

Sowing Science Seeds: The National Perspective on Science Education and Global Competitiveness

Presented by
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Thank you for the lovely introduction. I would like to thank Sally Schuler, Arlene Elrod, and the rest of the NSRC family for the opportunity to speak this afternoon. I feel honored to be here this afternoon.

1. Introduction to the talk

- Now, I've got a big task in front of me. My job is to try to convey to you some of the recent governmental fervor about America's competitiveness. This is particularly daunting since these government reports can be quite dry. In addition, I realize that you, my friends, have just eaten. According to my calculations, I anticipate food coma will strike is about 20 minutes. So, I will have to act fast.
- I should make the disclaimer that any grammatical errors, historical fabrications, or flights of fancy are solely my responsibility and do not represent Yale University, NSRC, the great state of NY or even my mother. This afternoon, I just want to share with you some observations and am speaking to you person to person.
- You may ask what qualifies me to speak with you. **That is a good question.** The lens I am looking through is that of a black woman scientist, who has gone through the science education process. My vantage also includes growing up an urban environment and now teaching at an institution that rejected my college application. From this vantage, I have learned the success in science relies on teachers. If it wasn't for a great teacher, I would not be in front of you today.

2. Warm-up

- a. In my opinion, teaching is the noblest profession. But, I am probably preaching to the choir when I say this.
 - i. Let's delve a bit deeper into the future of science education in the current political backdrop. Soon, you'll see why: (1) science education will be a hot topic, (2) how we got to this critical crossroads, and (3) why life will not be the same...or at least it should not be.

3. Outline

- a. So, for the next few moments we are together, I want to share with you (1) the importance of understanding science, (2) why the government is excited about this topic, (3) and, more importantly, why you should be excited about this topic too.

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Last year, two senators (Alexander and Bingaman) who are both on the committee on Energy and Natural Resources became concerned and charged The National Academies to come up with a list of suggestions to make the US competitive and by the way they needed the report **in 90 days**. Now this was a huge task because the group consisted of top scientists, CEOs, university presidents, and for fun a few Nobel Prize winners. It must have been a scheduling nightmare...but it happened.

The question posed was: **[Slide-Senator Question]**

"What are the 10 actions that policymakers could take to enhance the science and technology enterprise so that the US can successfully compete and prosper in the global community of the 21st century?"

Now, I am from New Jersey which makes me a bit of a pessimist, so that fact that they even asked the question means that something is already different. They asked, and I am paraphrasing: **What can we do, if anything, to keep America on top?**

Well, why did they ask this question? You may already be experiencing this—that is, **our economy is not your father's economy**. Things are different from when our parents were our age.

[Slide-Global Issues]

Here are some global issues:

- **Globalization** —*interaction between people and companies in distant locations. (More simply: It is the reason why we see McDonald's around the world)*
- **Outsourcing/Off-shoring** —*relocation of business from one country to another (More simply: It is the reason why you see "Made in China" labels on your clothes)*
- **Rise of other nations (China, India)**

These are very real shifts and we cannot ignore them any longer.

If you don't believe me, listen to others who have been saying this.

[Slide-Globalization is real]

Globalization is real. Here is my homework assignment to you.

- If you don't believe me, pick up Thomas Friedman's thick book "**The world is flat.**" It spells out for you in rigorous detail of how the world is changing.
- If you don't have time to read this, check out the PBS special called **1-800-INDIA**. There you can see the impact of call-centers on the Indian and US economy.
- If you can't catch that show, then try this simple experiment. **Call Dell Tech support** (here is the number: 1-800-624-9896) and see where your call is placed. Notice that your toll free call is connected to someone who is over 6000 miles away. You will witness first hand what economists are calling the "**death of distance.**" That is, customer support although miles away is now just moments away.

We are not alone in the economic change. Whole countries and their economies are being turned upside down too.

Take India for example.

- Their economy, particularly the work day, is upside down as young people work the graveyard shifts at call centers to support us. Dinnertime here is 3am in India.
- The other thing to note about their economy is that it is going up.

Well, what is going on at home? Well, the indicators are going in the opposite direction.

[Slide-Indicators]

Here are some other economic **indicators**:

- The US is the importer of high tech products (of our own inventions...IPOD, PC, etc.)
- US companies are generating less patents
 - Patents are markers of a company's priorities (**Innovation has a low priority**). US Companies are forfeiting the long term future for short term stock prices.
- One new chemical plant was built in the US last year; 50 were built in China
 - In the US, 70 plants were closed, and 40 more are scheduled. They are being relocated elsewhere.
- On the world stage, US 15yr olds are ranked 24th
- IBM, the creator of the PC, sold its business to China
- In this information age:
 - the nation's largest employer is **Wal-Mart!**
 - K-12 is slipping in math and science, which directly impacts our workforce.

Well, why is this economic shift happening?

[Slide-Pyramid—Education is the Foundation]

We haven't been sowing good seed. You see, **economies** are based on **business**, which are based on **innovation**, which rely on **education**. Our foundation is crumbling.

There a secret in science that I am going to tell you:

- 50% of all PhDs that come out of the US are foreign born. **(That is your tax dollars, by the way!)** So this speaks to the bottom of the pyramid that our economy rests on.
- Now, this is OK because many of the newly minted PhDs stayed in the US by getting their work H1-Visa after their diploma. So, things were just fine.

Then we got a wake up call.

1. After **9/11** getting a visa became incredibly difficult, everyone was suspect. We shut off our supply of eager future scientists. It is sad, that **our own fears are blocking our growth**.
 - a. Just as an aside, it was not uncommon for a foreign-born graduate student to go home for the holidays and not be able to return back to their US university because they were stopped at the border. Delay times can be up to 3 months.
2. The US started to lose its attraction and schools in Europe, India and China increased theirs with: (1) lesser barriers and (2) cheaper tuitions. **Our PhD pool is diminishing.**

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So, now you know the secret. Now, you are up to date. What's next?

The question is: Who will innovate if we won't use outside talent? Let's think about this...Hmmm.

I've got it!! What about all those kids in the US that we forgot about in the past!

They are already here. Why not train them and teach science education differently this time.

So...Finally our own forgotten children are getting the attention they deserve. The reasons are not pretty, **but we'll take it**. Finally we are doing the right thing, even if it is not necessarily from the right path.

This has happened before, that is, positive education reform created from less-than-positive reasons. This next slide is meant to be a bit provocative. But, let's look at other forces that have changed education.

[Slide-Force that Change Education]

- War (WWII, Korean War)
 - *GI Bills – direct scholarship program for higher education*
- Competition (Sputnik, The Cold War)
 - *The Age of Physics—the most prolific time for physics*
- Injustice (Civil rights)
 - *Desegregation of Schools—boycotters illuminated a wrong and forced change*
- Fear (Oil prices, Globalization, Homeland Security)
 - *Energy research, ??*

Admittedly, this is not a pretty report card. But, I show this slide just for a historical backdrop and to clarify forces that create change. But more importantly, so you can think of our recent economic events as **opportunity for change**. The iron is hot, it is time to strike.

[Slide-Pyramid—Education is the Foundation]

So...Here is where you come in...Did you notice the bottom of the pyramid has education. **Well, that's you**. Education is the foundation of our standard of living and our culture. Your role is now in the spotlight. It has become clear to policymakers that education needs to be reformed. The good news is that we have had the answers all along in the US and the NSRC is the place to get it. The NSRC provides hands-on science curriculums.

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So welcome to the education revolution. This is our American revolution.

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Admittedly, we have been a bit stuck in science education. We have been bogged down with testing and assessments, which has steered us away from our goal of teaching children **to think**. We are at a turning point.

So consider today as your official notification. You are now informed that education, science education, is a priority and it needs change.

If not, we may have to re-write the words to movies like in "the Graduate" when Dustin Hoffman hears the future is "Plastics." Without change, we'll have to redub "Plastics" to "Learn Mandarin."

I say this in jest, but I am also very serious. I've been to China and I am clear that we will not be #1 any longer unless we do something soon.

What did I see when I was in China?

- In China, everyone wants to be an engineer or scientist. It is cool to be a scientist there. I was a movie star out there. I loved it.
- Conversely, kids in the US don't want to be scientists or engineers. On a good day, you'll hear doctor, but mostly kids want to become lawyers or ballplayers or lawyers for ballplayers.

Our culprit is Hollywood. They are starting to make change with shows like CSI, CSI: New York, CSI: Miami, they may even make CSI: Albany. But, we can't wait that long. **The time is now, the change is us.**

Another thing I observed in China was...

- Most of the leaders in the Chinese parliament including the president of China have an advanced degree in science. And, that they innately know that technology is how you build a country.
- In the US, the most common degree for our policymakers is law followed by economics. And, we are where we are now because of it.

Things are really incongruent. I recently read that 20% of the CEO's of the top US companies have engineering degrees.

→ We've got to prepare the next generations of CEOs with a new science education strategy.

[Slide—Why is Science a Big Deal]

Science is good for the economy. More specifically:

- Science creates jobs
- 50% of all companies are based on innovation

Can we teach Innovation? The answer is a big fat YES. How?
With science education.

- Innovation is the creative process, the ability to think, to reframe, to see old things in a new way.
- This is what scientists do. Science is more than making a hypothesis and proving it. It is looking at something old in a new way.
- You innovate all the time when you figure out how to make lunch exciting for your kids every morning. That's innovation!

And, **we teach children innovation** when we teach them to think and we give them permission to imagine things differently. **We teach them innovation** when we teach them how to be playful around concepts. But first we must teach these concepts in ways that resonate with them.

Once students get these concepts; then they can learn to dance with them and innovate.

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Now, it's not our students' fault that they learn the way they do. You see, over 100 years ago, the US made a change and left schools behind. Back then, children already had experiences with force and pulleys and springs, and schools just provided the vocabulary.

Now students don't have those ingrained experiences. And schools took an assembly-line approach to get them up to speed.

To be effective today, schools must do double duty and provide the hands-on experience as well as the vocabulary. Fortunately, all children are innately scientists. Hands-on teaching methods can capture their imagination and give them the tools to innovate.

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Now, helping the economy is great, but a greater goal for science education is to give our kids the tools to make a **contribution**.

By knowing science we become empowered. With it:

1. **we can make informed decisions for ourselves.** We can tell for ourselves if **trans fat** is a good idea.
2. **we can understand the key questions of the day.** The current buzzword is nanotechnology. What is it? What can we do now that we could not do before? If you don't know science, you cannot be part of this discussion.
3. **Lastly...we learn to innovate.** By mastering concepts we can now piece them together in a new way to create new technologies. **(And, oh yeah, that helps the economy.)**

[Slide-Anatomy of IPOD-Innovation]

Let me show you innovation at work...

- In 1965, a handheld device that held 15,000 songs would be deemed science fiction and would have ended up in Mr. Spock's hand in Star Trek. Today, it is the IPOD. **(The most significant purchase I made last year and I bought a house last year.)**
- The IPOD is innovative by connecting already existing technologies of: signal processing, LCDs, rechargeable batteries, and hard disks storage together. That's innovation!
- Innovation is more than figuring out Big Bang theory. It is putting pieces together. But first, we must feel comfortable with the pieces.

As such, it is time to create the next generation of innovators with the best practice in K-12 science education.

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[Slide –Uncle Sam]

We need you more than ever.

Can you remember why you became a teacher?

Was it because of the great work hours? The travel perks?

Perhaps you became a teacher because

-you wanted to change lives.

-you wanted to leave the world better than you found it.

-Well, the world needs you **RIGHT NOW**.

There is a saying that "**where your talents and the world's needs intersect is your calling.**" Well, if you have not been formally introduced, let me now introduce you to your calling.

We need your help.

Here we are at a cross roads. In front of us is a future that you can help change.

Now, the government has a plan and you are a critical piece.

[Slide-Action Items for the US]

The plan is the following:

1. **Increase the number of teachers by 10,000 and thereby impact 10 million students.**
 - a. by providing incentives and scholarships at 4-year schools to create new teachers
2. **Increase the skills of 250,000 of our current teachers.**
 - a. **Hint:** This means you (+NSRC)!
 - b. Perhaps you'll one of the lucky ones to: join summer institutes; get master's degrees; or use **world-class** k-12 curriculum, such as those much acclaimed materials provided by the NSRC.
3. **Lastly, the plan is to enlarge the student pipeline.**
 - a. Here again, the legislation wants to give children incentives for taking AP classes and the like.
 - i. In my opinion, this is the weakest part of the plan but the most important and the place where you can make the largest impact.

Here's how...

The problem is that we need more scientists but kids don't think it is cool. **(Trust me, I know. I used to get beat up.)** We are fighting a culture that doesn't like intellectuals. Science is not cool.

Or as my Ebonics dictionary says: **Science is wack; and to do it would be mad stupid.** You see what we are up against.

If hip-hop artist embraced science in a rap, our work would be done. *Thirteen-year olds would rap the laws of physics.* **Until that day**, here is a humble list of a couple of things we can do.

First of all...

1. Know your impact

Teachers change people's lives everyday. Not everyone can say that. That makes you a hero. Get in touch with your inner superhero. As beat up as you may feel by life, the administration, and other speed bumps that are in the way, leave that outside of the classroom. Be a superhero in the class. Kids need a role model.

Think about it. Kids are highly distracted with over 500 channels, cell phones, IPODS, instant messages, blogs, chat rooms, ringtones, and plenty of other appliances. Plus, they are occupied by what Paris Hilton will do next.

Create an alternative space where learning and thinking is valued.

2. Embrace change.

We can't go back to the old ways of teaching science (as we have learned). We need to make changes. So, as a leader, when you go back to your home institution ask why we do things the way we do.

I liken change to a story I recently heard.

Story: A young mother is making her first Ham with her daughter.

Before placing the meat in the pan she cuts an inch off the ends.

Her daughter stopped her and said: "Mom, why did you cut the ends off the ham?"

The mother said "because we have always done it that way."

Not satisfied with the answer, the daughter called her grandmother and asked her why they made the ham that way.

The grandma paused and said: "**we had a small pan.**"

Moral of the story: Just because you have always done something a certain way doesn't mean you have to continue to do it that way.

[Slide-Science Saturdays]

3. Expose students to cool people who do science. I know this is a tall order. But, I say this to let you know that university professors and undergraduates want to be involved with your classroom. At Yale, we started a program to get children in contact with scientists with Saturday morning lectures called **Science Saturdays**. For one month of Saturdays, children come to hear lectures from Astronomy to Psychology by Yale's most enthusiastic science speakers. If you live too far to join us, you can get streaming videos or DVDs at: www.sciencesaturdays.org.

The best endorsement I got for this program was from a mom. She said "The first Saturday she had the wake up her kids to go; after that they were always ready before her."

What I have learned is that: **kids want science if you can make it real and accessible.**

So know that outlets like this are available. And if not, I'd be happy to get you plugged in or create something with you.

4. Be bold (enough to say "I don't know, but I'll find out."). We've got to change the mood towards science in the classroom. It is not the haves and the have-nots when it comes to knowledge.

A lot of us have science phobias. Phobias can be passed onto the next generation like a genetic trait. We don't want to do that. So, let me be **Dr. Phil** for a moment as I ask you to look your fear-of-not-knowing right in the face. We all can't know everything every time. That is **not** what science is about—science is not trivial pursuit. Science is the art of asking questions.

So...the next time a student asks you something you might not know, try this 'get out of jail' card. Say "I don't know, let's find out together."

The model of teachers knowing everything is out of date. Life is too fast paced and there is too much information. But, you can teach children the art of finding out and the art of being curious by showing them that it is OK not to know, as long as you are committed to finding out.

Here let's try it together, I'll ask a question and you'll respond "I don't know, let's find out together."

"Teacher, what is string theory?"

"I don't know, let's find out together."

"How fast is the universe expanding?"

"I don't know, let's find out together."

How do we see dark matter?"

"I don't know, let's find out together."

With this you can maintain an environment where asking questions is OK. That is the goal. That is what scientists do, we don't know, **but** we find out together; we discover together. Discovery is innate in children. **Let them know it is OK.**

Warning: After you say "let's find out together." You now need to do it.

Lastly, 5. Be an Enthusiastic Example

The other side of the coin for science phobia is science enthusiasm. Be enthusiastic about science. Enthusiasm is contagious.

Students will learn if they are excited about something. They'll devote time to it, keep at it, and overcome obstacles. **That is not just a lesson about science but about life.**

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In closing, I do hope that you'll accept this challenge of teaching the future generation science with methods that will resonate with them, particularly the hands-on way.

Our nation needs your help.

Can it be done? Absolutely. By you? Yes, indeed. In fact, you are the critical component to making this work.

You will **change our nation's course** and **you will change lives** along the way.

I hope that you will consider this opportunity.

Yes, the challenge may not seem easy. **But changing the world never is!**

Thank you and Good luck.