 00:07:22,010
proteins and no I'm not going to go into

157
00:07:26,200 --> 00:07:24,830
all the accessory proteins because yet

158
00:07:29,470 --> 00:07:26,210
again it would take too much time and

159
00:07:34,750 --> 00:07:29,480
honestly I don't do that research but

160
00:07:36,880 --> 00:07:34,760
isn't it pretty so this is this so what

161
00:07:41,560 --> 00:07:36,890
I just went through very briefly and

162
00:07:43,920 --> 00:07:41,570
very hopefully very simple simply very

163
00:07:46,600 --> 00:07:43,930

simply and not use too much jargon is

164
00:07:49,270 --> 00:07:46,610
the central dogma of molecular biology

165
00:07:52,450 --> 00:07:49,280
is the central dogma of informational

166
00:07:55,120 --> 00:07:52,460
flow inside the cell you have your main

167
00:07:57,220 --> 00:07:55,130
core of information your DNA this is the

168
00:08:00,670 --> 00:07:57,230
book of life and then this gets

169
00:08:03,820 --> 00:08:00,680
transcribed into short messages that go

170
00:08:06,640 --> 00:08:03,830
out and get translated and do things so

171
00:08:09,160 --> 00:08:06,650
it is an oversimplification of how

172
00:08:11,890 --> 00:08:09,170
information flows inside the cell it if

173
00:08:13,300 --> 00:08:11,900
I no means correct but it's the easiest

174
00:08:15,940 --> 00:08:13,310
way to convey it to all of those

175
00:08:17,080 --> 00:08:15,950
learning this for the first time or

176
00:08:18,460 --> 00:08:17,090
maybe for the second time but you

177
00:08:22,510 --> 00:08:18,470
haven't taken a biology class since high

178
00:08:26,320 --> 00:08:22,520
school okay so that's fascinating but

179
00:08:28,000 --> 00:08:26,330
you know how did all this begin so as

180
00:08:30,450 --> 00:08:28,010
you're going to hear today from some of

181
00:08:33,610 --> 00:08:30,460
the talks or seeing some of the posters

182
00:08:35,830 --> 00:08:33,620
amongst all of you or the group is

183
00:08:38,320 --> 00:08:35,840
riddled with prebiotic or origins of

184
00:08:40,420 --> 00:08:38,330
life investigators and what they're

185
00:08:42,909 --> 00:08:40,430
looking at is just what the name

186
00:08:45,430 --> 00:08:42,919
prebiotic implies before a large

187
00:08:48,400 --> 00:08:45,440
functional cell comes together what

188
00:08:50,350 --> 00:08:48,410

happened how did that how did this

189
00:08:53,770 --> 00:08:50,360
information become more and more complex

190
00:08:55,210 --> 00:08:53,780
well the predominant hypothesis or

191
00:08:57,610 --> 00:08:55,220
thought is that

192
00:09:00,490 --> 00:08:57,620
the world origins of life actually

193
00:09:04,059 --> 00:09:00,500
started as an RNA world so you have an

194
00:09:06,879 --> 00:09:04,069
RNA string that started and became more

195
00:09:09,069 --> 00:09:06,889
and more complicated with time now this

196
00:09:11,170 --> 00:09:09,079
would be an imply like a ribosomal world

197
00:09:13,360 --> 00:09:11,180
so you're not just talking about a

198
00:09:15,309 --> 00:09:13,370
string of information you need that

199
00:09:19,150 --> 00:09:15,319
information to actually be functional to

200
00:09:22,600 --> 00:09:19,160
and ribozymes as I said our catalytic as

201
00:09:24,429 --> 00:09:22,610
well as informational so they're

202
00:09:27,400 --> 00:09:24,439
obviously the dream of all origins of

203
00:09:30,160 --> 00:09:27,410
life researchers um obviously I'm not

204
00:09:32,949 --> 00:09:30,170
one so I'm talking in broad general

205
00:09:34,480 --> 00:09:32,959
terms for all of you but what they're

206
00:09:37,240 --> 00:09:34,490
looking at is they're looking at the

207
00:09:39,309 --> 00:09:37,250
evolution of the ribozyme so how did it

208
00:09:41,769 --> 00:09:39,319
has it changed through the three billion

209
00:09:43,480 --> 00:09:41,779
years of life on this planet and also

210
00:09:46,389 --> 00:09:43,490
how is it different or how is it

211
00:09:49,840 --> 00:09:46,399
actually very similar amongst all the

212
00:09:51,639 --> 00:09:49,850
branches of life so that's more of the

213
00:09:54,249 --> 00:09:51,649

evolutionary in the taxonomy and the

214
00:09:56,740 --> 00:09:54,259
phylogenetic they're also looking at

215
00:09:58,540 --> 00:09:56,750
some of the look at non-canonical basis

216
00:10:01,869 --> 00:09:58,550
which if some of you know bradley

217
00:10:04,449 --> 00:10:01,879
rapport that is what his research was as

218
00:10:07,650 --> 00:10:04,459
a PhD student so you're looking at

219
00:10:10,710 --> 00:10:07,660
obviously we have the four bases now for

220
00:10:13,749 --> 00:10:10,720
RNA but was that always the case

221
00:10:18,129 --> 00:10:13,759
probably not and there's actually a

222
00:10:21,639 --> 00:10:18,139
multitude of base units that can be used

223
00:10:23,259 --> 00:10:21,649
or incorporated into RNA and so that

224
00:10:25,540 --> 00:10:23,269
would be a non-canonical based research

225
00:10:27,639 --> 00:10:25,550
and then there's others that also look

226
00:10:31,210 --> 00:10:27,649
at all of those blinged-out bedazzled

227
00:10:34,389 --> 00:10:31,220
accessory proteins on the interior kind

228
00:10:37,569 --> 00:10:34,399
of middle area and exterior of the

229
00:10:39,579 --> 00:10:37,579
ribosome and so that's looking at how

230
00:10:42,369 --> 00:10:39,589
these proteins actually modulate and

231
00:10:47,889 --> 00:10:42,379
influence the in general overall

232
00:10:49,990 --> 00:10:47,899
functionality of throw its own so now

233
00:10:52,689 --> 00:10:50,000
that I am done with my very simple and

234
00:10:54,879 --> 00:10:52,699
very quick talk I talk a lot faster when

235
00:10:57,579 --> 00:10:54,889
I'm nervous even if I'm looking at my

236
00:10:59,769 --> 00:10:57,589
own screen and not any of you um but now

237
00:11:03,400 --> 00:10:59,779
it's time for the real research so I

238
00:11:05,110 --> 00:11:03,410

hope that some of the concepts that I

239
00:11:07,269 --> 00:11:05,120
briefly went over will allow you to

240
00:11:08,249 --> 00:11:07,279
understand they're very awesome research

241
00:11:10,109 --> 00:11:08,259
because I

242
00:11:12,659 --> 00:11:10,119
I think that we have a pretty good

243
00:11:18,269 --> 00:11:12,669
conference this year and entities so

244
00:11:20,519 --> 00:11:18,279
with that thank all of you will have

245
00:11:22,259 --> 00:11:20,529
anything else unless somebody must ask

246
00:11:24,779 --> 00:11:22,269
some questions and I'll attempt to to

247
00:11:26,429 --> 00:11:24,789
answer them and Brett will be taking

248
00:11:30,859 --> 00:11:26,439
over as chair for this session since I

249
00:11:33,119 --> 00:11:30,869
am out there and I can't regulate stuff