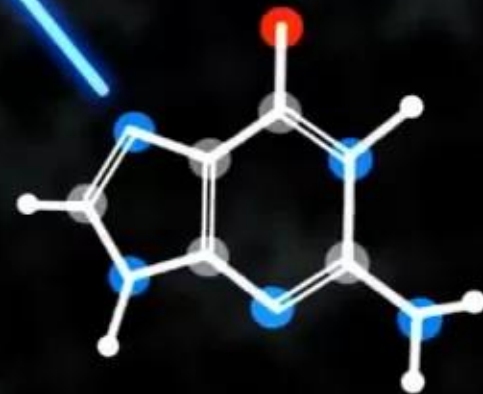


ADENINE



GUANINE

1

00:00:00,010 --> 00:00:04,150

[music] Mike Callahan: My name is Mike Callahan. I'm a

2

00:00:04,170 --> 00:00:08,270

research physical scientist in the Astrobiology Analytical Laboratory at NASA

3

00:00:08,290 --> 00:00:12,380

Goddard Space Flight Center. We've discovered a variety of nucleobases and nucleobase

4

00:00:12,400 --> 00:00:16,460

analog in meteorites. Now what a nucleobase is, is it's a small molecule

5

00:00:16,480 --> 00:00:20,560

that's found in DNA and RNA, and these molecules are essential

6

00:00:20,580 --> 00:00:24,670

for all of life. And so our results show that these molecules are extraterrestrial

7

00:00:24,690 --> 00:00:28,710

in origin, and they're products of a chemical reaction occurring on the meteorite.

8

00:00:28,730 --> 00:00:32,760

We believe that these nucleobases in meteorites are extraterrestrial based on three

9

00:00:32,780 --> 00:00:36,800

reasons, and the first is that we find nucleobase analogs in

10

00:00:36,820 --> 00:00:40,840

meteorites. What a nucleobase analog is, is that, it is a molecule

11

00:00:40,860 --> 00:00:44,850

that is structurally similar to the nucleobases you find in biology--

12

00:00:44,870 --> 00:00:49,000

but it's different in that these structures are actually either rare

13

00:00:49,020 --> 00:00:53,160

or even absent on Earth. The second reason is that

14

00:00:53,180 --> 00:00:57,270

in addition to looking at meteorite samples, we also study terrestrial samples.

15

00:00:57,290 --> 00:01:01,360

These meteorites are collected mostly in Antarctica, and one

16

00:01:01,380 --> 00:01:05,440

that's very famous called Murchison was collected in Australia. So, we have

17

00:01:05,460 --> 00:01:09,530

soil samples from that Murchison area in Australia, and we've also

18

00:01:09,550 --> 00:01:13,610

had--we were lucky enough to get an ice sample from Antarctica, where

19

00:01:13,630 --> 00:01:17,670

some of these meteorites were collected. And so when we look at these soil and ice samples in

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00:01:17,690 --> 00:01:21,710

the laboratory, we don't see the same distribution of nucleobases,

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00:01:21,730 --> 00:01:25,740

and with these nucleobase analogs, we don't see them at all in these

22

00:01:25,760 --> 00:01:29,760

terrestrial samples. The third reason why we think these nucleobases are extraterrestrial in

23

00:01:29,780 --> 00:01:33,880

meteorites is that in the laboratory, we study reactions of hydrogen cyanide,

24

00:01:33,900 --> 00:01:37,990

and when we extract these products from these hydrogen cyanide

25

00:01:38,010 --> 00:01:42,070

reactions, we also get nucleobases--and we actually get a similar

26

00:01:42,090 --> 00:01:46,180

suite of nucleobases to what's found in the meteorite. And so

27

00:01:46,200 --> 00:01:50,300

when we saw that, we were really excited, because we were thinking, well, hydrogen cyanide

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00:01:50,320 --> 00:01:54,380

is dispersed everywhere in the interstellar medium, and it's likely

29

00:01:54,400 --> 00:01:58,440

to have some sort of chemical reaction on the meteorite. And so, when we saw that,

30

00:01:58,460 --> 00:02:02,490

that really convinced us a lot that we're seeing something from

31

00:02:02,510 --> 00:02:06,530

a chemical reaction rather than some sort of biological contamination coming

32

00:02:06,550 --> 00:02:10,550

into the meteorite. So, this has implications for the origin of life on Earth.

33

00:02:10,570 --> 00:02:14,570

We know that meteorites contain amino acids, which are the building blocks of your proteins,

34

00:02:14,590 --> 00:02:18,710

and now from our research, we can show that nucleobases

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00:02:18,730 --> 00:02:22,840

--which are the building blocks of your genetic material, like DNA and RNA--

36

00:02:22,860 --> 00:02:26,970

could be found in meteorites. And so these things together could have seeded an early

37

00:02:26,990 --> 00:02:31,070

Earth with these really important molecules that could have built up to the larger molecules

38

00:02:31,090 --> 00:02:35,160

you see today that are essential for biology.

39

00:02:43,300 --> 00:02:39,240

[music, beeping]