



1

00:00:08,886 --> 00:00:15,053

My name is Donald Frazier and my current position is I am an emeritus

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00:00:15,053 --> 00:00:20,492

scientist working in tech transfer in the Science and Technology Office.

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00:00:29,412 --> 00:00:35,024

My formal training is as a physical chemist; I have a PhD

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00:00:35,024 --> 00:00:45,083

from Rutgers. I have worked in this area throughout my entire career,

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00:00:45,083 --> 00:00:51,220

which actually officially ended in December of 2012 and I came back

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00:00:51,220 --> 00:00:59,070

in retirement to do this additional work that I would like to do to help

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00:00:59,070 --> 00:01:05,043

advance technology with HBCUs, Historically Black Colleges and

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00:01:05,043 --> 00:01:11,917

Universities, and small colleges with some advanced technologies.

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00:01:11,917 --> 00:01:17,184

I was born in Nashville but moved to Detroit ultimately after a brief

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00:01:17,184 --> 00:01:26,054

stint in Los Angeles and grew up in Detroit. My early years in Detroit

11  
00:01:26,054 --> 00:01:34,136  
were that as a young boy who was  
just going from day to day making

12  
00:01:34,136 --> 00:01:40,019  
sure I was getting some of my moms  
good cooking and trying to do the

13  
00:01:40,019 --> 00:01:45,278  
right things to satisfy my parents,  
staying out of trouble, and I was

14  
00:01:45,278 --> 00:01:57,232  
not always successful at that. As  
far as how I got interested, and this is

15  
00:01:57,270 --> 00:02:04,171  
a story that I like to tell because  
it really played a role in my future

16  
00:02:04,197 --> 00:02:13,849  
work is that my parents gave me a  
chemistry set when I was a child which

17  
00:02:13,849 --> 00:02:16,814  
I really enjoyed, I liked that, they  
did not know I was

18  
00:02:16,814 --> 00:02:20,424  
going to like it as much as I did.  
I liked doing that, playing with that,

19  
00:02:20,424 --> 00:02:24,412  
and the other thing they wanted me  
to do was burn the trash. We had

20  
00:02:24,412 --> 00:02:30,042  
alleys in Detroit and that was  
how we got get rid of our weekly trash.

21  
00:02:30,042 --> 00:02:34,070  
We did not have any, I do not remember  
seeing any regular garbage pickups,

22  
00:02:34,070 --> 00:02:38,217  
they might have come in the alley  
somewhere along the line, but

23  
00:02:38,217 --> 00:02:42,224  
generally it was us going out,  
burning the trash, leaving all

24  
00:02:42,224 --> 00:02:49,033  
the ashes back there somewhere.  
I was fascinated by that, by what

25  
00:02:49,033 --> 00:02:53,110  
was going on in there in the  
combustion process. I was not

26  
00:02:53,110 --> 00:02:56,305  
calling it that back then, back  
then I was calling it burning

27  
00:02:56,307 --> 00:03:03,026  
the trash, but I came to realize  
that this was a process that

28  
00:03:03,026 --> 00:03:07,150  
required oxygen, that it was  
combustion, that it had some other

29  
00:03:07,150 --> 00:03:14,966  
meanings to it. I slowly learned  
that rusting corrosion was a

30  
00:03:14,966 --> 00:03:21,136  
similar process, the same process  
of oxidation except not as

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00:03:21,136 --> 00:03:23,136

exothermic, or it did not give  
off the heat, it was much slower,

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00:03:23,136 --> 00:03:28,182

and I said this is something else.  
Finally, I came to realize that

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00:03:28,182 --> 00:03:32,245

this was relevant to even  
electrochemistry, which is even

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00:03:32,245 --> 00:03:49,002

more subtle, nuanced, and which could  
involve oxygen. It just got me

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00:03:49,002 --> 00:03:53,879

into oxidation reduction processes,  
which is a form of physical

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00:03:53,895 --> 00:03:56,809

chemistry, so I became interested  
in physical chemistry. Then later

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00:03:56,809 --> 00:04:06,144

on, I was teaching up at SUNY  
before I got my PhD, but while I

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00:04:06,144 --> 00:04:08,419

was working on it, I went up to  
the State University of New York

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00:04:08,419 --> 00:04:16,113

where I got involved in a program  
which tried to encourage young people

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00:04:16,113 --> 00:04:20,930

to get into chemistry and the  
sciences. This was a STEM, the beginning

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00:04:20,930 --> 00:04:24,757

of my interest in STEM. I started thinking about this combustion

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00:04:24,757 --> 00:04:30,030

process I was involved in as a kid, what if you don't have oxygen

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00:04:30,030 --> 00:04:35,989

and you put heat into it? What you have is pyrolysis, and so if you do

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00:04:35,989 --> 00:04:42,027

that, if you take garbage and stuff that is biodegradable and burnable

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00:04:42,027 --> 00:04:47,222

and all of that but you exclude oxygen, you can do that using what is

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00:04:47,271 --> 00:04:50,251

called a tube furnace. You flow nitrogen over it and raise the

47

00:04:50,251 --> 00:04:54,022

temperature really high, those molecules can fly apart and they

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00:04:54,022 --> 00:05:01,465

come back together and form crude oil. So we started getting kids

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00:05:01,465 --> 00:05:07,085

doing that up in the State University of New York, Albany, and I found

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00:05:07,085 --> 00:05:12,057

out that there is a company, there was a company, this was back in

51  
00:05:12,057 --> 00:05:16,354  
the 1970s, it was a long time ago,  
called Oxidental, who also had

52  
00:05:16,354 --> 00:05:20,323  
that same idea, and they were  
converting garbage to oil in that

53  
00:05:20,323 --> 00:05:24,097  
way. Now, you don't get crude oil  
as it is coming out of the ground,

54  
00:05:24,097 --> 00:05:28,363  
but you get fractions of crude oil  
depending on what you burn. We had

55  
00:05:28,363 --> 00:05:34,041  
students taking the moisture out of  
garbage, banana peels, you name it,

56  
00:05:34,041 --> 00:05:40,014  
grinding it up to make a powder and  
putting it into tube furnaces and

57  
00:05:40,014 --> 00:05:45,982  
taking it up to temperature, absent  
oxygen, it comes back together,

58  
00:05:45,982 --> 00:05:50,906  
you cool it down, and it forms  
crude oil. These students became

59  
00:05:50,906 --> 00:05:56,310  
very excited. These are not students  
that you would normally expect

60  
00:05:56,310 --> 00:06:01,006  
to jump on and get into the science  
field, but the idea that they were

61  
00:06:01,006 --> 00:06:06,356  
striking oil from something they were  
very familiar with was extremely

62  
00:06:06,356 --> 00:06:11,625  
exciting to them, so we started  
doing other things. By the way,

63  
00:06:11,625 --> 00:06:16,699  
Occidental did build some plants in  
the Soviet Union, in Russia, somehow

64  
00:06:16,699 --> 00:06:21,202  
they got involved with them. I do not  
know what the status of that is now.

65  
00:06:21,202 --> 00:06:26,246  
if there is not enough energy involved  
for it to be an effective way to

66  
00:06:26,246 --> 00:06:30,760  
develop oil. And you do not get the same  
fractions, you get certain fractions

67  
00:06:30,760 --> 00:06:37,009  
depending on what you start with, what  
your starting point is. But you might be

68  
00:06:37,009 --> 00:06:41,679  
able to make butane, cigarette lighter fluid,  
you might be able to make candle wax

69  
00:06:41,679 --> 00:06:46,611  
you might be able to make some other  
petroleum products other than gasoline,

70  
00:06:46,611 --> 00:06:51,419  
you might be able to make gasoline if you  
have the right combination of things,

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00:06:51,419 --> 00:06:56,277  
But It is an interesting thing that touches  
kids, and students in general,

72  
00:06:56,277 --> 00:07:01,991  
is to enter an idea that maybe  
they can do something, they can

73  
00:07:01,991 --> 00:07:05,588  
really think through some things  
that are familiar to them if

74  
00:07:05,588 --> 00:07:09,976  
they have the right training.  
That is where, to me, STEM comes

75  
00:07:09,976 --> 00:07:17,700  
into the picture, into the  
process, by getting people

76  
00:07:17,700 --> 00:07:20,854  
involved by introducing them  
to something that is familiar

77  
00:07:20,854 --> 00:07:26,958  
to them. The other thing, and  
this is typical of anybody,

78  
00:07:26,958 --> 00:07:36,490  
along those lines, we decided  
what if we wanted to have an

79  
00:07:36,490 --> 00:07:42,253  
insecticide? What if we wanted,  
and this is not to say that a

80  
00:07:42,253 --> 00:07:45,266  
certain class of people have  
roaches, everybody sees a roach

81  
00:07:45,266 --> 00:07:48,689  
every now and then, and we know  
that that is a problem, it is a

82  
00:07:48,689 --> 00:07:53,152  
pesticide, we do a lot of  
development in the industry.

83  
00:07:53,152 --> 00:08:00,016  
What if you got around the  
immunization process or the

84  
00:08:00,016 --> 00:08:07,924  
fact that you can spray insects  
enough that they become immune,

85  
00:08:07,924 --> 00:08:12,542  
future generations become immune,  
build up an immunity to that

86  
00:08:12,542 --> 00:08:16,905  
particular chemical? Well, what  
you'd want to do is sterilize

87  
00:08:16,905 --> 00:08:22,130  
them, so we started thinking  
about attracting them, using

88  
00:08:22,130 --> 00:08:29,943  
pheromones, which is a sex attractant,  
to attract, let us say the male to

89  
00:08:29,943 --> 00:08:33,770  
the female and then doing some  
chemical synthesis, organic

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00:08:33,770 --> 00:08:37,999  
synthesis, synthesizing something,  
this is something that teaches,

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00:08:37,999 --> 00:08:43,386  
that is part of a STEM process,  
teach them something that would

92  
00:08:43,386 --> 00:08:45,386  
sterilize them, chemical sterilize  
them. There were a lot of chemical

93  
00:08:45,386 --> 00:08:48,002  
sterilants out there for fruit  
flies and that, so we ended up

94  
00:08:48,002 --> 00:08:51,823  
getting some formulations and the  
students would get into the lab

95  
00:08:51,823 --> 00:08:56,022  
and make these things. Then we  
would set up a thing where we

96  
00:08:56,022 --> 00:09:00,022  
would find the female, have to  
identify the female insect and

97  
00:09:00,022 --> 00:09:05,954  
the male insect. They may attract  
the male insect and then feed them

98  
00:09:05,954 --> 00:09:11,019  
these chemo sterilants. Sure  
enough, there were no future

99  
00:09:11,019 --> 00:09:15,974  
generations. You talk about  
exciting some students, these

100  
00:09:15,974 --> 00:09:21,982  
things worked elegantly. There  
were other ideas, we used other

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00:09:21,982 --> 00:09:26,903

ideas with other things, art with polyurethane, that sort of thing.

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00:09:26,903 --> 00:09:34,807

STEM education, i think, is something that needs to at least start with

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00:09:34,807 --> 00:09:41,117

familiarity, something the students are familiar with. This is not all

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00:09:41,117 --> 00:09:46,895

students, there are some that are just innately ready to learn

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00:09:46,895 --> 00:09:50,992

whatever without any kind of stimulant or creativity, but then

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00:09:50,992 --> 00:09:56,211

there is a large fraction that will learn it if you provide them with

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00:09:56,211 --> 00:10:03,994

the right incentive. I think we need to do more of that. The biggest part,

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00:10:03,994 --> 00:10:12,020

I think, is a thing that limits us in this whole STEM process is

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00:10:12,020 --> 00:10:19,217

resources, our resources. We do not provide the right amount of resources,

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00:10:19,217 --> 00:10:23,294

things like the things I just described still require somebody to

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00:10:23,294 --> 00:10:31,835

do it, someone to teach it, someone to pay for it. I think until we are

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00:10:31,835 --> 00:10:37,927

committed to providing the right amount of resources and the right

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00:10:37,927 --> 00:10:46,318

amount of direction, the right amount of incentive for the students to pick

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00:10:46,318 --> 00:10:53,008

it up, we are going to be fighting these fires, I think, a little bit

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00:10:53,008 --> 00:10:59,161

randomly. I know when I was a kid, one of the things, not when I was a

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00:10:59,161 --> 00:11:04,740

kid, when I was in college, one of the things I understood that separated

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00:11:04,740 --> 00:11:12,032

the teaching curriculums from the science curricula was the education

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00:11:12,032 --> 00:11:15,356

curricula, now this was years ago and I think they have improved on

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00:11:15,356 --> 00:11:20,037

that by now, the education curricula didn't require science, didn't require

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00:11:20,037 --> 00:11:32,888

mathematics, so the teachers who chose education as their pathway to

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00:11:32,888 --> 00:11:38,068

a degree were doing it largely  
because they wanted to avoid science

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00:11:38,068 --> 00:11:43,290

and mathematics. I had a few friends  
like that, so I know that was the

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00:11:43,290 --> 00:11:47,990

case then, I know that has improved  
now, but it is just an example of

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00:11:47,990 --> 00:11:55,080

what happens to a student who is  
being taught by someone who is

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00:11:55,080 --> 00:12:00,021

afraid of the topics, the STEM  
topics. That student is not going

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00:12:00,021 --> 00:12:04,023

to learn, so you propagate that  
same fear in the students, or

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00:12:04,023 --> 00:12:08,686

aversion to the topic. The student  
might be ever so inclined to learn

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00:12:08,686 --> 00:12:14,579

the topic, but there is no one  
available to introduce it.

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00:12:14,579 --> 00:12:20,963

That was then. I think now, they  
have corrected that. But even now,

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00:12:20,963 --> 00:12:27,210

I believe that pay for a STEM teacher  
is probably no better than the pay for

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00:12:27,210 --> 00:12:32,847

any other teacher. Although all teachers are great, do not get me wrong, art

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00:12:32,847 --> 00:12:41,201

all that is wonderful stuff. It is just that there is a short-change when

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00:12:41,201 --> 00:12:44,869

it comes to STEM education, just naturally. I think anyone who is

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00:12:44,870 --> 00:12:52,638

knowledgable about engineering, science, technology, mathematics, is going to

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00:12:52,638 --> 00:12:58,915

migrate naturally to the highest paying job and that is generally the case.

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00:12:58,947 --> 00:13:04,416

There are going to be some who are dedicated and willing to do things out

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00:13:04,416 --> 00:13:11,974

of their own pockets, but that is a rare individual, laudatory individual, but

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00:13:11,974 --> 00:13:16,006

it is not the mass, masses that you need in order to move STEM education

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00:13:16,006 --> 00:13:24,032

forward. What I'm doing now as an emeritus is free of charge; I don't get paid

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00:13:24,032 --> 00:13:32,744

to be an emeritus. I don't know how many people would do that, I'm not saying

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00:13:32,744 --> 00:13:38,190

there is something special about me, but  
it is going to require either resources or

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00:13:38,190 --> 00:13:42,762

someone saying they do not require  
resources to do it.

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00:13:42,762 --> 00:13:49,268

What we are doing is writing proposals,  
something for his career, trying to get

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00:13:49,268 --> 00:13:55,881

funded for some forward research, what  
we call low technical readiness level

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00:13:55,886 --> 00:14:04,242

work, low TRL. He has connections in  
turn; he got his PhD from Vanderbilt,

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00:14:04,242 --> 00:14:11,912

but he also has connections to smaller  
schools and HBCUs, Historically Black

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00:14:11,912 --> 00:14:16,865

Colleges and Universities, so he can  
tie in to those. What we are trying to

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00:14:16,865 --> 00:14:25,975

do is develop a network including  
especially HBCUs and OMUs, Other Minority

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00:14:25,975 --> 00:14:38,708

Universities, Latino Universities, Hispanic,  
Native American, and to develop work in

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00:14:38,708 --> 00:14:45,055

conjunction with perhaps some of the larger  
universities like Berkeley, Harvard,

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00:14:45,055 --> 00:14:53,058

Carnegie Mellon, to do some low technical readiness levels so that students that

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00:14:53,058 --> 00:14:59,359

need time to mature and develop because of this lack of STEM education, they

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00:14:59,359 --> 00:15:05,094

might need a little time. Hopefully that development and technology

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00:15:05,094 --> 00:15:10,832

development can converge at some time in the future, at which time

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00:15:10,832 --> 00:15:16,575

we would have a highly educated workforce from this particular set

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00:15:16,575 --> 00:15:21,058

of students and technologies. I think about things like that, and

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00:15:21,058 --> 00:15:26,097

that is just one of them. I presented that to Dr. Julien Earls last week,

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00:15:26,097 --> 00:15:31,224

actually, who is the former director of the Glenn Research Center. He is

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00:15:31,224 --> 00:15:36,248

doing some remarkable things himself as a retired director. He is the

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00:15:36,248 --> 00:15:40,034

product of an HBCU himself; he came out of Norfolk State University.

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00:15:40,035 --> 00:15:46,045

He has done many other things since.  
He went to the Harvard Business School

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00:15:46,045 --> 00:15:55,031

as well; Dr. Julien Earls is very well  
known in physics. He was very

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00:15:55,031 --> 00:16:04,859

supportive of this idea of retirees  
going back to where they came from to

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00:16:04,859 --> 00:16:12,727

some of these unpaid positions, such  
as an emeritus position, which that is

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00:16:12,727 --> 00:16:22,064

not something that is going to be done  
by a large number of people because

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00:16:22,064 --> 00:16:27,447

most people would like to increase  
their retirement earnings by doing

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00:16:27,447 --> 00:16:32,956

something they get paid for,  
compensated for. I am not saying that

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00:16:32,956 --> 00:16:41,981

I wouldnt eventually do that myself,  
but just as a possible avenue, getting

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00:16:41,981 --> 00:16:48,019

back and getting these young PhDs  
involved in this, which helps their

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00:16:48,019 --> 00:16:52,280

career, helps them navigate through  
full cost accounting and line

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00:16:52,280 --> 00:16:56,143

management because now you have somebody to go around and develop

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00:16:56,143 --> 00:17:04,003

partnerships within the organization, within the institution, and among the

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00:17:04,003 --> 00:17:08,109

universities, which you would not normally have the time to do it. You

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00:17:08,109 --> 00:17:12,067

work an eight to five job and are expected to deliver, for example, if

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00:17:12,067 --> 00:17:19,510

you are on the SSL team or some team that has deadlines to meet, there is

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00:17:19,510 --> 00:17:29,134

no time for a person who is working an eight-hour day in his organization to

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00:17:29,134 --> 00:17:34,039

do all of these other extra things. What I mean is we have a lack of

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00:17:34,039 --> 00:17:39,287

infrastructure to really approach them on the level that we need to

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00:17:39,287 --> 00:17:44,836

approach it.

What I am doing right now in this

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00:17:44,836 --> 00:17:49,282

emeritus role I am playing is I am trying to find a process whereby

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00:17:49,282 --> 00:18:00,011

we can encourage people to come back and mentor, and this gets

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00:18:00,011 --> 00:18:08,004

into mentoring on another level, mentoring of PhDs and people that

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00:18:08,004 --> 00:18:15,983

are advanced but are constrained by the institution to do these things

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00:18:15,983 --> 00:18:23,048

outside of the bounds of what they are expected to do. I am working with a

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00:18:23,048 --> 00:18:29,506

young man, Dr. Navreet Jackson, right now, this is the person I was talking

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00:18:29,506 --> 00:18:37,003

about who has his PhD and is very willing, energetic, and capable and

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00:18:37,003 --> 00:18:47,251

is making some of these connections. I think he had Jackson State up today

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00:18:47,251 --> 00:18:53,294

in a meeting with the folks from Tech Transfer. This is something that

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00:18:53,294 --> 00:18:59,972

needs to be looked at and thought about. I am not saying I am providing

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00:18:59,972 --> 00:19:10,819

the perfect solution. But it is at least something that could be discussed and considered.

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00:19:11,114 --> 00:19:19,087

Most of my teaching, here, was at Oakwood. I started physical chemistry

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00:19:19,087 --> 00:19:28,625

years ago at Oakwood College. I mean, at least I had something to do with the start

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00:19:28,625 --> 00:19:35,017

of physical chemistry at Oakwood College. That is where I did most of my teaching

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00:19:35,017 --> 00:19:43,032

At A&M, we, I, along with Dr. Benjamin Penn, another PhD, he is a polymer chemist

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00:19:43,032 --> 00:19:46,669

at Marshall Space Flight Center, helped develop the physics department

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00:19:46,669 --> 00:19:55,002

at Alabama A&M, which really rose to be one of the top physics departments,

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00:19:55,002 --> 00:20:02,980

at the time, in the country. Even now, they have a Nobel Prize speaker to

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00:20:02,980 --> 00:20:10,035

come to speak every year, it is called the Putcha Venkateswarlu

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00:20:10,035 --> 00:20:17,974

Nobel Laureate Series. They come once a year to A&M, sometime around

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00:20:17,974 --> 00:20:21,993

this time of year, actually, October, November timeframe, and give a

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00:20:21,993 --> 00:20:33,759

lecture. That department started years ago with our support from

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00:20:33,759 --> 00:20:39,162

Marshall Space Flight Center, and Dr. Benjamin Penn and myself were

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00:20:39,162 --> 00:20:42,244

the ones that did most of that work.

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00:20:43,413 --> 00:20:51,098

First of all, I started from scratch and second of all, I

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00:20:51,098 --> 00:20:56,855

could not do it on Saturdays because it's a Seventh-day Adventists school.

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00:20:56,855 --> 00:21:05,016

I had to do things like set up a laboratory for enough students, there

207

00:21:05,016 --> 00:21:09,646

were something like twelve, thirteen, fourteen students, I had to have enough

208

00:21:09,646 --> 00:21:19,949

experiments, and I had to write to do the lectures. We met every week

209

00:21:19,949 --> 00:21:31,460

and we had two lectures, about an hour and a half of lecture, i guess, and then

210

00:21:31,460 --> 00:21:37,146

I had a lab that was about three hours long. What I did was I accumulated

211

00:21:37,146 --> 00:21:42,269  
experiments, I went over to UAH and  
got some of their experiments, I went

212  
00:21:42,269 --> 00:21:45,211  
out to A&M and got some of their  
experiments and put them all together,

213  
00:21:45,211 --> 00:21:50,001  
got my own set of ideas and developed  
a bunch of experiments that the

214  
00:21:50,001 --> 00:21:55,199  
students had to work their way through.  
We got the equipment, we had some

215  
00:21:55,199 --> 00:22:03,217  
equipment that was already there.  
Dr. Lai Hing, who was another physical

216  
00:22:03,217 --> 00:22:09,206  
chemist at Oakwood, he's the main guy there  
now, or he was, and he helped with some

217  
00:22:09,206 --> 00:22:18,976  
calorimeters and the pieces of equipment  
that were there, and we set it up. They

218  
00:22:18,976 --> 00:22:26,119  
did fashion, they did write the hours to  
match my work schedule. I would come down

219  
00:22:26,119 --> 00:22:32,111  
here after work at Marshall and run the  
lab, do the lab and teach, do the

220  
00:22:32,111 --> 00:22:41,998  
lectures. I did that for six, seven, eight years  
at Oakwood. That was a very, very good

221

00:22:41,998 --> 00:22:50,013

experience because some of those students  
became extremely talented and went on to

222

00:22:50,013 --> 00:22:55,783

medical school and one of them, she  
found out from me that she did not really