The Arc of a Scientist – How We Can Excite Our Kids with STEM

Teacher Enrichment Program

June 2019
Who am I? Why is my ‘arc’ at all interesting to you?

» Earned B.S., M.S., and Ph.D. degrees — all in Physics

» Studied psychology and education as an undergrad

» Taught physics in Prep School, Community College, and elsewhere (e.g., Naval War College, Defense Commands)

» Practiced physics

> Branch Head (Naval Intelligence)
> Chief Scientist (Epoch Engineering)
> Technical Director (GTE/BBN Technologies)
> Partner & VP (Booz Allen Hamilton)
> Research Director & SVP (NORC at the University of Chicago)
> Consultant (D E Himberger Consulting, LLC)

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Why am I up in \textbf{front of you}? What do I have to \textbf{share}??

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Educated in \textbf{Science}
Trained in \textbf{Communication}
Experienced in \textbf{Teaching}

So what? Why should you care?
Here’s the thing…

» Science did not come easily for me

  > I struggled with math – mightily – in grammar school, middle school, and even high school

  > I was very interested in the Space Program in grammar school, and became “hooked” on Science in middle school…but then realized that I would have to work hard to get the math background, and even harder to understand the science

» I worked at Science – and worked, and worked…

  > There were other subjects that were easier for me – but they didn’t really capture my imagination

  > Science was tough…but it seemed to be worth it

Even though Science didn’t come naturally, I wanted it!
You will have students that find it doesn’t come easily either…

So that’s me...now on to you
Who are we? What do we know about this whole room of Scientists?

» When did you first know you were interested in STEM? Who first captured your interest?

» When did you first know you wanted to become a Scientist...or a “STEM-ist”?

» Have you ever considered leaving STEM for another field? Why? What made you stay?

So, here we all are...a bunch of STEM-ists... wondering... where I’m going with all this?
Let’s back up – What is Science? Certainly we all know...don’t we?!

Science answers the question, “Why?”
How do we **find our ‘arc’ in Science?**

If only Science had a **roadmap**...it could help us find starting points, and mid-course markers...

Clearly, an updated map is needed (for Physics, at least)!
Where can Science take us and our students (or, as an example, where did it take me)?

» Science can literally take you around the world
  > For me – from Nebraska to continents worldwide

» Science can lead you to projects and careers you’d never imagine
  (More on this later…)
  > For me – from academia, to industry, to Government…and beyond

» Science can keep you engaged for your entire life
  > For me – retirement is neither possible, nor desired!

Our message to our students: the ‘arc’ can be amazing!
With such rich possibilities, how do we **point others to Science** (easily and painlessly)?

Do we see **Science in “real life?”**

Let’s take a look at some **examples**...
The Amusement Park...Physics
Climate Change...Physics, Climatology, Geology, Biology, and many other fields

The Big Bang Theory:

- **Astrophysicist** (Experimental)
- **Waitress (former)** (Cheesecake Factory)
- **Physicist** (Experimental - Particle)
- **Engineer** (Aerospace)

**Physicist** (Theoretical – Particle)

[Sheldon exhibits a strict adherence to routine, a total lack of social skills, a tenuous understanding of irony, sarcasm, and humor, a general lack of humility or empathy, and displays textbook narcissistic behavior.]

**Trivia Question:**
Is Sheldon a theoretical or experimental physicist?
Cartoons...Physics (but sometimes only loosely!)

In fact, it’s been said:

“Everything I Ever Needed to Know About Physics I learned from Road Runner Cartoons”

The Cartoon Laws of Physics:

• Any body suspended in space will remain in space until made aware of its situation
• Everything falls faster than an anvil
• All principles of gravity are negated by fear
• As speed increases, objects can be in several places at once
• Any body passing through solid matter will leave a hole conforming to its perimeter
Even with all of this, how do we build **enthusiasm in our students**?

This was my experience... and I lived to love science anyway!

This is a counterpoint – there must be a better way!
So where do I stand on all this?

» My teaching philosophy:

I wish to encourage mastery of the subject, but even more important, critical thinking skills that allow transference of specific information to broad knowledge – and even wisdom. I strive for enlightened citizens who can access resources, and distinguish science from pseudoscience.

My goals for students include the development of that critical thinking, solid use of scientific method when solving problems, and the ability to communicate very clearly, findings, and thoughts.

I believe study must connect to the real world (e.g., case study, and heavily on both individual and group work, and use technology where relevant – e.g., simulations, interactive tools, etc.).

I wish to be a facilitator, a coach, and even an evangelist on the subject. I love to advise and mentor, but do not do the work for the students. Further, I believe I am a “guide on the side.” I’ll invite you to learn, not force you (or do it for you!).

I believe in assessing (I am NOT going to read this, but know that I have thought long and hard about it! It’s less about teaching than pointing, and our pointing perspective comes from our ‘arc’). This is required in many cases (e.g., for grades that roll into GPA, allow entrance to other institutions, etc.), and desired by most. For this, my grades will typically be on a percentage scale. I will use different types of assessment tools where appropriate – to include homework, traditional tests, and lab projects – but I will put a premium on evidence of independent thought (e.g., through innovative activities by the students, pro-active engagement in class, etc.) and provide feedback on what I see.

I am NOT this ...
So what about this ‘arc’ of mine? Where can a Scientist go?

My projects have defined my path & mid-course changes

> Medical Ultrasound
> Anti-missile Defense (e.g., Brilliant Pebbles)
> Naval Shit (e.g., anti-sonar ship coating)
> Law Enforcement (e.g., Robust Laser Interferometer)
> Avionics (e.g., Distant Thunder)
> Information Assurance (e.g., IATAC)
> Community Resilience (e.g., Megacommunities)
> Emergency Response (e.g., Pandemics)

It’s all about the scientific method!!

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Your ‘arc’ can position you to provide meaningful help & direction

» Professional organizations
  > Arenas for networking and professional growth and hubs for members helping members – as well as moving the science forward

» Non-profits
  > Centers of strength for underserved populations and community-minded efforts, and often focus on students

» Community organizations
  > Groups that serve local citizens, including students – they benefit from “the scientific approach”

And, of course, your classrooms!
So let’s go...follow our ‘arcs’!

» You must **want to be involved in Science**...it can’t be forced, and those you teach (or those with whom you interact) will pick up if you don’t have true passion!

» You need to **collaborate on Science**...so work in groups and networks,ledge, and

» You have to **love it**...and share that love

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**I love Science...and, who knows, maybe you do too!**

Spread the word, and **find your own ‘arc’!**

Even more important, **help your students find theirs!!**
Let’s do an experiment...

» Let’s start (we don’t have time to finish!) the NOAA “Beat the Uncertainty – Planning Climate-Resilient Cities” exercise

» This exercise connects to the real world – much of my experience is in disaster response and mitigation – so this is the type of thing our students should be thinking about...especially in this area of the country!

» This exercise allows our students (and us!) to think, explore, and experiment!
NOAA’s “Beat the Uncertainty – Planning Climate-Resilient Cities”

You and your fellow players are the leaders—citizens, policymakers, business leaders, nonprofit leaders, and researchers—of a coastal city. Your job is to make smart decisions that will increase the city’s resilience to climate change.

https://games.noaa.gov/beat-the-uncertainty/welcome.html
Use this experiment as a start on the way ahead

» Find the elements of your “arc” that connect to your students

» Find the activities that excite, energize, and motivate your students

» Explore (not just “teach”) science – and STEM – together with your students

I would love to hear more about your “arcs” and how they connect with your students!