



ABSTRACT

It is difficult to teach for both understanding and application, and the climate crisis highlights this in profound ways. Even those who understand the extreme threats posed by anthropogenic climate change have been largely at a loss for how to generate a response to such threats at scale. What drives people, organizations and governments to actually act in the face of crisis?

In at least several historical examples, the impetus for action includes being astounded and scared while also having reason for hope and the ability to display courage. These steps are infused with building visceral understanding of the problems' magnitude. Examples that follow this pattern include US involvement in World War II, the Apollo Program, and the civil rights movement.

"Where Does Gasoline Go?" and "Fire & Brimstone & Fort McMurray" are presentations that, when brought together apply this framework to climate change communication. Americans burn 391 million gallons of gasoline per day, each containing 5.5 pounds of carbon. To sequester that carbon by tree-planting requires the equivalent of growing a 2x4 for each gallon. If the US were to offset current emissions from gasoline (roughly a quarter of total US emissions) by planting trees, we'd need to grow 4.3 billion pounds of wood every day - more than 1.5 trillion pounds/year. When you fill your tank, count 2x4s as the gallons roll by, and mentally scale this up to every driver in the country. If one understands both scale and the basics of climate change, this is both astonishing and terrifying.

We have faced terrifying situations before and we have emerged from them. Indeed, throughout human history, we have always lived in times characterized by the wonderful and horrible simultaneously. We have also always made apocalyptic prophecies that, at least at the global scale, have not come to pass. For the credible ones, people eventually acted and were able to meet the challenges (though sometimes at horrific costs). Recognizing that we have always been wrong in predicting global apocalypses and that when the situation becomes dire (as it is doing now) we have taken effective action is reason for hope.

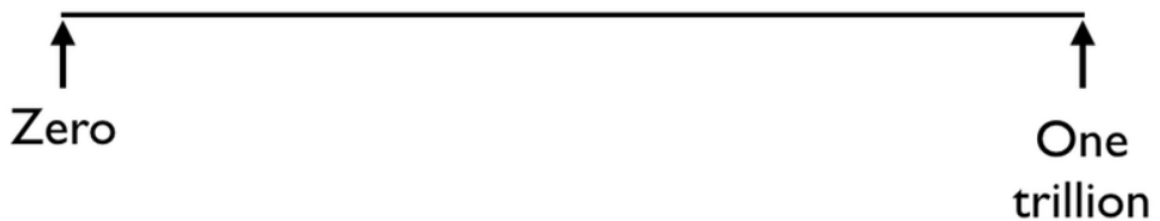
The process described here, through the story of a gallon of gasoline, couples clear science with powerful emotion. It closes with hope. And, it offers tools and a broader approach that can be widely replicated.

ASTOUND & SCARE

Scale Boot Camp

Respond at [PollEv.com/dondugganhaa852](https://poll-ev.com/dondugganhaa852)

Click where you think a billion belongs between zero and one trillion.

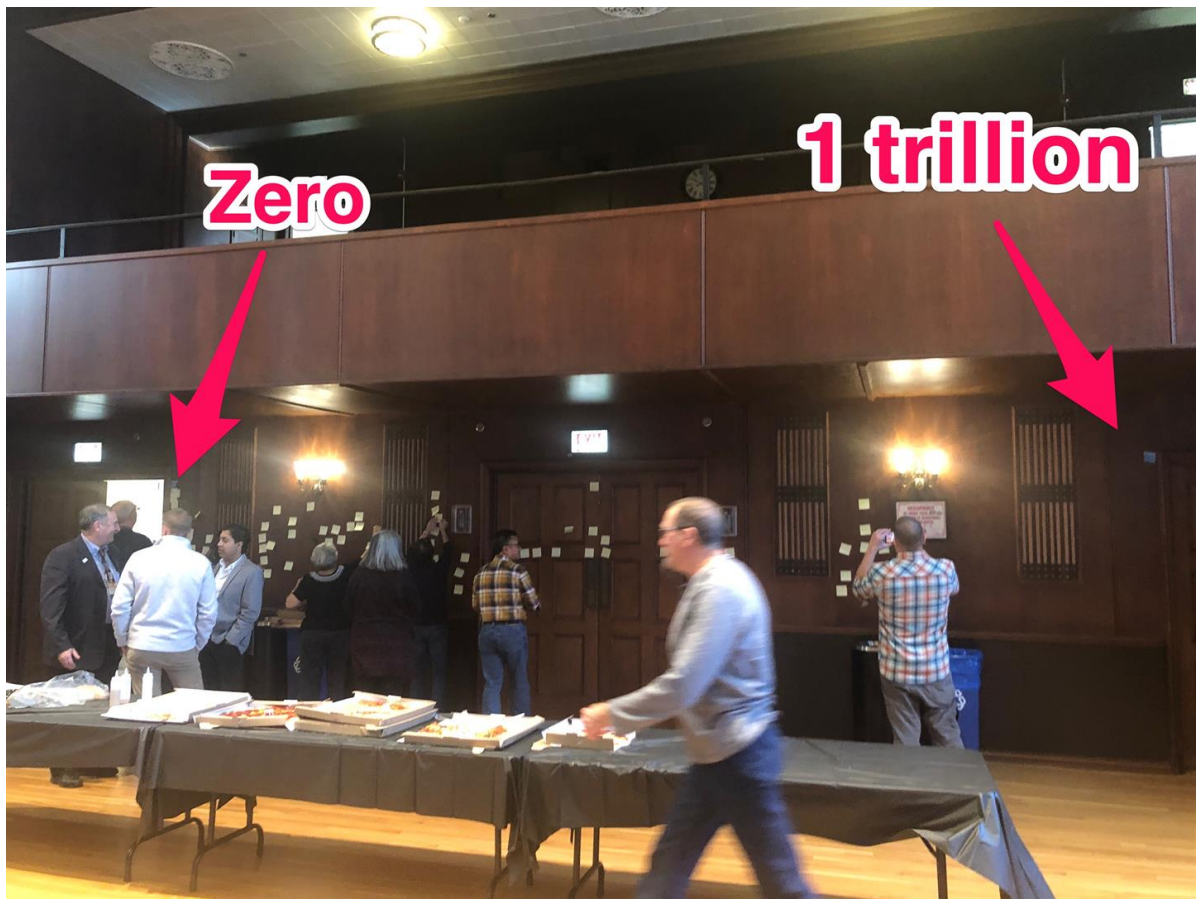


 Poll Everywhere



The discussion involves a lot of big numbers. That's a common attribute of many controversial issues, and people struggle to understand really large and really small numbers. "Social math" is a set of strategies for helping people understand really big and really small numbers.¹

Shortly after the first really big number is brought up - that 391 million gallons of gasoline - participants are asked to place Post-it Notes labeled with a thousand, a million, and a billion on a wall with the corners labeled with zero and a trillion.²



Folks struggle. We're polite but corrective. All of the Post-it notes should be in the first third or an inch in this case, where zero and 1 trillion were 30' apart.

Most of us don't have a good understanding of scale

(because it's hard to understand)

- A thousand seconds is about 17 minutes.
- A million seconds is about 12 days.
- A billion seconds is about 32 years.
- A trillion seconds is about 32,000 years.
- *Homo sapiens* (us!) have been around for less than 10 trillion seconds.

Talking through how long a thousand, a million, a billion, and a trillion seconds is in other units of time helps to make scale more comprehensible, as does discussing money.

There are now roughly 330 million Americans, so when the government spends a billion dollars, that's about 3 bucks for each and every American. A trillion dollars means \$3000 for each of us. The deficit for 2019 is projected to be about 1 trillion dollars, meaning that the US government is spending \$3,000 more than it's bringing in for each of us. And the debt is \$23 trillion dollars meaning that the share for a family of four is over a quarter of million dollars.

Wow.

The tale of the 2x4 brings these big numbers back to gasoline.

WHAT'S WITH THE 2X4?

This 2" x 2" x6" block is pure carbon.

- It's graphite, the main ingredient in pencil lead.
- The quarter is to show scale.
- How do you think it compares to the amount of carbon in a gallon of gasoline?

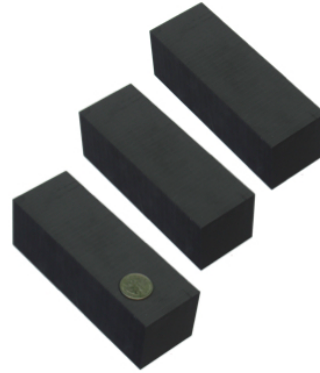


That's not big enough.

Here's what that looks like:



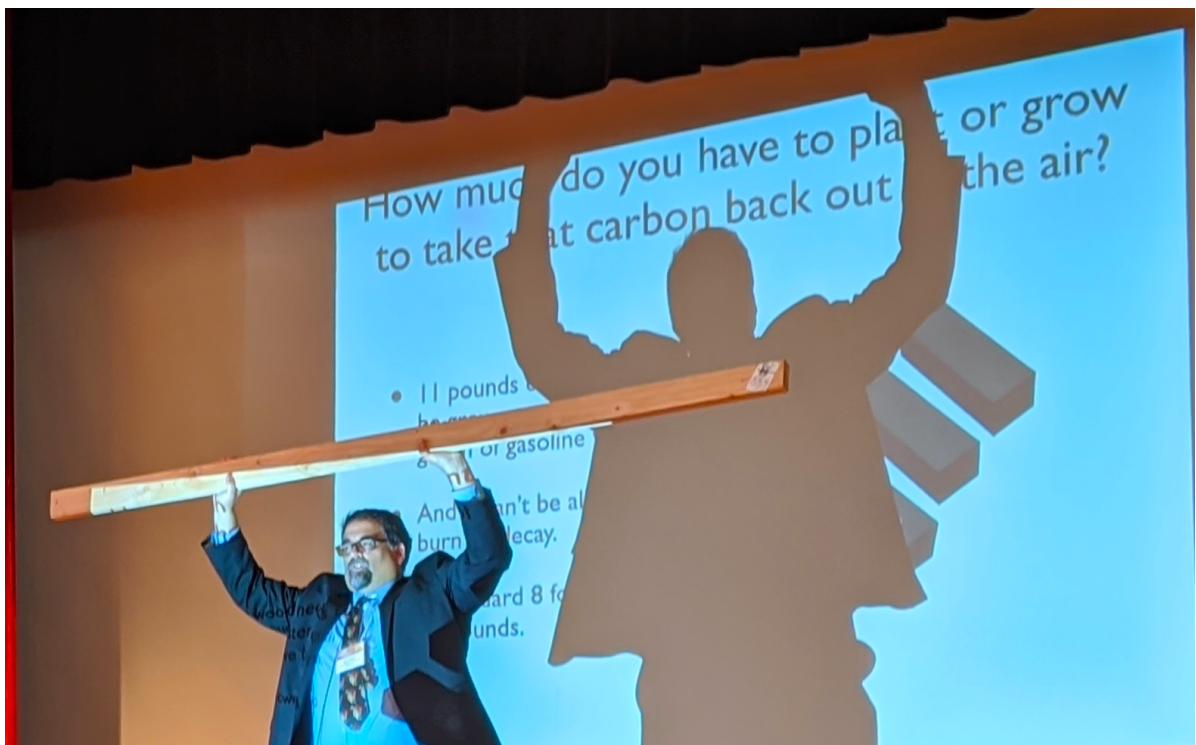
1 gallon weighs ~ 6 pounds



About 5.5 pounds
of that is carbon.

That six pound gallon of gasoline is 87% carbon by weight. That means that a gallon of gas has about 5.5 pounds of carbon in it.

Again, that produces 19 pounds of CO₂. How much wood do you need to grow to take that 5.5 pounds of carbon back out of the air?



11 pounds. Wood is about half carbon. A standard 8' 2x4 weighs 11 pounds.

So, for each and every one of those 391 million gallons of gasoline we burn every day in the US, we need to grow the equivalent of a 2x4's worth of wood.

That's 4,300,000,000 pounds of wood every day.

Just from burning gasoline.

That's about a quarter of US total emissions.

That's more than 1.5 trillion pounds of wood a year.

And that doesn't account for prior years - it's just to offset a single year's gasoline related emissions.

Next time you fill your tank, watch the gallons roll by and say to yourself, "2x4, 2x4, 2x4, 2x4...."

BUILD COURAGE AND INSPIRE ACTION

It's Too Late

Vol XCHH, No. 311

Friday, November 8, 2019

\$1.25

Let's get to work anyway



We're routinely too late!

It is too late to prevent horrible consequences of climate change, but when it's too late is when we generally get to work. We ended slavery too late. We stopped Hitler and his fascist allies too late. We got to work on civil rights and getting out of Vietnam too late. Being too late doesn't mean that it's too late to do something. It means we're already letting people suffer, but we can prevent some future suffering.

Shit's getting real. The fires in the Amazon, California, Africa, and the Arctic bring to mind fire and brimstone. This year's flooding on the Mississippi was also biblical in scale. European heat waves this summer were killers. As I write this, the Atlantic hurricane season is getting

Hurry!

Relying on K-12 education is too slow!

Relying on educating young people to address the climate emergency, if carried out in traditional ways, will make us even more too late. So, we must work in nontraditional ways. Some of that means helping our students to lead us. That means helping our students to be effective climate educators, communicators and activists. They didn't make this mess, and they shouldn't be responsible for dealing with it, but there's no real choice. And, we can help them lead government and corporate leadership to do what's right.

Greta Thunberg is an inspiration!

She breaks all the rules of schooling!

Greta is teaching us by not going to school. She sees her Asperger's as a feature, not a bug. At 16, she's taking a stand and getting global attention for it. Like Greta, we have to break the rules of schooling to make the kinds of change we need. If we wait for society to continue to drive us must redesign education to actually improve things on a broad scale. It must be highly interdisciplinary, build understandings of both the nature of complex systems, and of how systems change. This is poorly matched to the highly disciplinary nature of K-12 education.



We're routinely too late on important matters.

Fire and Brimstone and Fort McMurray:
Considering Some Implications of Apocalyptic Rhetoric in Climate Communication

Don A. Haas, Ph.D. dad55@cornell.edu

1. The kind of story is every community must, though often a violent perception of biblical and mythological roots. By paying attention to structures, origins, and implications, we're more likely to use them more appropriately.

2. Such approaches may have substantially different outcomes for different people within the same audience. Using a doom-and-gloom framework for environmental problems will.

3. For educators, there are good opportunities for interdisciplinary connections, particular to English language arts and the social sciences.

4. Attending to these issues is a vehicle for building understanding and appreciation of complexity.

5. Understanding the use of mythological rhetoric can help identify problematic claims.

Bottom line:

Oil = Evil

Fire of Fort McMurray

The fire has closed the main route out of town.

PALEONTOLOGICAL

Fire & Brimstone & Fort McMurray

This section of the talk takes its title from the horrific fires in the Canadian Rockies in 2016. Those fires led to the most expensive disaster in Canadian history, and the largest evacuation in Canadian history. The evacuation of Fort McMurray looked like hell on Earth.

[VIDEO] <https://www.youtube.com/embed/sLz8qJhi054?feature=oembed&fs=1&modestbranding=1&rel=0&showinfo=0>
The fire burned for 458 days.

The overwhelmingly dominant industry in Fort McMurray is oil sands (or tar sands) extraction.



It's a massive operation, and one of the most energy intensive ways of extracting and producing oil.



Sulfur is a byproduct of that production. It's also known as brimstone.

For more discussion of the links among fire and brimstone and Fort McMurray, see the presentation materials linked in the center bottom box on this iposter.

Prophecies

This is pretty depressing so far, but we're not done. As long as humans have been telling stories, we've been telling stories about the end of days. We've always been wrong, at least about apocalypses at a global scale.

Part of the reason we've been wrong is that many of the prophecies were not credible.

Part of the reason that we've been wrong is that when the prophecies were credible, we took them seriously and changed our behavior, sometimes on a massive scale. That is, we repented.

While we often get busy too late to avoid serious harm - as we are too late right now - being too late doesn't mean we shouldn't act. Indeed, it means just the opposite. We urgently need to act, and at such a scale as to address these ominous challenges.

It's time to get busy.

The talk is adaptable and has different modules depending upon audience and duration. Discussions of the use of apocalyptic rhetoric in climate change communication is commonly included. This video includes both "Where does gasoline go" and "Fire & Brimstone & Fort McMurray: Considering the Implications of Apocalyptic Rhetoric in Climate Change Communication,"

[VIDEO] <https://www.youtube.com/embed/-svqHBC8nBI?feature=oembed&fs=1&modestbranding=1&rel=0&showinfo=0>

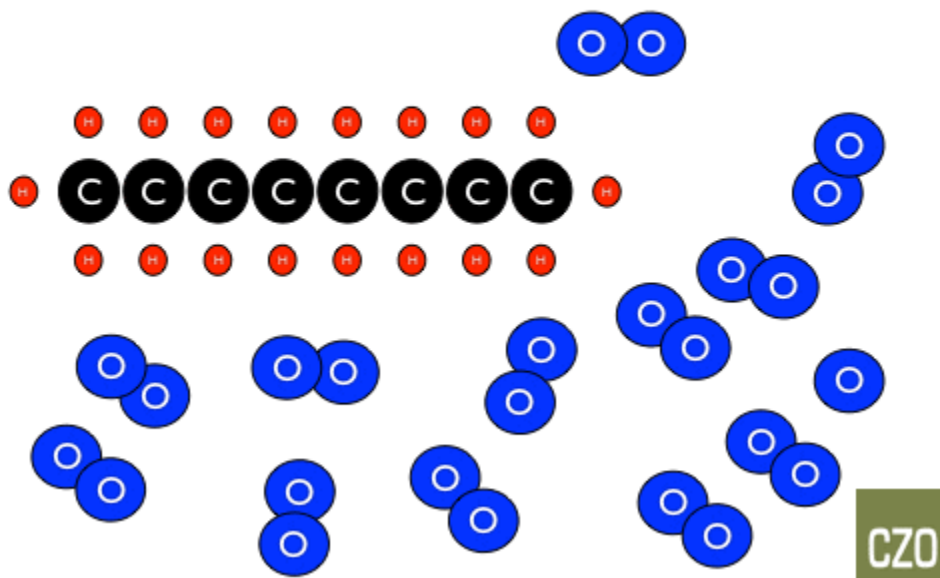
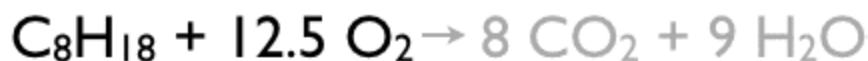
ASTOUND: WHERE DOES GASOLINE GO?

This presentation tells the story of a gallon of gasoline and places it in the context of the 391 million gallons of gasoline burned every day in the United State. That's more than a gallon of gasoline for each and every American each and every day. And that's just a quarter of US carbon emissions.

A gallon of gasoline weighs about six pounds, so if you put 10 gallons in your tank each week, that means 60 pounds of gasoline seemingly disappears.

Gasoline is complex mixture of hydrocarbons, but On average, it's chemical formula is something like this: C_8H_{18} . That's octane.

What do you get when you burn octane?



You get water vapor, carbon dioxide and energy.

The carbon dioxide weighs about 19 pounds - more than three times the weight of the gasoline we started with. That's not magic. It's chemistry. The carbon in the gasoline combines with oxygen from the atmosphere to make the CO_2 .

While it's fairly easy to understand that a gallon of gas weighs six pounds, and to have a sense for what that looks like in the world, picturing 19 pounds of an invisible gas is more of a challenge.

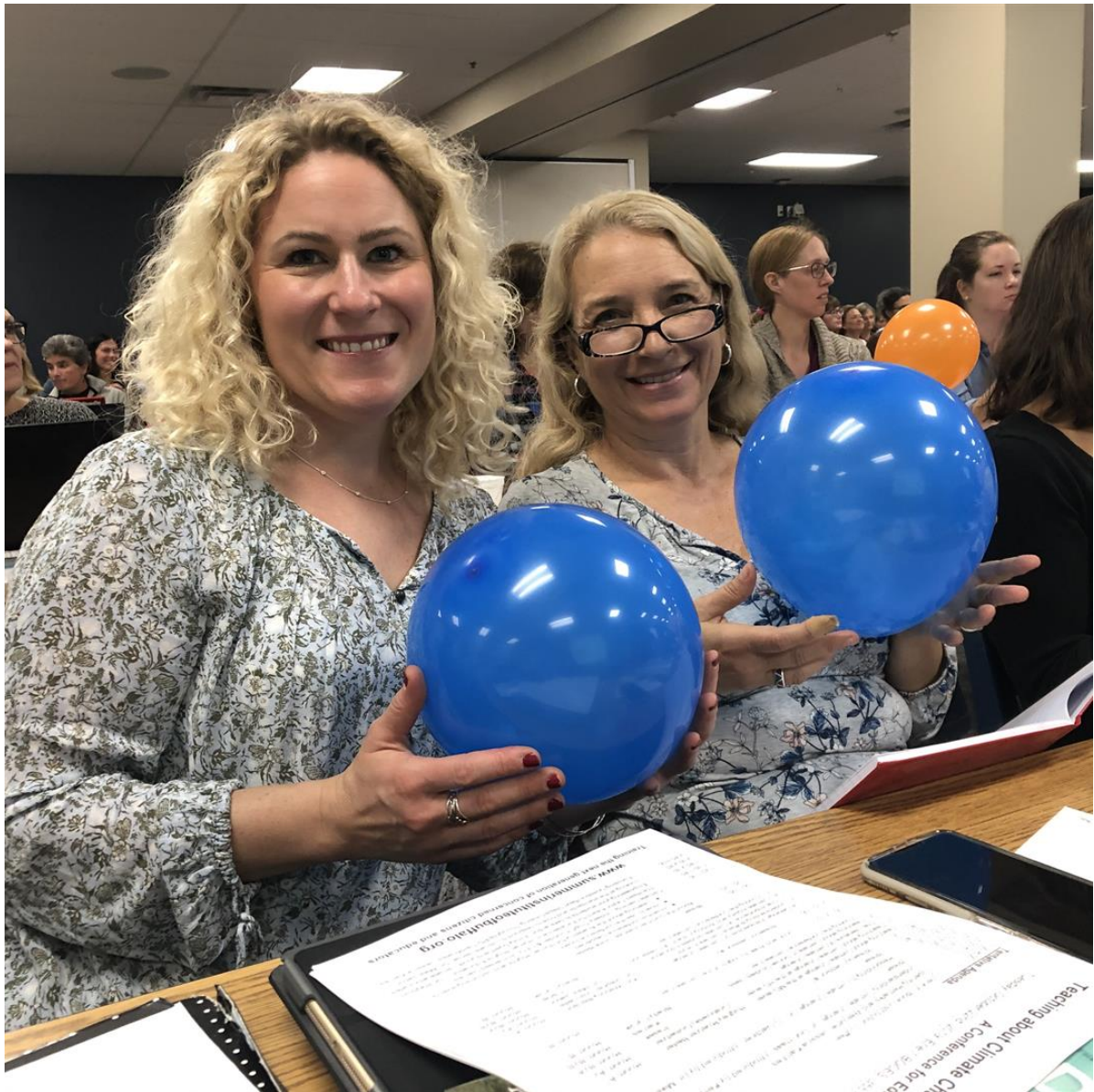
Balloons are used to process this, with each participant blowing up a balloon to about the size of the gallon jug.

How many gallon-sized balloons does it take to hold 19 pounds of CO_2 ?

How many?

- It doesn't weigh very much, does it?
- What are some things that weigh about 19 pounds?
- Here comes the answer in balloons...
- About 1100.





How many?



It would take about 1100 gallon-sized balloons to contain the carbon dioxide emitted by burning one gallon of gasoline.

And we burn 390 million gallons of gasoline a day.

PRESENTATION MATERIALS

Three Modules

This e-lightening talk discusses a set of presentations and presentation materials. There are now three modules used in Don Haas's hour-long sessions. Typically, resources are shared with participants through a Google Doc. On November 8, 2019, Don gave the talk, "It's too late. Let's get to work anyway" at the 12th Chicago International Education Conference. This year's theme was: The Hot Topic: Strategies for Teaching Global Climate Change. It was hosted by the University of Chicago

URL for the session materials document for this workshop is: <http://bit.ly/HaasHotTopic> (<http://bit.ly/HaasHotTopic>). The content of the document is excerpted below.

A few words before a few links:

I found preparing for today's talk to be unusually challenging. There is so much important to share with this diverse gathering of educators. The biggest, most important ideas that everyone - everyone - should understand about climate change are:

- **Climate change is real.**
- **It's mostly caused by humans**, especially through the burning of fossil fuels.
- **It's a very serious problem** - perhaps one of the greatest ever faced by humanity.
- **We can do things to make it less bad** (and we're not doomed, unless we keep doing what we've been doing).

I have lots more to say about the last point than I'll have time to say today. If you think it could be better, drop me a note at dad55@cornell.edu.

And, in the short-term, the most important thing we can do is talk about climate change. Most Americans only do so rarely. We need to change that.

Presentation Materials for the November 8, 2019 Conference:

It's too late. Let's get to work anyway.

This presentation (a Prez found here: <https://prezi.com/kh6jyq-4100m/its-too-late-lets-get-to-work-anyway/>) was originally written as an essay (https://serc.carleton.edu/integrate/workshops/sust_societies/essays/231440.html) for the Earth Education for Sustainable Societies workshop (https://serc.carleton.edu/integrate/workshops/sust_societies/index.html) in October 2019.

Where Does Gasoline Go?

This presentation is available in three formats - Apple's Keynote, in which it was created and works best, and Microsoft PowerPoint, where the animations don't work as well, but the basic content is the same, and, a blog post that writes out the presentation's information that was published in August 2019:

- Where does gasoline go? (Keynote (<https://drive.google.com/file/d/1nh-SvP-LGIYIn5P-TISOmMME9DWdxtY/view?usp=sharing>))
- Where does gasoline go? (PowerPoint (https://drive.google.com/file/d/1VIOje9Rof_ab8opB9dJdW1tDpTOB_dow/view?usp=sharing))
- Where does gasoline go? (Blog post (<http://criticalzone.org/national/blogs/post/where-does-gasoline-go/>))
- Where does gasoline go? (Video - first half of the video (https://www.youtube.com/watch?time_continue=1482&v=-svqHBC8nBI&fs=1&modestbranding=1&rel=0&showinfo=0))

Fire & Brimstone & Fort McMurray

The Prezi is found here (<http://bit.ly/TRBrimstone>). The second half of the video mentioned directly above is “Fire & Brimstone & Fort McMurray.” The direct link to the video is here (https://www.youtube.com/watch?time_continue=1482&v=-svqHBC8nBI&fs=1&modestbranding=1&rel=0&showinfo=0&fs=1&modestbranding=1&rel=0&showinfo=0).

Don's List of Interdisciplinary Climate Resources

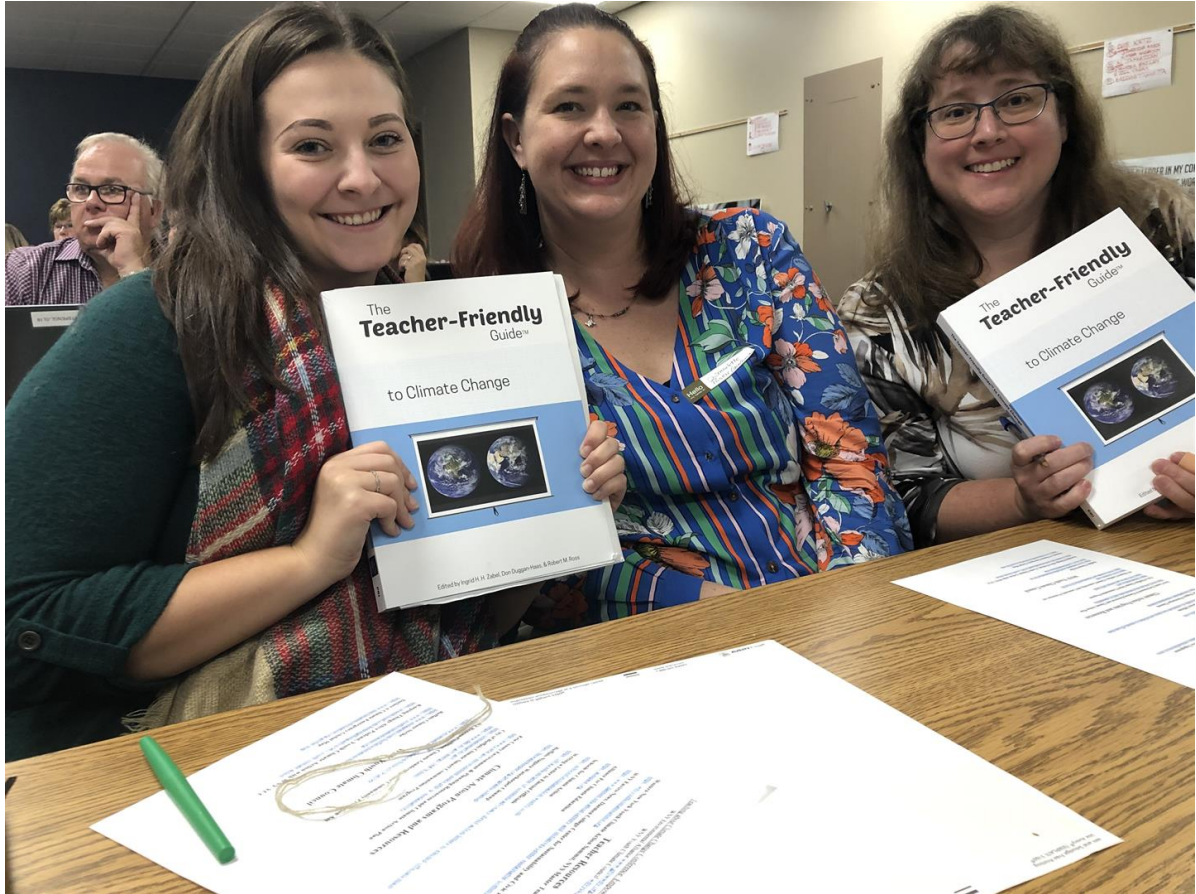
URL for the Interdisciplinary Climate Resources document: <http://bit.ly/InterdisciplinaryClimate> (<http://bit.ly/InterdisciplinaryClimate>)

This partially annotated list of resources points to both resources created by my colleagues and me at the Paleontological Research Institution and a number of links from a range of other institutions and individuals. Some are subject specific - several are from different professional organizations that represent educators from across the disciplines. Did you know, for example, the National Council of Teachers of English released a Resolution on Literacy Teaching on Climate Change (<http://www2.ncte.org/statement/resolution-literacy-teaching-climate-change/>)? Or that the theme for the 2020 International Federation for Home Economics (IFHE) World Congress is *Home Economics: Soaring Toward Sustainable Development* (<http://www.cvent.com/events/ifhe-2020/event-summary-df64e24cf1f64596ad83baaa8c57e21c.aspx?dvce=1>)?

REFERENCES

¹Wallack, Lawrence. News for a Change: An Advocate's Guide to Working with the Media. SAGE, 1999.

²Paulos, John Allen. Innumeracy: Mathematical Illiteracy and Its Consequences. New York: Hill and Wang, 1988.



Zabel, I.H.H., D. Duggan-Haas, and R. M Ross, eds. The Teacher-Friendly Guide to Climate Change. Ithaca, NY: Paleontological Research Institution, 2017. <https://priweb.org/tfgcc/>.

Sorry but time is up!

ABSTRACT

It is difficult to teach for both understanding and application, and the climate crisis highlights this in profound ways. Even those who understand the extreme threats posed by anthropogenic climate change have been largely at a loss for how to generate a response to such threats at scale. What drives people, organizations and governments to actually act in the face of crisis?

In at least several historical examples, the impetus for action includes being astounded and scared while also having reason for hope and the ability to display courage. These steps are infused with building visceral understanding of the problems' magnitude. Examples that follow this pattern include US involvement in World War II, the Apollo Program, and the civil rights movement.

"Where Does Gasoline Go?" and "Fire & Brimstone & Fort McMurray" are presentations that, when brought together apply this framework to climate change communication. Americans burn 391 million gallons of gasoline per day, each containing 5.5 pounds of carbon. To sequester that carbon by tree-planting requires the equivalent of growing a 2x4 for each gallon. If the US were to offset current emissions from gasoline (roughly a quarter of total US emissions) by planting trees, we'd need to grow 4.3 billion pounds of wood every day - more than 1.5 trillion pounds/year. When you fill your tank, count 2x4s as the gallons roll by, and mentally scale this up to every driver in the country. If one understands both scale and the basics of climate change, this is both astonishing and terrifying.

We have faced terrifying situations before and we have emerged from them. Indeed, throughout human history, we have always lived in times characterized by the wonderful and horrible simultaneously. We have also always made apocalyptic prophecies that, at least at the global scale, have not come to pass. For the credible ones, people eventually acted and were able to meet the challenges (though sometimes at horrific costs). Recognizing that we have always been wrong in predicting global apocalypses and that when the situation becomes dire (as it is doing now) we have taken effective action is reason for hope.

The process described here, through the story of a gallon of gasoline, couples clear science with powerful emotion. It closes with hope. And, it offers tools and a broader approach that can be widely replicated.

SWITCH TEMPLATE

