TED演讲者：Penny Chisholm | 佩妮 • 奇斯霍姆

演讲标题：The tiny creature that secretly powers the planet | 秘密为地球提供动力的微小生物

内容概要：Oceanographer Penny Chisholm introduces us to an amazing little being: Prochlorococcus, the most abundant photosynthetic species on the planet. A marine microbe that has existed for millions of years, Prochlorococcus wasn't discovered until the mid-1980s -- but its ancient genetic code may hold clues to how we can reduce our dependence on fossil fuels.

海洋学家佩妮 • 奇斯霍姆向我们介绍了一种神奇的小生物：原绿球藻，地球上最丰富的光合作用物种。尽管这种微生物已经存在了数百万年，却直至1980年代才被发现——但它的远古基因代码可能包含了我们如何减少化学燃料依赖的密码。

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I'd like to introduce you to a tiny **microorganism** that you've probably never heard of: its name is Prochlorococcus, and it's really an amazing little being.	我想向你们介绍一种小小的微生物, 你们可能从没有听说过: 它叫原绿球藻, 是一种非常神奇的微生物。[00:12]
For one thing, its ancestors changed the earth in ways that made it possible for us to evolve, and hidden in its genetic code is a **blueprint** that may inspire ways to reduce our **dependency** on fossil fuel.	一方面,它的祖先 改变了地球环境, 使其适合人类的演化, 而隐藏在其遗传密码中的 是一个蓝图, 可以启发我们找到减少 对化石燃料依赖的方法。[00:23]
But the most amazing thing is that there are three billion billion billion of these tiny cells on the planet, and we didn't know they existed until 35 years ago.	但最让人惊奇的是 地球上拥有3乘10的27次方之多的 这种微生物, 而我们直至35年前 才知道它们的存在。[00:40]
So to tell you their story, I need to first take you way back, four billion years ago, when the earth might have looked something like this.	要给你们讲它们的故事, 我需要首先带你们回到过去, 40亿年前的地球可能长这样。[00:51]
There was no life on the planet, there was no oxygen in the atmosphere.	毫无生息, 大气层中没有一点氧气。[01:00]
So what happened to change that planet into the one we enjoy today, **teeming** with life, **teeming** with plants and animals?	是什么让地球变得 像今天这样宜居, 充满生命, 到处是植物和动物? [01:05]

microorganism: n.[微]微生物;微小动植物 **For one thing:** 首先;一则 **blueprint:** vt.计划;制成蓝图/n.蓝图,设计图;计划 **dependency:** n.属国;从属;从属物 **teeming:** adj.多产的,丰富的;热闹的/v.充满(teem的现在分词)

Well, **in a word**, **photosynthesis**.	一个词,光合作用。[01:15]
About two and a half billion years ago, some of these ancient ancestors of Prochlorococcus evolved so that they could use solar energy and absorb it and split water into its component parts of oxygen and hydrogen.	在大约25亿年前, 原绿球藻的部分 远古祖先发生了进化, 这样它们就可以使用太阳能, 吸收这些能量, 并利用其将水分解成氧和氢。[01:18]
And they used the chemical energy produced to draw CO2, carbon **dioxide**, out of the atmosphere and use it to build sugars and **proteins** and **amino acids**, all the things that life is made of.	它们使用产生的化学能 把二氧化碳从大气中抽取出来, 并用于制造糖分,蛋白质和氨基酸, 所有这些组成生命的元素。[01:33]
And as they evolved and grew more and more over millions and millions of years, that oxygen **accumulated** in the atmosphere.	随着它们不断演化,数量日渐增加, 历经数百万年之后, 大气中的氧气慢慢积累起来。[01:47]
Until about 500 million years ago, there was enough in the atmosphere that larger **organisms** could evolve.	直到大约5亿前, 大气中的氧气足够多到 让更大的生物可以进化。[01:57]
There was an explosion of **life-forms**, and, ultimately, we appeared on the scene.	迎来了生命形态的大爆发, 最终,人类出现在了历史舞台上。[02:03]

in a word: 总之;简言之 **photosynthesis:** n.光合作用 **dioxide:** n.二氧化物 **proteins:** n.[生化]蛋白质(protein复数) **amino:** adj.氨基的/n.[化学]氨基 **acids:** n.[化学]酸,酸类;有酸味的东西(acid的复数) **accumulated:** adj.累积的;累计的;达到/v.累积(accumulate的过去分词) **organisms:** n.[生物]生物体(organism的复数);[生物]有机体 **life-forms:** n.生物

While that was going on, some of those ancient photosynthesizers died and were **compressed** and buried, and became fossil fuel with sunlight buried in their carbon **bonds**.	在这一切发生的过程中, 部分这些远古的光合作用系统死去, 被压缩和埋葬, 变成了用碳键 储存太阳能量的化石燃料。[02:08]
They're basically buried sunlight in the form of coal and oil.	它们基本上是用煤炭 和石油的形式储存太阳能的。[02:23]
Today's photosynthesizers, their engines are **descended** from those ancient **microbes**, and they feed basically all of life on earth.	今天的光合作用系统, 它们的引擎是那些 古老微生物的后代, 它们基本上养育了 地球上所有的生物。[02:28]
Your heart is beating using the solar energy that some plant processed for you, and the stuff your body is made out of is	你心脏的跳动使用的是来自植物 为你加工的太阳能, 你的身体部件是由植物为你加工的 二氧化碳

made out of CO2 that some plant processed for you.	制造而成。[02:40]
Basically, we're all made out of sunlight and carbon dioxide.	总的来说,我们都由 阳光和二氧化碳所造。[02:53]
Fundamentally, we're just **hot air**.	说白了,我们只是热空气罢了。[02:58]
(Laughter) So as **terrestrial** beings, we're very **familiar with** the plants on land: the trees, the **grasses**, the **pastures**, the **crops**.	（笑声） 作为陆地生物, 我们对地上的植物很熟悉: 树木,草,牧场,庄稼。[03:00]
compressed: adj.被压缩的;扁平的 **bonds:** n.镣铐;监禁;盟约(bond的复数)/v.使...凝固;充当...的保证人;团结一致(bond的第三人称单数) **descended:** adj.出身于...的;从一个祖先传下来的 **microbes:** n.细菌,[微]微生物;微生物类(microbe的复数形式) **hot air:** 吹牛;大话 **terrestrial:** adj.地球的;陆地的,[生物]陆生的;人间的/n.陆地生物;地球上的人 **familiar with:** 熟悉 **grasses:** n.草地(grass的复数);稻科植物类;禾本种/v.放牧(grass的三单形式);使长满草 **pastures:** 牧草 **crops:** n.农作物(crop的复数);收成;[冶]切头/v.种植(crop的三单形式);收割;修剪;产庄稼	
But the oceans are filled with billions of tons of animals.	但海洋里充满了数十亿吨的动物。[03:13]
Do you ever wonder what's feeding them?	你们有没有好奇它们都吃些什么? [03:17]
Well there's an invisible pasture of **microscopic** photosynthesizers called **phytoplankton** that fill the upper 200 meters of the ocean, and they feed the entire open ocean **ecosystem**.	海洋里面有一片看不见的牧场, 由一种叫做浮游植物的 微型光合成器组成, 填满了海洋顶层的200米, 它们为整个海洋生态系统提供食物。[03:21]
Some of the animals live among them and eat them, and others swim up to **feed on** them at night, while others **sit in** the deep and wait for them to die and **settle down** and then they **chow down** on them.	有些动物生活于其中,以它们为食, 另一些晚上游过来吞食它们, 还有一些静坐海洋深处, 等待它们死亡,沉降, 从而享受美餐。[03:35]
So these tiny phytoplankton, **collectively**, weigh less than one percent of all the plants on land, but **annually** they **photosynthesize** as much as all of the plants on land, including the **Amazon rainforest** that we consider the lungs of the planet.	这些微小的浮游植物 加在一起,只占地球 植物重量不到1/100, 但每年它们的光合作用总量 不亚于陆地上的所有植物, 包括亚马逊雨林在内, 这个我们视为地球之肺的雨林。[03:47]
microscopic: adj.微观的;用显微镜可见的 **phytoplankton:** n.[植]浮游植物(群落) **ecosystem:** n.生态系统 **feed on:** v.以...为食;以...为能源 **sit in:** 列席,旁听;参加;代理 **settle down:** 定居;安定下来;专心于 **chow down:** 吃饭;大快朵颐 **collectively:** adv.共同地,全体地 **annually:** adv.每年;一年一次 **photosynthesize:** vi.起光合作用;光能合成/vt.通过光合作用产生 **Amazon:** 亚马逊; 古希腊女战士 **rainforest:** n.(热带)雨林	
Every year, they fix 50 billion tons of carbon in the form of carbon dioxide into their bodies that **feeds** the ocean ecosystem.	每一年,它们以二氧化碳的形式 在体内固定500亿吨的碳, 从而为整个海洋系统提供食物。[04:04]
How does this tiny amount of **biomass** produce as much as all the plants on land?	这些微小的生物是如何产生 跟地上的植物一样多的氧气的呢? [04:14]
Well, they don't have **trunks** and **stems** and flowers and fruits and all that to maintain.	它们并没有树干和茎, 鲜花和果实这些维持生命的东西。[04:19]
All they have to do is grow and divide and grow and divide.	它们所要做的无非是 重复地成长和分裂。[04:25]
They're really lean little photosynthesis machines.	它们是非常小的光合作用机器。[04:27]
They really **crank**.	真是全力以赴地在工作。[04:33]
So there are thousands of different species of phytoplankton, come in all different shapes and sizes, all roughly less than the width of a human hair.	有成千上万种不同种类的浮游植物, 有不同的形状和大小, 它们的尺寸都小于 人类的头发宽度。[04:39]
Here, I'm showing you some of the more beautiful ones, the textbook versions.	这里,我给大家展示 其中最漂亮的一些, 几乎是教科书版本。[04:48]
I call them the **charismatic** species of phytoplankton.	我称它们为魅力非凡的浮游植物。[04:54]
And here is Prochlorococcus.	这就是原绿球藻。[04:59]
feeds: n.[畜牧]饲料;一餐(feed的复数)/v.提供(feed的第三人称单数形式);饲养 **biomass:** n.(单位面积或体积内的)[生态]生物量 **trunks:** n.中继线;运动短裤;男式游泳裤 **stems:** n.[植]茎(stem的复数);树管;阻挡物/v.起源于(stem的三单形式);除去...的茎;给...装杆;止住 **crank:** n.曲柄;奇想/adj.易怒的/vt.装曲柄 **charismatic:** adj.超凡魅力的;神赐能力的	
I know, it just looks like **a bunch of schmutz** on a microscope slide.	我知道。 这看起来就像是 显微玻璃片上的脏东西。[05:03]
(Laughter) But they're in there, and I'm going to reveal them to you **in a minute**.	（笑声） 但它们就在其中, 我马上就会展示给你们看。[05:08]
But first I want to tell you how they were discovered.	但首先,我想告诉大家 它们是如何被发现的。[05:15]
About 38 years ago, we were playing around with a technology in my lab called flow cytometry that was developed for **biomedical** research for studying cells like cancer cells,	在大约38年前, 我们在实验室里时兴玩一项 叫做流式细胞术的技术, 该技术是为研究癌细胞等 生物医学研究而开发的,[05:19]
but it turns out we were using it for this **off-label** purpose which was to study phytoplankton, and it was beautifully	但结果,我们用它来 实现这个标示外的目的, 用于研究浮游植物, 也是非常适合的。[05:32]

suited to do that.

And here's how it works: so you **inject** a sample in this tiny little **capillary** tube, and the cells go single file by a laser, and as they do, they **scatter** light **according to** their size	这是它工作的原理: 你把样本注入到这个 微小的毛细管中, 细胞在激光照射下一个个通过, 在这过程中,它们根据 不同的大小散射光线,[05:41]

a bunch of: 一群;一束;一堆 **schmutz:** n.污物;废物;垃圾 **in a minute:** 马上;立即 **biomedical:** adj.生物医学的 **off-label:** adj.用于未标志用途的;没被临床试验认可的药物 **suited:** adj.合适的/v.适合(suit的过去分词) **inject:** vt.注入;注射 **capillary:** n.毛细管/adj.毛细管的;毛状的 **scatter:** vi.分散,散开;散射/vt.使散射;使散开,使分散;使散播,使撒播/n.分散;散播,撒播 **according to:** 根据,按照;取决于;据...所说

and they emit light according to whatever **pigments** they might have, whether they're natural or whether you stain them.	并根据它们可能含有的色素发出光, 不管是天然的还是后天被染色的。[05:55]
And the **chlorophyl** of phytoplankton, which is green, **emits** red light when you shine blue **light on** it.	浮游植物的叶绿素 是绿色的, 当你把蓝光照射在上面时,就发出红光。[06:01]
And so we used this **instrument** for several years to study our phytoplankton cultures, species like those charismatic ones that I showed you, just studying their basic cell biology.	所以我们使用这种仪器好些年 去研究我们的浮游植物培养群, 这种我给你们看的有魅力的物种, 只是研究它们基本的细胞生物学。[06:10]
But all that time, we thought, well wouldn't it be really cool if we could take an instrument like this out on a ship and just **squirt seawater** through it and see what all those **diversity** of phytoplankton would look like.	但在这段时间里, 我们想,假如我们把 这种仪器带到船上, 用它来喷洒海水, 看看多样性的浮游植物会是什么样子,这不是很酷吗? [06:21]
So I managed to get my hands on what we call a big rig in flow cytometry, a large, powerful laser with a money-back guarantee from the company that if it didn't work on a ship, they would take it back.	所以我设法得到了 我们称之为流式细胞仪中的大钻机, 一个大型,强大的激光器, 并得到了卖方假如无法在船上工作, 可以退货退款的保证。[06:34]

pigments: n.[颜料]颜料,染料;[物][生化]色素(pigment的复数形式) **chlorophyl:** n.叶绿素 **emits:** 发出/放射/发行(emit的动词单数第三人称形式) **light on:** 偶然遇见(碰见,发现);停落于 **instrument:** n.仪器; 工具; 乐器; 手段; 器械 **squirt:** n.喷射;注射/vt.喷湿/vi.喷出 **seawater:** n.海水 **diversity:** n.多样性;差异

And so a young scientist that I was working with at the time, Rob Olson, was able to take this thing apart, put it on a ship, put it back together and take it off to sea.	于是一个我一直在合作的年轻科学家, 罗伯 · 奥尔森,把这东西拆开, 运到船上,再重新 组装好,带到海里去。[06:48]
And it worked like a charm.	它的效果出人意料的好。[06:58]
We didn't think it would, because we thought the ship's **vibrations** would **get in the way** of the focusing of the laser, but it really worked like a charm.	我们没想到效果这么好, 因为我们以为船的晃动 会阻碍激光的聚焦, 但它的效果真的十分惊艳。[06:59]
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And so we **mapped** the phytoplankton **distributions** across the ocean.	于是,我们绘制了整个海洋的 浮游植物分布图。[07:06]
For the first time, you could look at them one cell **at a time** in real time and see what was going on -- that was very exciting.	这是首次可以实时地 看一个细胞单元, 看看发生了什么—— 这实在非常令人兴奋。[07:10]
But one day, Rob noticed some faint signals coming out of the instrument that we **dismissed** as electronic noise for probably a year before we realized that it wasn't really **behaving** like noise.	有一天,罗伯注意到机器中 有一些微弱的信号, 这些信号一年来一直被我们当做 电子噪音, 直至我们意识到, 它们并不是噪音。[07:16]
It had some regular patterns to it.	它的信号表现出了一些固定的模式。[07:30]

vibrations: n.[力]振动;共鸣;动摇(vibration的复数) **get in the way:** 妨碍;挡道;挡住去路;阻碍 **mapped:** v.映射(map的过去式和过去分词形式);计划;绘制...之地图 **distributions:** n.分派;分派;分销(distribution的复数形式) **at a time:** 一次;每次;在某时 **dismissed:** v.开除,解散(dismiss的过去分词);摒弃/adj.解雇的;解散的,被排除的 **behaving:** 表现/运动表现/规矩地行事

To **make a long story short**, it was tiny, tiny little cells, less than **one-one** hundredth the width of a human hair that contain chlorophyl.	长话短说, 它是非常非常微小的细胞, 不到人类头发宽度的百分之一, 它含有叶绿素。[07:34]
That was Prochlorococcus.	这就是原绿球藻。[07:44]
So remember this slide that I showed you?	还记得刚才展示过的 这张幻灯片吗? [07:46]
If you shine blue light on that same sample, this is what you see: two tiny little red **light-emitting** cells.	如果你用蓝光照射这些样本, 就会看到这样一幕: 两个微小的红色发光细胞。[07:50]
Those are Prochlorococcus.	这些都是原绿球藻。[07:58]
They are the smallest and most abundant **photosynthetic** cell on the planet.	它们是地球上最小, 但数量最多的光合细胞。[08:02]
At first, we didn't know what they were, so we called the "little greens."	一开始,我们不知道它们是什么, 所以叫它们 “小绿” ,[08:08]
It was a very **affectionate** name for them.	这是一个非常亲切的称呼。[08:12]
Ultimately, we knew enough about them to give them the	最后,我们对它们有了深入的了解, 就把它取名叫原

name Prochlorococcus, which means "**primitive** green **berry**." 绿球藻, 意思是“原始的绿色浆果”。[08:14]

And it was about that time that I became so **smitten** by these little cells that I **redirected** my entire lab to study them and nothing else, and my loyalty to them has really paid off. 大概是在那个时候 我就被这些小细胞迷住了, 我把我整个实验室的 研究方向都转到了它们身上, 而我对它们的忠诚 也得到了丰厚的回报。[08:20]

make a long story short: 长话短说,简而言之;总之 **one-one:** adj.成对比的;一对一的(等于one-to-one) **light-emitting:** adj.发光的 **photosynthetic:** adj.[生化]光合的;光合作用的 **affectionate:** adj.深情的;充满深情的 **berry:** n.浆果(葡萄,番茄等)/vi.采集浆果 **smitten:** v.打击,摧毁(smite的过去分词) **redirected:** v.重新传入,重新寄送(redirect的过去分词形式)

They've given me a **tremendous** amount, including bringing me here. 它们带给了我很多, 也让我今天能够站在这里。[08:34]

(Applause) So over the years, we and others, many others, have studied Prochlorococcus across the oceans and found that they're very abundant over wide, wide ranges **in the open** ocean ecosystem. （鼓掌） 过去那些年,我和很多其他人, 穿越了各个海域研究原绿球藻, 发现它们在开放的海洋生态中的 数量十分庞大,且分布广阔。[08:39]

They're particularly **abundant in** what are called the open ocean **gyres**. 它们在公海环流中尤其丰富。[08:59]

These are sometimes referred to as the deserts of the oceans, but they're not deserts at all. 这些区域有时被称为海洋的沙漠, 但它们其实根本不是沙漠。[09:03]

Their deep blue water is teeming with a hundred million Prochlorococcus cells per liter. 深蓝色的海水 每升富含1亿个原绿球藻。[09:09]

If you crowd them together like we do in our cultures, you can see their beautiful green chlorophyl. 如果把它们按 处理培养群那样聚在一起, 就可以看到它们美丽的绿色叶绿素。[09:16]

One of those test **tubes** has a billion Prochlorococcus in it, and as I told you earlier, there are three billion billion billion of them on the planet. 其中一个试管中有 10亿个原绿球菌, 正如我刚才提到的, 地球上有3乘10的27次方的原绿球藻,[09:22]

That's three octillion, if you care to convert. 相当于3倍的10亿的3次方, 如果你想转换的话。[09:31]

tremendous: adj.极大的，巨大的；惊人的；极好的 **in the open:** 在户外;在野外 **abundant in:** 富于;富有 **gyres:** n.旋转;螺旋形(gyre的复数)/v.旋转(gyre的第三人称单数) **tubes:** n.[材]管子,导管;管状虫;伦敦地铁(tube的复数)

(Laughter) And collectively, they weigh more than the human population and they photosynthesize as much as all of the crops on land. （笑声） 它们的重量加起来 超过了人类总人口的重量, 光合作用程度 跟地球上所有作物一样多。[09:36]

They're **incredibly** important in the global ocean. 对全球海洋来说非常重要。[09:46]

So over the years, as we were studying them and found how abundant they were, we thought, hmm, this is really strange. 这些年来,随着研究的不断推进, 我们发现它们的含量如此丰富, 不禁感到很奇怪。[09:50]

How can a single species be so abundant across so many different **habitats**? 一个物种如何能在如此多的 不同栖息地都如此丰富? [09:57]

And as we isolated more into culture, we learned that they are different ecotypes. 当我们把更多的原绿球藻 隔离在培养液中, 我们了解到它们是 不同的生态类型。[10:02]

There are some that are **adapted** to the high-light **intensities** in the surface water, and there are some that are **adapted** to the low light in the deep ocean. 有一些适应高光强度的 表层水, 另一些则适应深海的低光环境。[10:06]

In fact, those cells that live in the bottom of the **sunlit** zone are the most efficient photosynthesizers of any known cell. 事实上,那些生活在 阳光照射区底部的细胞 是所有已知细胞中 最有效的光合成器。[10:14]

And then we learned that there are some **strains** that grow **optimally** along the **equator**, where there are higher temperatures, and some that do better at the cooler temperatures as you go north and south. 然后我们了解到有一些菌株 在赤道上生长得最好, 那里温度更高, 有一些则在更低温度中表现更好, 沿着经线考察就会发现。[10:22]

incredibly: adv.难以置信地；非常地 **habitats:** n.[生态]栖息地;(动植物的)[经]产地(habitat的复数形式) **adapted:** adj.适合的/v.使适应,改编(adapt的过去式) **intensities:** 强烈 **sunlit:** adj.阳光照射的;被日光照射了的 **strains:** n.[微]菌株(strain复数);种族/v.[力]拉紧;使过度劳累(strain的第三人称单数形式) **optimally:** adv.最佳;最适宜 **equator:** n.赤道

So as we studied these more and more and kept finding more and more diversity, we thought, oh my God, how **diverse** are these things? 所以当我们更深入地研究这些问题时, 就会不断发现更多的多样性, 我们不禁感叹,老天, 这些东西到底有多少种? [10:34]

And about that time, it became possible to sequence their **genomes** and really look under the hood and look at their genetic **makeup**. 大约在那个时候,技术已经发展到 可以对它们的基因组进行测序了, 可以仔细看看它们的基因组成。[10:40]

And we've been able to sequence the genomes of cultures that we have, but also recently, using flow cytometry, we can isolate individual cells from the wild and sequence their individual genomes, and now we've **sequenced** hundreds of Prochlorococcus. 我们已经能够对所拥有的 培养物的基因组进行测序, 但也在最近,使用流式细胞术, 我们可以将单个细胞 从野生环境中分离出来, 并对它们的个体基因组进行测序, 现在我们已经对数百种 原球菌进行了测序。[10:49]

And although each cell has roughly 2,000 genes -- that's one tenth the size of the human genome -- as you sequence 尽管每个细胞大约只有 2000个基因—— 是人类基因组的1/10—— 但随着测序越来越多, 你会发现

more and more, you find that they only have a thousand of those in common and the other thousand for each individual strain is drawn from an **enormous** gene pool,

它们之间 有上千种基因是相似的, 而每个个体的另外一千个基因 都是从一个巨大的 基因库中提取出来的,[11:04]

and it **reflects** the particular environment that the cell might have **thrived** in, not just high or low light or high or low temperature, but whether there are **nutrients** that limit them like nitrogen, **phosphorus** or iron.

它反映了细胞可能 在其中生长的特殊环境, 不只是在光照强度和温度上有差别, 还包括是否有营养物质限制了它们, 比如氮、磷或铁。[11:24]

diverse: adj.不同的；多种多样的；变化多的 **genomes:** n.[遗]基因组(genome复数) **makeup:** n.化妆品;组成;补充;补考 **sequenced:** [数][计]序列 **enormous:** adj.庞大的，巨大的；凶暴的，极恶的 **reflects:** 反照/反射 **thrived:** v.兴盛,繁荣(thrive的过去式和过去分词形式) **nutrients:** 营养盐/[食品]营养素 **phosphorus:** n.磷

It reflects the habitat that they come from.

同时也反映了它们的栖息地。[11:39]

Think of it this way.

可以这样想。[11:42]

If each cell is a **smartphone** and the apps are the genes, when you get your smartphone, it comes with these **built-in** apps.

如果每个细胞是部智能手机, 应用是基因, 当你拿到智能手机时, 它已经预装了一些应用。[11:44]

Those are the ones that you can't delete if you're an iPhone person.

这些预装应用你是无法删除的, 如果你用的是iPhone。[11:54]

You **press on** them and they don't **jiggle** and they don't have x's.

你按下它们,它们不会抖动, 不会出现删除标记。[11:57]

Even if you don't want them, you can't get rid of them.

[12:00]

(Laughter) Those are like the core genes of Prochlorococcus.

这些是原绿球藻的核心基因。[12:03]

They're the essence of the phone.

它们就像手机的核心。[12:09]

But you have a huge pool of apps to draw upon to make your phone **custom-designed** for your particular lifestyle and habitat.

但你也有一个巨大的应用库, 可以根据你的生活方式和习惯 来对你的手机进行个性化设置。[12:11]

If you travel a lot, you'll have a lot of travel apps, if you're into financial things, you might have a lot of financial apps, or if you're like me, you probably have a lot of weather apps, hoping one of them will tell you what you want to hear.

如果你到处旅行, 就会有很多旅行应用, 如果你是搞金融的, 可能就有很多财经应用, 或者如果你像我一样, 你可能会有一大堆天气应用, 希望里面起码有一个 预测能让你心花怒放。[12:21]

smartphone: n.智能手机 **built-in:** adj.嵌入的;固定的/n.内置 **press on:** 强加于;向前推进 **jiggle:** n.轻摇;微动/vt.轻摇 **custom-designed:** adj.专门设计的;定做的

(Laughter) And I've learned the last couple days in **Vancouver** that you don't need a weather app -- you just need an **umbrella**.

（笑声） 我在温哥华最后几天学到的是 你未必需要天气应用, 你只需要一把伞。[12:36]

So --

所以——[12:43]

(Laughter)

（笑声）[12:44]

(Applause) So just as your smartphone tells us something about how you live your life, your lifestyle, reading the genome of a Prochlorococcus cell tells us what the pressures are in its environment.

（鼓掌） 所以正如你的智能手机 能够告诉我们一些你的生活, 你的生活方式那样, 阅读原绿球藻细胞的基因 能够告诉我们原绿球藻 所生活的环境,比如压力强度。[12:46]

It's like reading its diary, not only telling us how it got through its day or its week, but even its **evolutionary** history.

就如同阅读它的日记, 不仅告诉我们它的一天, 或一周如何度过, 甚至还包括它们的演化历史。[13:04]

As we studied -- I said we've sequenced hundreds of these cells, and we can now project what is the total genetic size -- gene pool -- of the Prochlorococcus **federation**, as we call it.

随着进一步的研究, 我们已经测序了几百种这些细胞, 我们现在已经可以预估 整个基因集合的大小 —— 基因库—— 原绿球藻的基因联邦, 我们是这样称呼它的。[13:14]

It's like a **superorganism**.

这就像一个超级有机体。[13:28]

And it turns out that **projections** are that the collective has 80,000 genes.

预测的结果是 整个集合共有8万个基因。[13:29]

That's four times the size of the human genome.

相当于人类基因组的4倍。[13:35]

Vancouver: n.温哥华(加拿大主要港市) **umbrella:** n.雨伞;保护伞;庇护;伞形结构 **evolutionary:** adj.进化的;发展的;渐进的 **federation:** n.联合;联邦;联盟;联邦政府 **superorganism:** n.超个体(指群居昆虫等的群体) **projections:** n.预测,推测(projection的复数形式);[数][测]投影;发射,规划;突出部分

And it's that diversity of gene pools that makes it possible for them to **dominate** these large regions of the oceans and maintain their stability **year in and year out**.

正是这多样化的基因库 让它们可以 统治这广阔的海域, 一年接一年地维持 它们的稳定性。[13:38]

So when I **daydream** about Prochlorococcus, which I probably do more than is healthy --

当我畅想着原绿球藻的的时候, 我做这个可不仅是为了健康——[13:52]

(Laughter) I imagine them floating out there, doing their job, **maintaining** the planet, feeding the animals.

（笑声） 我想象它们漂来漂去, 做着本职工作, 维持地球的运转, 喂饱动物,[13:58]

But also I **inevitably** end up thinking about what a **masterpiece** they are, **finely tuned** by millions of years of

但同时也不可避免想到 它们真是大自然的鬼斧神工, 历经了数百万年精细的进化。[14:09]

evolution.	
With 2,000 genes, they can do what all of our human **ingenuity** has not figured out how to do yet.	只有2000个基因, 它们就做到了我们人类 还没有搞明白怎么做的事情。[14:18]
They can take solar energy, CO2 and turn it into chemical energy in the form of organic carbon, locking that sunlight in those carbon bonds.	它们可以把太阳能,CO2 以有机碳的方式变成化学能, 把阳光锁在那些碳键中。[14:26]
dominate: vt.控制;支配;占优势;在...中占主要地位/vi.占优势;处于支配地位 **year in and year out:** 年复一年;一年到头 **daydream:** vi.做白日梦/n.白日梦 **maintaining:** n.维护;保养/v.维持;保养(maintain的ing形式) **inevitably:** adv.不可避免地；必然地 **masterpiece:** n.杰作;绝无仅有的人 **finely:** adv.非常地;细微地;美好地;雅致地 **tuned:** adj.经调谐的;谱好曲的;调好台的/v.调整;调音;发出乐音(tune的过去分词) **ingenuity:** n.心灵手巧,独创性;精巧;精巧的装置	
If we could figure out exactly how they do this, it could inspire designs that could reduce our dependency on fossil fuels, which brings my story full circle.	如果我们能够弄明白 它们是如何做到的, 就可以激发我们设计一些方法来 减少对化学燃料的依赖, 这也就让我的故事圆满了。[14:37]
The fossil fuels that are buried that we're burning took millions of years for the earth to bury those, including those ancestors of Prochlorococcus, and we're burning that now in the **blink** of an eye on **geological timescales**.	我们用来燃烧的 埋葬在地下的化石燃料 需要地球花费长达 数百万年的时间去积累, 包括这些原绿球藻的远古祖先, 而我们眨眼之间就把它们燃烧了, 从地质时间的尺度来看就是一瞬间。[14:50]
Carbon dioxide is increasing in the atmosphere.	二氧化碳在大气中积累。[15:06]
It's a greenhouse gas.	这是一种温室气体。[15:09]
The oceans are starting to warm.	海洋开始变得温暖。[15:11]
So the question is, what is that going to do for my Prochlorococcus?	所以问题是,我的原绿球藻 接下来会怎样？[15:13]
And I'm sure you're expecting me to say that my **beloved** microbes are doomed, but in fact they're not.	我确定你们会觉得我想说, 我心爱的微生物要遭受灭顶之灾了, 但事实并非如此。[15:18]
Projections are that their populations will expand as the ocean warms to 30 percent larger by the year 2100.	我们的预测是,随着海水 温度上升,它们的数量会在2100年增加30%。[15:25]
Does that make me happy?	这让我们开心了吗？[15:35]
Well, it makes me happy for Prochlorococcus of course --	当然,这让我为原绿球藻感到高兴——[15:38]
blink: vt.眨眼;使...闪烁/vi.眨眼;闪烁/n.眨眼;瞬间;闪光 **geological:** adj.地质的,地质学的 **timescales:** n.时标;时间量程(timescale的复数) **beloved:** adj.心爱的；挚爱的/n.心爱的人；亲爱的教友	
(Laughter) but not for the planet.	（笑声） 但对地球可就不是这么回事儿了。[15:40]
There are winners and losers in this global experiment that we've **undertaken**, and it's **projected** that among the losers will be some of those larger phytoplankton, those charismatic ones which are expected to be reduced in numbers,	在这场我们正在进行的 全球实验中,难免会有输家和赢家。 而根据预计,输家是那些 更大一些的浮游植物, 那些有魅力的 预期数量会大为减少,[15:46]
and they're the ones that feed the **zooplankton** that feed the fish that we like to harvest.	它们是为人类喜欢捕捞的鱼类 提供食物的浮游植物。[16:00]
So Prochlorococcus has been my **muse** for the past 35 years, but there are **legions** of other microbes out there maintaining our planet for us.	在过去35年中, 原绿球藻就是我的命运女神, 但还有很多其他的微生物 在帮我们维持地球的环境平衡。[16:08]
They're out there ready and waiting for us to find them so they can tell their stories, too.	它们就在那儿, 准备就绪,等待着我们去寻找它们, 并传颂它们的故事。[16:18]
Thank you.	谢谢。[16:24]
(Applause)	（鼓掌）[16:25]
undertaken: v.从事;开始进行(undertake的过去分词) **projected:** adj.投影的,投射/v.投射(project的过去分词);计划 **zooplankton:** n.浮游动物 **muse:** n.沉思;冥想/vt.沉思;沉思地说/vi.沉思;凝望 **legions:** n.罗马军团;军队(legion的复数);万马千军	