

Tyler Dewitt: Hey Science Teachers Make It Fun

https://www.ted.com/talks/tyler_dewitt_hey_science_teachers_make_it_fun

Let me tell you a story.

It's my first year as a new high school science teacher, and I'm so eager. I'm so excited, I'm **pouring myself into**¹ my lesson plans. But I'm slowly coming to this **horrifying**² realization that my students just might not be learning anything.

This happens one day: I'd just assigned my class to read this textbook chapter about my favorite subject in all of **biology**³: **viruses**⁴ and how they attack. And so I'm so excited to discuss this with them, and I come in and I say, "Can somebody please explain the main ideas and why this is so cool?"

There's silence. Finally, my favorite student, she looks me straight in the eye, and she says, "The reading **sucked**⁵." And then she **clarified**⁶. She said, "You know what, I don't mean that it sucks. It means that I didn't understand a word of it. It's boring. Um, who cares, and it sucks."

These **sympathetic**⁷ smiles spread all throughout the room now, and I realize that all of my other students are **in the same boat**⁸, that maybe they took notes or they memorized definitions from the textbook, but not one of them really understood the main ideas. Not one of them can tell me why this stuff is so cool, why it's so important.

I'm totally **clueless**⁹. I have no idea what to do next. So the only thing I can think of is say, "Listen. Let me tell you a story. The main characters in the story are **bacteria**¹⁰ and viruses. These guys are **blown up a couple million times**¹¹. The real bacteria and

¹盡全力

²可怕的

³生物學

⁴病毒

⁵爛透了

⁶解釋

⁷相合的，滿意的

⁸同樣處境

⁹毫無線索

¹⁰細菌

¹¹放大好幾萬倍

viruses are so small we can't see them without a **microscope**¹², and you guys might know bacteria and viruses because they both make us sick. But what a lot of people don't know is that **viruses can also make bacteria sick.**"

Now, the story that I start telling my kids, it starts out like a horror story. Once upon a time there's this happy little **bacterium**¹³. Don't **get too attached to**¹⁴ him. Maybe he's **floating**¹⁵ around in your stomach or in some **spoiled**¹⁶ food somewhere, and all of a sudden he starts to not feel so good. Maybe he ate something bad for lunch, and then things get really horrible, as his skin **rips apart**¹⁷, and he sees a virus coming out from his **insides**¹⁸. And then it gets horrible when he **bursts open**¹⁹ and an army of viruses **floods out**²⁰ from his insides. If -- Ouch is right! -- If you see this, and you're a bacterium, this is like your worst nightmare. But if you're a virus and you see this, you **cross those little legs of yours**²¹ and you think, "**We rock**²²." Because it took a lot of **crafty**²³ work to **infect**²⁴ this bacterium. Here's what had to happen. A virus grabbed onto a bacterium and it **slipped**²⁵ its DNA into it. The next thing is, that virus DNA made stuff that **chopped up**²⁶ the bacteria DNA. And now that we've gotten rid of the bacteria DNA, the virus DNA takes control of the cell and it tells it to start making more viruses. Because, you see, DNA is like a **blueprint**²⁷ that tells living things what to make. So this is kind of like going into a car factory and replacing the blueprints with blueprints for killer robots. The workers still come the next day, they do their job, but they're following different instructions. So replacing the bacteria DNA with virus DNA turns the bacteria into a factory for making viruses -- that is, until it's so filled with viruses that it bursts. But that's not the only way that viruses infect bacteria. Some are much more crafty. When a secret agent virus infects a

¹²顯微鏡

¹³ bacteria 的單數

¹⁴附屬的；依戀的

¹⁵浮動

¹⁶壞掉的

¹⁷撕開

¹⁸內部,內臟

¹⁹爆開

²⁰淹沒;迫使背井離鄉

²¹交叉雙腿

²²我們好棒

²³狡猾的，詭詐的

²⁴感染

²⁵塞入

²⁶切碎;剝碎

²⁷藍圖

bacterium, they do a little **espionage**²⁸. Here, this **cloaked**²⁹ secret agent virus is slipping his DNA into the bacterial cell, but here's the **kicker**³⁰ It doesn't do anything harmful -- not at first. Instead, it silently slips into the bacteria's own DNA, and it just stays there like a terrorist **sleeper cell**³¹, waiting for instructions. And what's interesting about this is now whenever this bacteria has babies, the babies also have the virus DNA in them. So now we have a whole **extended**³² bacteria family, filled with virus sleeper cells. They're just happily living together until a signal happens and -- **BAM!** -- all of the DNA **pops out**³³ takes control of these cells, turns them into virus-making factories, and they all burst, a huge, extended bacteria family, all dying with viruses **spilling out of their guts**³⁴, the viruses taking over the bacterium. So now you understand how viruses can attack cells. There are two ways: On the left is what we call the **lytic**³⁵ way, where the viruses go right in and take over the cells. On the [right] is the **lysogenic**³⁶ way that uses secret agent viruses.

So this stuff is not that hard, right? And now all of you understand it. But if you've graduated from high school, I can almost guarantee you've seen this information before. But I bet it was presented in a way that it didn't exactly stick in your mind. So when my students were first learning this, why did they hate it so much? Well, **there were a couple of reasons.**

First of all, I can guarantee you that their textbooks didn't have secret agent viruses, and they didn't have horror stories. You know, in the communication of science there is this **obsession**³⁷ with seriousness. It kills me. I'm not kidding. I used to work for an educational **publisher**³⁸, and as a writer, I was always told never to use stories or fun, **engaging**³⁹ language, because then my work might not be viewed as "serious" and "scientific." Right? I mean, because God **forbid**⁴⁰ somebody have fun when they're

²⁸ 間諜活動

²⁹ 隱形的，遮掩的

³⁰ 出乎意料的結局；突然的轉折

³¹ A group of people (sleepers) who remain dormant in a community until activated, by a prearranged signal, to perform acts of espionage, and/or terrorism

³² 大家庭

³³ 彈出來

³⁴ 從他們的肝膽流出

³⁵ 溶解的

³⁶ 引起溶解的

³⁷ 執迷

³⁸ 出版商

³⁹ 迷人的；吸引人的

⁴⁰ 禁止

learning science. So we have this field of science that's all about slime, and color changes. Check this out. And then we have, of course, as any good scientist has to have, explosions! But if a textbook seems too much fun, it's somehow unscientific.

Now another problem was that the language in their textbook was truly **incomprehensible**⁴¹. If we want to summarize that story that I told you earlier, we could start by saying something like, "These viruses make copies of themselves by slipping their DNA into a bacterium." The way this showed up in the textbook, it looked like this: "Bacteriophage replication is initiated through the introduction of viral nucleic acid into a bacterium." That's great, perfect for 13-year-olds.

But here's the thing. There are plenty of people in science education who would look at this and say there's no way that we could ever give that to students, because it contains some language that isn't completely accurate. For example, I told you that viruses have DNA. Well, a very tiny fraction of them don't. They have something called RNA instead. So a professional science writer would circle that and say, "That has to go. We have to change it to something much more **technical**⁴²." And after a team of professional science editors went over this really simple explanation, they'd find fault with almost every word I've used, and they'd have to change anything that wasn't serious enough, and they'd have to change everything that wasn't 100 percent perfect. Then it would be accurate, but it would be completely impossible to understand. This is horrifying.

You know, I keep talking about this idea of telling a story, and it's like science communication has **taken on**⁴³ this idea of what I call the **tyranny of precision**⁴⁴, where you can't just tell a story. It's like science has become that horrible storyteller that we all know, who gives us all the details nobody cares about, where you're like, "Oh, I met my friend for lunch the other day, and she was wearing these ugly jeans. I mean, they weren't really jeans, they were more kind of, like, **leggings**⁴⁵, but, like, I guess they're actually kind of more like **jeggings**⁴⁶, like, but I think — " and you're just like, "Oh my God. What is the point?" Or even worse, science education is becoming

⁴¹ 不能理解的

⁴² 專門的

⁴³ 承担

⁴⁴ 堅持精確的暴政

⁴⁵ 內搭褲

⁴⁶ 牛仔樣式緊身褲

like that guy who always says, "Actually." Right? You want to be like, "Oh, **dude**⁴⁷ we had to get up in the middle of the night and drive a hundred miles in total darkness." And that guy's like, "Actually, it was 87.3 miles." And you're like, "Actually, shut up! I'm just trying to tell a story."

Because good storytelling is all about **emotional connection**. We have to convince our audience that what we're talking about **matters**⁴⁸. But just as important is knowing which details we should **leave out**⁴⁹ so that the main point still **comes across**⁵⁰. I'm reminded of what the architect Mies van der Rohe said, and I **paraphrase**⁵¹, when he said that sometimes you have to lie in order to tell the truth. I think this **sentiment**⁵² is particularly relevant to science education.

Now, finally, I am often so disappointed when people think that I'm **advocating**⁵³ a **dumbing down**⁵⁴ of science. That's not true at all. I'm currently a Ph.D. student at MIT, and I absolutely understand the importance of detailed, specific scientific communication between **experts**⁵⁵, but not when we're trying to teach 13-year-olds. If a young learner thinks that all viruses have DNA, that's not going to ruin their chances of success in science. But if a young learner can't understand anything in science and learns to hate it because it all sounds like this, that will ruin their chances of success.

This needs to stop, and I wish that the change could come from the institutions at the top that are **perpetuating**⁵⁶ these problems, and I beg them, I **beseech**⁵⁷ them to just stop it. But I think that's unlikely. So we are so lucky that we have resources like the Internet, where we can **circumvent**⁵⁸ these **institutions**⁵⁹ from the bottom

⁴⁷一般都是男生在叫其他男性友人時為了引起對方注意就會說"hey dude" 或是 "yo,man!"，翻成中文有點像"老兄"

⁴⁸重要、有關係

⁴⁹遺漏

⁵⁰傳達

⁵¹釋義

⁵²情緒

⁵³主張

⁵⁴把難學的教材簡化，讓學生容易學一點

⁵⁵專家

⁵⁶延續

⁵⁷懇求

⁵⁸規避

⁵⁹機構

up. There's a growing number of online resources that **are dedicated to**⁶⁰ just explaining science in simple, understandable ways. I dream of a Wikipedia-like website that would explain any scientific concept you can think of in simple language any middle **schooler**⁶¹ can understand. And I myself spend most of my free time making these science videos that I put on YouTube. I explain **chemical equilibrium**⁶² using **analogies**⁶³ to awkward middle school dances, and I talk about fuel cells with stories about boys and girls at a summer camp. The feedback that I get is sometimes **misspelled**⁶⁴ and it's often written in **LOLcats**⁶⁵, but nonetheless it's so appreciative, so thankful that I know this is the right way we should be communicating science.

There's still so much work left to be done, though, and if you're involved with science in any way I **urge**⁶⁶ you to join me. Pick up a camera, start to write a blog, whatever, but leave out the seriousness, leave out the **jargon**⁶⁷. Make me laugh. Make me care. Leave out those annoying details that nobody cares about and just get to the point. How should you start? Why don't you say, "Listen, let me tell you a story"? Thank you.

Comprehension questions

1. What happened when Tyler Dewitt first started teaching high school science?
2. What was his students' response when he was teaching them about viruses and how they attack?
3. What did he do afterwards?
4. How can viruses make bacteria sick?
5. What role does DNA play in this?
6. What is the other way that virus can attack cells?
7. How was the same lesson presented in ordinary classrooms?
8. When his students were first learning this, what is the first reason why they hated it so much?
9. When his students were first learning this, what is the second reason why they hated it so much?
10. What does it mean "good storytelling is all about emotional connection?"

⁶⁰ 致力於

⁶¹ 學生

⁶² 化學平衡

⁶³ 類比

⁶⁴ 拼錯字

⁶⁵ funny cat pictures with hilarious captions

⁶⁶ 鼓勵

⁶⁷ 專門術語, 行話

11. What does the speaker mean “we can solve the problem from the bottom up?”

Discussion Questions

1. What is the main topic of this talk?
2. What did you learn from this talk?
3. Can you think of any previous teachers you’ve had who tried to teach in an interesting way? What did he/she do?