TRANSCRIPT : How Tall Is Mount Everest? Hint: It's Changing

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MADDIE SOFIA, HOST:

You're listening to SHORT WAVE from NPR.

Maddie Sofia here with Lauren Frayer - first time on the show. Lauren, welcome.

LAUREN FRAYER, BYLINE: Hey. Thanks for having me.

SOFIA: Absolutely. OK, so you cover South Asia for NPR. What do you have for us?

FRAYER: So, Maddie, today, I have for you a number.

ROXANNE VOGEL: The number itself, 29,029, it just becomes something that you, I guess, fixate on. It becomes just this special number in your mind. And, like, you hear it and you just know immediately what it means.

FRAYER: So, Maddie, before I tell you who this person is, I want to ask you - you're a climber. I bet you know what this number means.

SOFIA: Yeah, climber's a strong word for what I do out there, Lauren, but yeah, I totally know what that number is. But why don't you tell our audience who might not know what it is?

FRAYER: OK, so it is the height of Mount Everest...

SOFIA: Oh, yeah, yeah.

FRAYER: ...The world's highest peak. It's on the border of Nepal and China - a height that Roxanne Vogel, whose voice you just heard there, she knows every single foot of. And that's because last year, she set a speed record there.

VOGEL: I became the first person to successfully climb Everest - from my home in San Francisco, all the way to the top - and return home in 14 days.

SOFIA: Wow.

VOGEL: We called it a lightning ascent.

SOFIA: That's fast, Lauren. That's too fast.

FRAYER: Yeah. Total underachiever, that Roxanne there.

SOFIA: But how can a person even do that, Lauren?

FRAYER: Well, so to prepare for this lightning ascent, Roxanne trained like mad. And she was constantly focused on that number.

VOGEL: Twenty-nine thousand twenty-nine.

Having never been that high...

Twenty-nine thousand twenty-nine.

...It was certainly something that focused my training.

Twenty-nine thousand twenty-nine.

FRAYER: And so she kept plugging in that number, doing calculations.

LAUREN FRAYER AND ROXANNE VOGEL: Twenty-nine thousand twenty-nine.

VOGEL: Like, OK, here's how many thousand feet I need to be sleeping at.

FRAYER: And then to finally stand there...

VOGEL: Twenty-nine thousand twenty-nine.

FRAYER: ...At that altitude...

VOGEL: That's the closest to heaven or the closest to outer space that I will ever get on this earth. And it's kind of life-changing when you're up there.

(SOUNDBITE OF MUSIC)

FRAYER: But here's the thing - that number that Roxanne was fixated on, that she kept plugging into all of her equipment, that she spent years dedicating her life to reaching, it might not actually be the height of Everest, or at least not for long.

SOFIA: So today on the show, we talk about the ridiculously complicated science it takes to measure the world's highest peak and why the height of Mount Everest is ever-changing. This is SHORT WAVE from NPR.

(SOUNDBITE OF MUSIC)

SOFIA: OK, Lauren Frayer, today we are talking about Mount Everest, which is the highest mountain on Earth when you measure from sea level. And today we're focusing on how that measurement is made. Where do we start?

FRAYER: How about some old-timey newsreel?

(SOUNDBITE OF ARCHIVED RECORDING)

UNIDENTIFIED PERSON: So George Everest, following his survey of 1841, estimated its height at 29,000 feet. Although Sir George...

FRAYER: So back in the 19th century when George Everest, a Brit, was the surveyor general of India, they used trigonometry to measure the height of the mountain.

SOFIA: Like what we learned in middle school, like, points and angles and triangles?

FRAYER: Totally, yeah. And incidentally, the mountain got its English name from Sir George Everest, but it was actually an Indian mathematician, Radhanath Sikdar, who did most of the work and actually figured out that this mountain is the highest point on Earth.

SOFIA: That sounds right for colonialism, you know?

FRAYER: Totally, yeah.

SOFIA: OK, so how accurate was this trigonometry approach?

FRAYER: Well, I put that question to be B. Nagarajan. He's a geoscientist, one of George Everest's successors at the Survey of India office, which still exists, but is now staffed by Indians.

B NAGARAJAN: In fact, I was sitting in the same chair at the same location that George Everest was sitting because I didn't want to change the room (laughter).

SOFIA: (Laughter).

FRAYER: So he says the trigonometry that his predecessors used throughout the 19th and 20th centuries was surprisingly accurate. I mean, the standard height everyone now uses for Everest, that 29,029 feet, it dates back to 1955.

SOFIA: Wow, that's pretty impressive. OK, so how did they actually calculate that measurement for a mountain? Like, walk me through it.

FRAYER: It was not easy. They measured it from eight different points.

NAGARAJAN: The horizontal angle, distance and everything - and computed and took the mean. It was a very difficult method, very heavy machines.

FRAYER: Heavy machines called theodolites, optical instruments used to measure angles between visible points on the horizon and vertical planes. They're like a cross between a telescope and a compass.

SOFIA: OK.

FRAYER: You might have seen municipal surveyors using them, sort of on a tripod.

SOFIA: Oh, yeah. No, I've seen those folks with their, like, reflective vests and their little tripods.

FRAYER: Them, yes.

SOFIA: Yeah, OK.

FRAYER: So - but for measuring mountains, there are these big, heavy versions.

NAGARAJAN: I don't know how many hundreds of kilograms they weighed and then carried forward to make this measurement. It is cloud-covered. Most of the time it is snow-covered. So the effort that was put on was very difficult. Now it is nothing much - what the Chinese are doing or Nepalese are doing. They are high-tech instrumentation...

FRAYER: What the Chinese and the Nepalese are doing now involves satellites. So instead of measuring Everest from afar on the horizon with these theodolite contraptions, they send a team up to the top of the mountain with a handheld GPS receiver.

SOFIA: OK, that sounds, like, a little easier to me.

FRAYER: Maybe, but maybe not. Here is Dinesh Manandhar. He's a GPS expert from Nepal who teaches now at the University of Tokyo.

DINESH MANANDHAR: It's a very harsh environment there, very, very windy. And you have all these battery or power problems. And, like, the people who climbed Everest, they can't stay there probably more than half an hour. I think that's limit for them because they're already exhausted.

FRAYER: So they've got 30 minutes to connect to multiple satellites 'cause there are solar flares and interference at altitude. You can't rely on just one reading.

SOFIA: Got it.

FRAYER: And they have to measure the thickness of ice and snow underfoot because you want a reading from the actual rock mountain - right? - not the ice.

SOFIA: Yeah.

FRAYER: And so for that, you need a ground-penetrating radar.

SOFIA: So another piece of equipment to haul up the mountain.

FRAYER: Yeah. So fumbling with all of that on top of Everest - you've got wind, you've got your oxygen depleting, the clock is ticking. And that is still the easy part, Manandhar says, because all of that data from the top of Everest, it's only half the story.

MANANDHAR: Yeah. So you need a reference point. And that's the biggest problem. They need a sea reference somewhere. But we don't have a sea reference in Nepal because Nepal is a landlocked country. It's land everywhere. The nearest sea level is in India.

FRAYER: So to know how high this mountain is, you first need to know how low sea level is. And you need a reference point, sea level, which it turns out varies depending on where you are.

SOFIA: Yeah. I mean, sea level is tricky, right? It's not necessarily constant. And climate change is really messing with sea level these days.

FRAYER: Yeah. And as Manandhar says, there isn't even a sea next to Everest.

SOFIA: Right.

FRAYER: So here's how they do it. They measure sea level in India at the Bay of Bengal, at China's Yellow Sea, at many other points, hundreds of them, to calculate the mean sea level. And then they figure out where sea level would be if there were a sea right next to Everest.

SOFIA: Oh, OK. And then you just measure from there up to the peak.

FRAYER: Well...

MANANDHAR: No, no, no (laughter).

FRAYER: You have to account for the shape of the Earth.

MANANDHAR: The shape of the Earth - OK? - it's ellipsoidal, very much ellipsoidal.

SOFIA: Right. The Earth is ellipsoidal, like an oval-shaped watermelon, because of the Earth's rotation. It makes it kind of bulge slightly at the equator.

FRAYER: Plus, you have to account for how gravity affects sea level in different places around the world. And mountains themselves affect gravity.

SOFIA: Right.

FRAYER: So the Earth at sea level, this invisible line along the Earth's surface, it's actually, like, kind of lumpy.

SOFIA: So you're telling me that we are standing on a lumpy ellipsoid? That's what...

FRAYER: That's exactly what I'm telling you.

SOFIA: (Laughter).

FRAYER: Yes, yes. So sea level is actually not level at all. And so the next step - you got to map those lumps, essentially variations in the Earth's gravitational force, and then you get the geoid.

SOFIA: A - I'm sorry, a geoid?

FRAYER: Yeah. So the geoid is the shape of the Earth at sea level, taking into account gravity and the planet's rotation. And now you follow that geoid to a point directly under Everest. And that's what you use as a reference point for the mountain's height.

SOFIA: OK. So after all that - sea levels, gravity - you finally get a reference point. You take that, you compare it to your GPS measurement from the top of the mountain, and, voila, you get Everest's height.

FRAYER: Well, not so fast because there's also these pesky plate tectonics.

SOFIA: Oh, my God. Lauren, this is harder than actually climbing Everest. I'll say it. I'll say it...

FRAYER: Yeah.

SOFIA: ...Right now.

FRAYER: Yeah, yeah. So the mountain's peak is variable, too. Like - and I'm not just talking ice and snow. Like, the rock is actually moving. Sridevi Jade is an engineer and expert on Himalayan plate tectonics.

SRIDEVI JADE: I have done fieldwork in the Himalayas for the last 20, 25 years. And then...

FRAYER: Everest is on the edge of two plates, the Eurasian plate and the Indian plate. And Jade has measured how the Indian plate is slipping underneath the Eurasian plate and how that is pushing Everest skyward.

JADE: That measurement for the last 20 years - 1.4-millimeter increase in height per year. So, like, if you take for a hundred years, we can round it of to...

FRAYER: Jade has concluded that Everest is gaining roughly a centimeter every 10 years, so that's about a foot every 300 years. Other scientists say that's far too conservative, that the growth could be three times, even four times that much. But, I mean, however fast Everest is rising, things can happen very quickly to change that, like earthquakes.

SOFIA: Oh.

FRAYER: Or at least they have in the past. So Professor Jade studied a 1934 quake that she calculated took about 60 centimeters off the mountain's height. So that's at least 600 years of growth erased in an instant. And there's been another quake since, in 2015. And we're not sure how that affected the height because there haven't been any definitive measurements since then.

SOFIA: So I'm guessing you're about to tell me it's time to remeasure Mount Everest.

FRAYER: It is, indeed. So last year, Nepal sent up a team of scientists to do just that. And this year, with the climbing season cancelled for COVID, China did the same. And both countries have been analyzing their findings. And they're due to release the measurements pretty much any day now.

SOFIA: This is very exciting.

FRAYER: Yeah, so especially because most of the surveys of Everest over the centuries have been done by foreigners - you know, British colonial rulers. There was an American survey. There was an Italian one. And Professor Manandhar, the GPS expert from Nepal says, yeah, he's motivated by science and the search for truth and all of this, but, you know, also in part by...

MANANDHAR: Nepalese pride, yes. Why don't we measure our own mountain?

FRAYER: And so Nepal did. And we are waiting for those findings now. it may turn out to be taller, shorter, whatever. The point, though, is that it's changing. And that's what scientists say matters to them. Here's Nagarajan, the former Survey of India guy, again.

NAGARAJAN: I feel the joint work, you know - sharing the knowledge will give the society a bigger understanding. What is there a big deal if you come and say, OK, I'm announcing Mount Everest's height is this much? Hell with that - who cares, you know? The question is the learning, the teaching, how the people understand, how the people perceive, how much effort you put in, what model you used. Then we'll be happy, yes.

FRAYER: He's happy about what this tells us about the Earth overall. The technology they're fine-tuning on Everest has all these practical applications, from agriculture to defense, and scientists say if their research gets more eyeballs because it involves the tallest mountain in the world, hey, you know, that's a great thing for science.

(SOUNDBITE OF MUSIC)

SOFIA: Today's episode was produced by Rebecca Ramirez, edited by Viet Le and fact-checked by Ariela Zebede. Special thanks to NPR's India producer Sushmita Pathak and Brent Bachman. I'm Maddie Sofia. Thanks for listening to SHORT WAVE from NPR.

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FRAYER: Hey, this is Lauren again. I just want to leave you with a couple fun facts we couldn't fit in this podcast, which are - if you measure from the Earth's core to a mountain's peak, the tallest mountain in the world is not Everest. It's in Ecuador - Mount Chimborazo. And if you measure from base to peak, the tallest mountain - nope, not Everest - Mauna Kea, a mountain in Hawaii. It's just mostly underwater.