MS. CARLY LETTERO: Before we get started I would just like to remind you to silence your phones and also ask that you not take photos this evening during the keynote.

And before I tell you a little bit about the Tribunal and introduce Sandra Steingraber I would like to begin by acknowledging that Corvallis is located in the traditional territory of the Chepenefu or the Mary's Rivers Band of the Kalapuya. And after the Kalapuya Treaty in 1855 Kalapuya people were forcibly removed to what are now the Grand Ronde and Siletz reservations.

Jan Michael Looking Wolf is an enrolled member of the Kalapuya Confederated Tribes of Grand Ronde and he's also a world renowned Native American flute player. When he heard about Sandra Steingraber's work and the Tribunal he offered to compose a song for this evening along with Dana Reason who is a composer and musician and good friend of the Spring Creek Project.

And so we've invited Jan and musicians to debut this new song this evening and they have generously offered to donate all the proceeds of this song, which they've already mastered, to help with the TREMAINE & CLEMENS, INC. EUGENE, OREGON (541)343-8833
fight against fracking.

The song doesn't have a name yet so I invite you, while you're listening to it, to imagine what you might name it and then tomorrow on social media we'll ask for your suggestions and pick one of them. So I would like to welcome our musicians [Applause].

MR. JAN MICHAEL LOOKING WOLF: How is everybody doing? Good?

The song is a beautiful song but it's actually an hour and a half long. So most of tonight will be this song.

I just want to say my name is Jan Michael and here I'm here with Dana and Ryan Biesack and Keith Summers. And, Carly, it's an honor to be here for this event. We really enjoyed writing this song and recording it.

And, you know, I am half Irish. My mom is 5-ft tall and she's almost full-blooded Irish and my dad's like 6'3 and he's native of this land. Like she'd mentioned I'm Kalapuya, Santiam Kalapuya. I actually speak my own language and I just want to introduce this song by saying that for us the inspiration was water.

Water for all people of the world is so important. We're not the only indigenous people here.
I mean we're all indigenous. You all have indigenous ancestors who came from a thing called oral tradition. That means there wasn't a written language. So we all go back to time immemorial from an indigenous person who really understood and respected how to properly use water. Water is so important. Just as I've introduced this song there's been two to three children who aren't with us now because they didn't have clean water. But we're here tonight and it's beautiful and tonight we play this song for them, we play this song for Carly and we play this song for the cause. Thank you.

[Song performance] [Applause].

MS. CARLY LETTERO: When Jan and I were corresponding about that song he wrote in an e-mail thank you for your commitment to Mother Earth and all who stand on her, swim in her water and fly in her sky. And I thought that was such a beautiful thank you and I would like to extend that same thank you to all of our musicians this evening.

How many of you got a chance to go upstairs and check out the Pop Up Art Gallery? Awesome.

Well, this show, Unsilenced: Art And Sounds of Resistance, will be open after we wrap up here until about 8:30. And so I invite you to check it out after
the keynote if you haven't already.

They are going to breakdown a few things here while I keep us going.

There are posters and sound submissions from Corvallis and from across the U.S. in the gallery upstairs and there is a listening room integrated into the gallery. And I would like to thank Jason Fick and Dana Reason and Allison Johnson and Mike Gamble and Melody Owen for conceptualizing and collaborating on that project.

I'd also like to thank Melody Owen, who is a student in the Environmental Arts and Humanities graduate program for curating the poster show and curating the exhibit that was right around the corner in this wonderful little gallery. If you haven't seen it yet this CEI's Art Works Gallery and that was hanging a week before this evening.

I would also like to thank our local incredible bookstore, Grassroots Books & Music and Sierra is here with books. She'll be here after the keynote and Sandra will be right here signing and so, hopefully, we'll have a nice flow there.

I would like to thank the Ceres Trust for helping to bring Sandra Steingraber this evening to Corvallis.
For many people the concept of a Tribunal is vaguely familiar and so I thought I might begin by just introducing it a little bit.

In the very late 1960's and early 1970's a man named Lelio Basso testified at tribunals about human rights violations in Vietnam and in Latin American. And after those tribunals he thought it would be a really good idea to establish a Permanent Peoples' Tribunal. And his vision was that a Permanent Peoples' Tribunal would serve as an instrument and also a platform to give recognition and visibility and voice to people suffering violations of their fundamental human rights.

And so nearly 40-years later the Permanent Peoples' Tribunal, which is based in Rome, has held 44 sessions all over the world. Most recently in London on Myanmar's crimes against the Rohingya and Chetnians peoples.

So anyone in the world can propose a session to the Permanent Peoples' Tribunal and that's exactly what a very small group of people did about four years ago. In early 2014 Tom Kerns and Anna Grear and Damian Short came together to petition the Permanent Peoples' Tribunal to take on fracking and climate change.

And that petition convinced the Permanent Peoples' Tribunal that there were potentially grave
violations of human rights happening because of fracking
and climate change and so they decided to devote the
45th Tribunal to that topic.

It's been a really busy couple of years since
then. Four pre-tribunals were conducted, two in Ohio,
one in Virginia and one in Australia. More than 200
witnesses have testified. There have been 17 Amicus
Briefs submitted by 14 attorneys and 20 non-
governmental organizations in seven countries on five
continents.

All of those people, in some way or another,
are scheduled to testify and speak this week before a
panel of 10 judges who are from six different countries.

And this session of the tribunal is historic
for a number of reasons. The Permanent Peoples'
Tribunal has had sessions on environmental issues in the
past, including in Chernobyl or about Chernobyl and
Bhopal but this is the first time that they're taking on
an environmental issue that is as wide-reaching, that
can affect everyone of us who lives on earth now and in
the future.

This session is also historic because it
expands the scope of the Permanent Peoples' Tribunal for
the very first time to include arguments about the
rights of nature in addition to the rights of humans.
And for the first time the entire Tribunal is on-line, which is an inclusive format that the Tribunal is excited to try out because it gives people from around the world the opportunity to testify and also to follow along.

And so it's really been an honor for the Spring Creek Project to co-organize the Tribunal because it so closely aligns with our commitment to working on the most urgent and daunting environmental issues of our time.

And the format is something new for Spring Creek Project but at its core the Tribunal is about story telling. The Tribunal offers people from around the world the opportunity to tell their stories. It's courageous story telling and the Spring Creek Project is really proud to support it.

And so throughout the week attorneys will take these courageous stories and along with scientific findings they are going to weave them into arguments that they are going to present before this international panel of judges that has been appointed by the Permanent Peoples' Tribunal.

And then after the Tribunal the judges are going to convene, probably for a few months, and write a judicial opinion about if and how fracking constitutes a
breach of human rights. And that judicial opinion then can be used by peoples and communities around the world to change the conversation about fracking and climate change and thus change the policies and laws and norms. And in this way the Tribunal offers an international stage for story telling to be transformational. And that is exactly what Spring Creek Project is dedicated to doing to telling stories that have the power to shift the trajectory of environmental devastation toward a future that is just and restorative for all living beings. And so throughout the week each session of the Tribunal is going to be available on Spring Creek Project's youtube page and Facebook page. I also just learned that the Unitarian Universalist Congregation is going to be showing a viewing of the tribunal. And so if you want to sit with folks and watch it they're going to be open every day and you're welcome there. Spring Creek Project has also been hosting a series of lectures called the Bedrock Lectures on Human Rights and Climate Change for the last 16 weeks leading up to the Tribunal and those are available on our web site and youtube page. If you would like to learn more about Spring
Creek Project I invite to join our mailing list in the
lobby.

Sandra Steingraber is often quoted for saying
that we are all members of a great human orchestra and
it is now time to play the Save The World Symphony. You
do not have to play a solo but you have to know what
your instrument is. What instrument you hold and find
your place in the score.

And this evening and the Tribunal are possible
because so many people have found their place in the
score.

Over the last few years dozens of people have
volunteered thousands of hours behind the scenes to make
this Tribunal happen. And I especially want to thank
Tom Kerns, who was one of the three people who
originally petitioned the Permanent Peoples' Tribunal,
for really his unwavering dedication to making this
happen for the last four years. It simply wouldn't have
happened without his willingness to step out of his
comfort zone again and again and to just forge ahead.

I also want to thank Kathleen Dean Moore who
many of you know is a great writer and philosopher.
She's also a great connector and she first brought the
idea of the Tribunal to Spring Creek Project.

I want to thank Gianni Tognoni, who is the
Secretary General of the Tribunal and has been with us every step of the way and also Simona Fraudatario who is the Coordinator of the Tribunal in Rome.

And special thanks to the graduate students in the Environmental Arts and Humanities Program who have helped conceptualize and run the Tribunal in the months leading up to it, really the year leading up to it, and also this week.

And finally a really deep thanks to my Spring Creek Project staff, Shelly Stonebrook and Emily Grubby. It's a small daily miracle to work with people who are so hopeful and good and joyful. So thanks for every detail.

Sandra Steingraber is the really the perfect person to Keynote the opening session of the Tribunal because she has been a courageous story teller for decades. She's an ecologist, a cancer survivor and an author who explores the links between human rights and the environment.

Her work focuses on chemical contamination, climate change and fracking. She's the award winning author of three books including the acclaimed Living Downstream, Having Faith and Raising Elijah.

She's been featured in two documentaries, Living Downstream and very recently Unfractured.
She's received many honors for her work as a science writer, including in 2011 a Heinz Award. And that award came with a $100,000.00 cash price that she donated to the anti-fracking movement.

And then a year later she then become the cofounder of New Yorkers Against Fracking, which is a state-wide coalition of more than 280 grassroots organizations. And she cofounded Concerned Health Professionals of New York and serves as a science advisor to Americans Against Fracking.

Her work has been featured all over the place, in many publications, and she's earned what I think are some of my favorite nick names for a writer because of that. Rolling Stone has called her the Toxic Avenger. And Sojourner Magazine has called her a "poet with a knife". She's been named Woman Of The Year by Ms. Magazine and Person Of The Year by Tree Hugger and one of 25 visionaries who are changing the world by the Utne Reader.

She's a recipient of the biennial Rachel Carson Leadership Award and she recently edited the book, Rachel Carson: Silent Spring and other Writings on the Environment, which is a really beautiful edition that was added to the Library of America this year. It just came out but you'll want to check it out when you can.
She is a contributing essayist and editor at Orion Magazine and a distinguished scholar and resident at Ithaca College in New York.

So please join me in welcoming Sandra Steingraber.  [Applause].

DR. SANDRA STEINGRABER: Thank you for that amazing introduction. A spot for all my audio visual aids up here.

What an honor to serve as the opening Keynote Speaker for the historic Permanent Peoples' Tribunal Session on Human Rights, Fracking And Climate Change.

This is a convocation many years in the making. Bravo to our hosts the Spring Creek Project and Oregon State University here in Corvallis for bringing us together in this elegant White Side Theater and by live-streaming around the world.

As with so many good ideas this week long series of hearings was inspired by the actions of an extraordinary individual, the philosopher and ethicist Dr. Tom Kerns who I hold in highest esteem.

Thank you, Tom  [Applause].

As you've heard the Permanent Peoples' Tribunal is an august international forum. Its origins story is as an investigation of human rights breaches during the war in Vietnam.
Since then its hearings have examined abridgments of human rights standards in Bhopal, India, in the Ukranian city of Chernobyl and most recently among the Rohingya and Chetnian refugees of Myanmar.

Today we've begun an exploration into the potential human rights violations of a newish technology called unconventional high volume hydraulic fracturing combined with horizontal drilling, so called fracking for short.

Fracking is what the industry calls it and fracking is what the enemies of that industry both call it.

Fracking is a technology developed at the end of the 20th century in sparsely populated western regions of the United States using public money from taxpayers.

In a line fracking turns fresh water into a poisonous club to smash apart shale bedrock in order to extract otherwise unattainable bubbles of oil or natural gas, methane, trapped inside of that rock.

Fracking has since spread east, west, north and south, including to the densely populated regions of the northeast where I live and to Southern California and to the bread basket of midwestern agricultural regions.
A dramatic increase in fracking over the past decade in the United States has pushed oil and gas extraction operations into heavily populated areas. At least 6% of the US population, 17.6 million Americans now live within a mile of an active oil or gas well. A number that includes 1.4 million children and 1.1 million elderly people. At least 8.6 million people are served by a drinking water source located less than a mile from a well pad.

These facts alone, along with emerging evidence revealing that fracking sites and associated fracking infrastructure are disproportionately sited in non-white, low income and indigenous communities, both in the United States and in countries like Argentina, Mexico and Canada where fracking has been exported, means that it is right and necessary to understand the potential for human exposures and accompanying adverse impacts, not only as an issue of public health but fundamentally as an issue of human rights.

My frame for this Keynote tonight is the biologist, Rachel Carson, whose 1962 book Silent Spring, about the unintended consequences of pesticides like DDT, sparked a revolution in environmental consciousness and is rightly credited as a founding force of American environmentalism.
It was the second great honor of my life this year to edit this new collection of Rachel Carson's environmentalist writings for Library of America, including Silent Spring but also some never before published letters and speeches.

And I should say that Library of America exists to canonize iconic American writers and pledges when they collect the writings of an American author and reissue them that they will be kept in print forever, eternally.

So it's like watching an actor receive their star on the Hollywood Walk Of Fame to see a Library of America collection. It's long overdue that Rachel Carson should receive her star but here it is and I had the great honor and privilege of being able to edit this collection this year.

In these writings, in this book Carson makes clear that the environmental crisis is first and foremost a crisis of human rights. And it's that element of her writing that I want to foreground and embrace for our purposes tonight.

Carson writes, "If the Bill Of Rights contains no guarantee that a citizen shall be secure against lethal poisons distributed by either private individuals or by public officials it is surely only because our..."
forefathers, despite their considerable wisdom and foresight, could conceive of no such problem."

And she went on in lyrical descriptive prose to trace the invisible drift of pesticides from the atmosphere into our rivers, aquifers, breast milk, egg shells of song birds and into, finally, the subcellular machinery of our own bodies creating genetic injuries and blazing trails for cancer, birth defects and altered development.

Her panoramic language that takes us from crop dusters into groundwater and into the nucleus of cells is an artistic exploration in which language becomes a cinematic camera showing us the connections in the natural world that are otherwise invisible to us.

So I want to take a Carsonesque approach tonight and speak to you first as a creative writer and use language as a camera to take you down into the dark heart of the planet, into the bedrock that lies beneath our feet and I want to rewrite for you, as a landscape, that this bedrock of our nation is not a void, a lifeless place of inertia darkness with oil and gas pocked inside the rock but, rather, it is a living ecosystem, a subterranean coral reef, if you will, that is teeming with life, a habitat that is animate and beautiful and is connected to the carbon cycle by
metabolizing organisms who live there and thus is connected to us here at the sunlit surface.

Rachel Carson reminds us that wars waged against the web of life will sooner or later transform the cells of our own bodies into battle fields. And this is also true when we turn the weapons of destruction against our nations bedrock.

So let's begin here.

400 million years ago shallow seas overlay parts of the North American continent. One of them was in the part of the world that I live in the northeast and the shallow ocean that extended from approximately where the Catskill Mountain Range now is all the way to the middle of Ohio.

And I, who live in the Finger Lakes region of upstate New York, would have lived along its northern banks of the sea. The southern reach went all the way into West Virginia. The ocean floor became a graveyard of the organisms who lived here.

And remember 400 million years ago was before fur, before back bones, before three and four chambered hearts, before breasts, before eyeballs, before fins and flippers. The organisms we're talking about who lived here were sea lilies, squid, diatoms and plankton. And when they died they fell to the bottom of the sea and
that ocean began to fill with silt because it was
surrounded by mountains and as the mountains eroded they
turned into dust. And dust changed its name when it
falls into the water and then we call it silt.

Mountains are full of entire periodic charts
of elements but as these mountain ranges eroded the
elements drifted with the silt into the bottom of the
ocean. These are things like barium, strontium,
uranium, lead, mercury. So these elements became part
of the floor of these shallow seas.

So the organisms died and they fell to the
ground, the bottom of the ocean by gravity but, because
of earth's atmosphere wasn't as oxygenated 400 million
years ago as it is now, there were not yet land plants.
The organisms didn't have enough oxygen to completely
decompose. So, instead, they turned into bubbles of
methane, which is carbon with four hydrogens or a
heavier hydrocarbon molecule or something that we would
call petroleum or oil.

So not just across the northeast but also in
North Dakota, in California, in Oklahoma, in Texas these
similar oceans existed at similar times and these
phenomenon went on.

So eventually then these corpses were covered
by the silt that fell upon them and they were buried and
eventually then the whole ocean floor petrified and turned from silt into shale. And these organisms were then trapped as bubbles of oil or natural gas inside the rock itself. And they've stayed there like that for 400 million years. Those hydrocarbon bubbles of oil and gas are the quarry of fracking.

But these ancient ocean floors that became our shale bedrock are not just a graveyard. They are also a living ecosystem. They are inhabited by living organisms now. Some are bacteria but many others occupy an ancient domain of life called archaea. And these organisms feed on the hydrocarbons that are down there. They also, some of them, feed on radioactive decay. They're strange. They have, some of them, arsenic instead of phosphorus in their DNA.

And now I'm just going to speak to my fellow biologists in the room and the rest of you can kind of float with this for a minute.

They lack electron transport systems, which is very unusual for organisms. We don't see that in living things who live here on the earth's surface. And the way they can avoid oxidate stress without an electron transport system is that they actually send electrons out into the surrounding rock.

They're organized into colonies in order to do
this and they use nanowires to send across themselves a large number of electrons and, thus, they alter the rock and change it from one element to another.

So I'm going to pause here for a minute and make kind of a theological or philosophical query. What I'm saying is that the biologic is the creator of the abiotic. These organisms are down there a mile below our feet making rock, altering it and reshaping it and turning it into something else.

And altogether geologists believe that these deep life organisms by a biomass actually exceed the biomass of living things here on the sunlit surface of our planet.

That's why I say we need to think of our bedrock as kind of a subterranean coral reef, another world down there that we may not know much about but whose destruction and poisoning may have consequences for us.

So fracking uses water, 2 to 20 million gallons per frack job and sends it down into that shale by drilling straight down into it and then turn the drill bit sideways and tunneling like a robotic mole for another mile or more.

And first we send down explosives into that tunnel to start fracturing the shale but what really
widens those cracks is water. So fresh drinking water
is then sent down the hole.

Water is not compressible under high pressure
and you can imagine what kind of pressures are required
because the lithostatic pressure of the earth pressing
down on the shale a mile or more of substrate above the
shale bedrock has to -- in order to blow that up down
there, water has to be under immense amounts of pressure.

And if it were only water that was used as the
agent for fracking it wouldn't work because as soon as
you release the pressure to let the gas flow out all of
the fractures that you create you turn the bedrock into
shards at this point. They would all close up again as
the weight of the earth presses down upon them. So
instead sand is added to fracking fluid, and not just
any kind of sand, but silica sand. Because the grains
of silica sand are shaped in such a way that they resist
crushing under immense pressure.

So really the water is used to create the
fractures but also to shoot the sand grains into the
cracks created and like tiny door stops they hold open
those spaces so the bubble of oil or gas can then escape
and go up the bore hole after the pressure is released.

But in order to get sand down the hole and
around the bend without settling out and clogging the
pipe you need to thicken that water with jelling agents
to move the sand around the bend and shoot it into the
cracks. So jelling agents are added to fracking fluid
along with things like friction reducers and anti-
scaling agents.

But those living organisms, those bacteria and
those archaees that are down there at that depth, will
feed on those gelling agents and they'll grow inside the
pipes and interfere with the flow of gas. And so
powerful biocides are added like glutaraldehyde to
fracking fluid, which is why it's so toxic, because we
have to engage in a mass extermination campaign, an
underground pesticides spraying program of the bedrock
in order for fracking to work.

And some of the water that is used to liberate
the bubbles of oil and gas remains trapped within the
fractures zone and, as such, has now been permanently
removed from the hydrologic cycle forever entombed among
the fractured shards.

And I want to pause here a moment and ask
another philosophical question about humans making water
disappear. We've never done that before to actually
remove water from the hydrologic cycle, ground water
that is the mother of rivers, that flow to the sea, that
evaporate into clouds, that fall as rain or snow and
rise again as mist and fog, we've never done that before.

Fresh water is only 1% of all the water available on earth. Most of it, 98% of it is sea water, 2% of the earth's water is fresh water, and a half of that is frozen at the poles. So that only leaves 1% of water to be part of the living cycle of which we are all 65% water by weight. So by weight we are 2/3rd's rain drops.

And so what does it mean that we're making water disappear in a time of a climate crisis when lack of availability of fresh water is getting more insecure.

The water used to fracture shale will never again flow as a river, never again rise as mist, never again rise as sap, never become nectar attracting bees, never again blood plasma or breast milk or tears or cerebral spinal fluid or the breath of our exhaled lungs on a cold winter day or never the snow flakes on that day.

Some of the water travels back up to the surface, that's called flowback fluid, and it contains not only the chemical additives that were used to turn the water into fracking fluid but also now it contains brine, heavy metals, radioactive elements, all those things that were deposited by the eroding of ancient
mountain ranges that are now inside the shale. Toxic elements that wouldn't hurt anyone as long as they're trapped down below but now we are going to bring them up to the surface.

The result is a massive amount of poisonous liquid waste and we have a problem with no solution because no technology exists to turn fracking waste back into drinkable water. Its safe containment is for eternity. It could be reused to frack another well but not unless it's highly diluted because the more you use it the more salty and toxic and corrosive it becomes.

So the practice is to inject it in other deep wells where it has been definitively linked to earthquakes because fracking fluid contains anti-friction agents.

Remember a fracking bore hole is only about 5-inches or so in diameter and to shoot that vast amounts of water with that kind of pressure you need to reduce the friction. So you make fracking fluid very slippery. But if you then inject it back down in to the earth it lubricates fault lines and allows rock formations to slip past each other and that is how earthquakes are generated. We have absolute proof about this link.

So this raises to me another ethical question.
about generational inequity. How is it right that this
generation of people alive now can liquidate the bedrock
and enjoy the profits from the oil and gas that we blow
the bedrock up to extract and then produce toxic waste
which must be curated eternally by our children and
grandchildren who will receive none of the profits.

But I want to widen the lens now and take an
even a bigger view of fracking because it really doesn't
start with the drill bit screwing into the ground. It
starts in the upper midwest with the mining of fracked
sand.

Frack sand mining has now become the No. 1
export of the state of Wisconsin, more than cheese.
Wisconsin is exporting itself and it's changing its
landscape to do that. The coolies and hills and bluffs
of Wisconsin are disappearing. They're made of
sandstone and that sandstone is made of grains of silica
sand that are in high demand for fracking.

So we have all these frack sand mining
operations going on in Minnesota and Iowa and Wisconsin
and in my part of the world in down state Illinois where
I grew up.

Silica sand makes silica dust and silica dust,
like asbestos, is linked to lung cancer. It's also
linked to silicosis. So although the people in the
upper midwest live far from the fracking fields their bedrock is being extracted and blown apart to be carted off to the place in the world where I now live, to be shoved into the ground, to hold open the cracks in the destroyed bedrock of the northeast or taken to the fracking fields in the Bakken shale of North Dakota or Colorado.

And then where does the gas go or the oil go after it comes out the ground?

Well, there is a massive amount of infrastructure involved to take that oil and gas from the point of its extraction to wherever the burner tip is. And that takes the form of pipelines and compressor stations and hundreds of underground and above ground gas and oil storage facilities.

And here in the northwest LNG facilities where natural gas, through the energy intensive process of cryogenics, is super-chilled so it can be loaded on to tankers and taken to places where pipelines can't run, such as across the ocean.

And, of course, the story doesn't end there because methane leaks at every step of this process from the moment the drill bit goes into the ground and contacts the shale methane is pouring out of the hole.

It pours out of the valves of every single pipeline,
every single compressor station along the way.

And the result is that methane is being loaded into the atmosphere. Methane 86 times more powerful than carbon dioxide at being able to trap heat in our atmosphere. More methane leaks from fracking operations than we previously appreciated, which means natural gas via fracking is not any cleaner for the climate than coal, and it may be worse.

Methane emissions are 20 to 60% higher than previously thought. The ongoing surge in methane levels are now driving climate impacts and a sharp uptick in global methane levels since 2006 is largely attributable to fossil fuel extraction processes, notably fracking.

So let's pause here for a minute and consider these molecules of methane in the atmosphere and remind ourselves that carbon, when we talk about decarbonizing and loading the atmosphere with carbon, carbon is not the first name for carbon dioxide.

Carbon comes in two flavors, carbon dioxide and methane. And these are two naturally occurring components of our earth that actually make life on earth possible. Let's just pause for a moment and consider that.

So methane comes from dead things. Carbon dioxide is our exhaled breath of all living things. And
both of these molecules have the ability, when struck by thermal radiation, which is heat, to vibrate. So when methane and carbon dioxide are in our atmosphere and then the earth's surface turns away from the sun at night the light from the sun, the light energy entirely vanishes but the heat energy does not entirely vanish, if it did we would all — it would be like the Disney movie Frozen. Our oceans would turn into ice rinks every night. Our blood plasma would freeze stiff.

That doesn't happen because two molecules, methane and CO₂ when the sun's heat energy bounces off the surface of the earth and bounces back into the atmosphere and encounters a molecule of CO₂ or methane, those molecules begin to vibrate and their vibration traps the heat. That's what we mean when say it's a greenhouse heat trapping gas.

So these vibrational molecules, all dancing all night long up in the sky, prevent us from dying every night. So they're the living's exhaled breath and the dead. The living and the dead conspire together to make life possible on earth. So it's good that we have greenhouse gases.

And, by the way, of the two molecules, CO₂ lasts longer in our atmosphere than methane. Methane is more potent at trapping heat but it will fall apart
after about a decade whereas CO2 goes on trapping heat for a century. Which means your exhaled breath will out live you. You will be dead and gone but your breathing, your whole lifetime of breathing, has changed the chemistry of the atmosphere and those molecules of your exhaled breath, representing all the things that you did to metabolize all your life, will go on trapping heat for the people and all the living organisms, all of our relatives, that come after us.

And, of course you know, through the miracle of photosynthesis, that some of that CO2 will be taken out of the atmosphere by our friends the plants, who take them through their stomata of their leaves -- remember that in 7th grade, the stomata -- and combine them with sunlight and water from the earth up through the roots and through the miracle of photosynthesis spin that into sugar and form the beginning of the food chain.

So for all of the earth's history that photosynthesis and the exhaled breath of all the animals have existed in a kind of balance but 150 years ago when we exhumed the cemeteries of Devonian to animals and plants and this unholy trinity of fossil fuels, oil, coal and gas, and we lit those bodies on fire in the crematoria that we call power plants, we loaded up our
atmosphere with 40% more CO2 than pre-industrial levels and almost tripled the amount of methane.

So now at night we have many more dancing vibrating molecules and it's like a blanket that we can't kick off. And the consequences, as you know, involve melting ice caps, rising seas and, of course, the acidification of the ocean because CO2 turns into carbonic acid when it falls into ocean water.

Our plankton stocks are now in trouble because of rising acidity levels and also because of the rising surface temperatures of the ocean. Phytoplankton provide us half of the oxygen in our atmosphere, land plants provide the other half, and so 1 out of every 2 breaths that we breathe is brought to us by the world's plankton. And if the plankton are in trouble, my friends, we are in trouble as well.

And if you're hearing this science for the first time then that is a failure of my field. If you hear about the falling Dow industrial stocks but not about the plankton stocks and how they're doing when you turn on your cell phone every morning or you read the ticker in Times Square, ask why we have a public conversation about economic stocks but not about ecological stocks? And why aren't scientists having public conversations with us about these issues?
So I've talked to you now as a creative writer and that was my best attempt to use language to create a visual picture for you, both down in this landscape that no one has seen, not even the frackers who are destroying it, and up in the upper reaches of our atmosphere where gases trap heat for us.

And now I want to switch things up a bit and talk to you as an activist and tell the story of how we defeated the shale gas army in New York state and won a statewide ban on fracking in 2014. [Applause].

We did that.

So in 2009 I was invited back to Cornell University where I'd previously been on the faculty to give a talk on the public health implications of fracking. And I was surprised by the invitation because I didn't know much about fracking then and I didn't realize the toxic chemicals that were used.

And when I discovered they included things like glutaraldehyde and benzene, and that formaldehyde was often released, those are chemicals I know very well from my earlier work. So I went to work investigating it and I was stunned and shocked by what I learned.

And in the summer of 2011 I went across the United States to look at places in the west where fracking was actually happening to begin to kind of do...
some field work on what this actually looked like and what I should be thinking about.

I took my kids with me and we were camping the whole time. So we called it sort of like camping with drill rigs. And it was when I was in Utah interviewing people in the Redrock community of Utah about proposed fracking operations that I got two phone calls. One was to say that the student, Tim DeChristopher, was about to be sentenced for his action as a civil disobedient in attempting to stop fracking in the area where I was actually studying. He was going to be sentenced in a federal courtroom in Salt Lake City and I was asked to come and speak there outside the courtroom while he was being sentenced. So I did. And it was my first experience with civil disobedience.

So Tim was sentenced for his peaceful actions that actually did succeed in stopping fracking. He was sentenced to two years in federal prison and he was hauled out of the courtroom by federal marshals in handcuffs and manacles.

And then everyone in that area filled the streets during rush hour and simply sat down. And in my mind there was one image that I couldn't shake and it was an image of a young woman holding a sign that said, "Climate Justice Now" who sat down on the tracks of the TREMAINE & CLEMENS, INC. EUGENE, OREGON (541)343-8833
light rail commuter train and then here came the train full of commuters and it had to slow and stop. She held her sign.

And on the side of the first car of that train, that street car, was a public service announcement by the American Cancer Society that had a pink ribbon and a slogan that said "Just Get A Mammogram."

And I thought well, here it is, my life in public health. Just get a mammogram versus climate justice now. We can either detect problems after they've already arisen or we can try to prevent them.

The next day I was back in the field and I got a phone call from Theresa Heinz Kerry letting me know that I was the lucky recipient of this year's Heinz Award which came with this $100,000.00 check.

Had I not just been through what I'd been through the day before I might have thought, oh, what a great windfall. I can use this to do my research. That's what scholars and writers mostly do when these things happen, lucky things happen.

But, instead, I decided I wanted to do climate justice now, not just get a mammogram, and I wanted to use the money not just to study fracking but to stop it. [Applause].
I had just heard Tim DeChristopher say to a judge "I don't want -- I'm not asking for mercy. I'm asking you to join us. This is what love looks like."

So I went back to my unfractured state of New York and I let it be known that I wanted to somehow unite all of these local groups that were springing up all over trying to stop fracking into a mighty state-wide coalition. I didn't know how to do that. I'm just kind of a nerdy biologist.

But there were some people who had some political skills and they included groups like Frack Action, Catskill Mountain Keepers, United For Action, Food And Water Watch. And so there were kind of five groups plus me, this crazy biologist with a check, and we all kind of pitched in and we started New Yorkers Against Fracking.

We were only these handful of groups at the beginning but more and more groups joined us and by the time we banned fracking in 2014 there were more than 400 groups as part of our coalition. And they included Businesses Against Fracking which, itself, was a coalition of a thousand different businesses. Faith Leaders Against Fracking, more than 500 churches and synagogues, and so on.

And so we changed the public opinion on
fracking and we took the governor's base away from him.

So it now was a bigger problem for him to diss us than it was to diss the oil and gas industry.

And as this mighty social movement began unfolding I was able to retreat and do what I do more comfortably, which is to analyze data. That is how I became a cofounder of Concerned Health Professionals of New York. We became the scientists in residence to the anti-fracking movement. And we began to analyze the data, to translate the data into plain and simple English and not only bring it before our state legislatures in testimony and write memoranda for our governor, and our commissioner of health and our commissioner of the environment, but also take it to people.

Myself and my colleagues in the sciences and medicine spent the better part of two years speaking every Friday and Saturday night in a church basement somewhere, in a Rotary Club, in a junior high school auditorium, in a town hall, in a public library and we gave our Fracking 101 PowerPoint presentation.

When we started there were only 65 studies in the peer reviewed published literature about the risks and harms of fracking. Our goal was to keep the moratorium that we had going. Our feeling was that a
moratorium was just a ban with a deadline. And our
hunch was that if we could stop fracking for long enough
the data would come in and make it look unthinkable.
And that was our strategy.

And as we went we were operating on a moving
stream of data. By the time we banned fracking in
December 2014, and the governor did announce a ban on
the basis that fracking was a demonstrable public health
risk, with risks both known and unknown, there were 400
studies in the peer reviewed literature. Now there are
1,300 studies in the peer reviewed literature.

So we, and Concerned Health Professionals of
New York, continued to edit and bring out new editions
of our compendium, which has the very sexy title
Compendium of Scientific Medical and Media Findings
Demonstrating Risk and Harms of Unconventional Gas and
Oil Extraction.

[Applause].

So Concerned Health Professionals of New York
partnering with Physicians For Social Responsibility,
who won the Nobel prize, right, for insisting that
nuclear war was unregulatable and needed simply to be
abolished, so they were our natural partners in making
the same case about fracking.

Our first edition of this was so slight we
I could staple it and mail it to the governor. Now you can see with 1,300 studies all peer reviewed and footnoted it's quite a mighty document. And now we keep bringing out these editions every year to help other states and other nations to provide them good data for their own fight.

But I guess I want to close this part of my talk off by saying, yes, science won a ban on fracking in New York state but science alone did not win. If science alone could make good public policy we would have solved the climate crisis and we would all be using solar power now, right. We had good science on climate at least 20 years ago, if not before.

But science together with activism was our winning combination. Activism and social change created the ability for science to speak so that the governor could announce that, yes, science -- that the science on fracking was troubling. There were public health risks and this became the way forward for our state.

And so now we're engaged in a process where we're trying to allow the governor to wear the mantel of climate hero. Turn our state into an incubator and laboratory for renewable energy.

This is the governor who saw sea water sloshing through our subway system after the 2012
hurricane Sandy. So we want him to play that role for
us.

At the same time, even though we banned
fracking, we haven't yet banned fracking infrastructure.
So New York state is still used as a staging ground for
pipelines, compressor stations, natural gas power plants
and gas storage depots are still being built-out.

My work involves fighting those too. And when
we fought against the gas storage facility that took
over the salt caverns underneath Seneca Lake, which is
where I live and a source of drinking water for 100,000
people -- so I'll back up and say a Houston based gas
company bought five miles of prime lake front property,
not because it enjoyed the view or loves our wineries,
but wanted to get access to the holes in the ground left
over by a century of salt mining and use those holes as
a gas station for the products of fracking before -- so
the price could go up before it could put it into
pipelines and send it to east coast markets.

Storing gas in what is called interbedded salt
and shale formations is one of the most dangerous ways
to store gas and has led to fatalities in other states.

So we thought that was a bad idea and we
attempted to do, for that fight, for what we were doing
with the fracking fight, which is to do really good
science on the hydrology of using salt caverns to store compressed gas, the flow of ground water, how our lake could become salinated, what would happen to the wineries, what would happen to air quality with the flare stacks and all the associated infrastructure, but we failed.

In this case the decider was not our state but rather the Federal Energy Regulatory Commission who simply said, after all of our testimony and all of the work we had done, we're simply not looking at that and went ahead and approved the project.

So then began a civil disobedience campaign. I decided if you wouldn't listen to my data as a biologist then you will listen to my mother's body. I gave birth just down the road from this facility in my son goes to summer camp not far away and there is no good evacuation plan. So I'll place my mother's body in between the truck with the drill head and the place where the truck with the drill head wants to go and the driveway of this facility.

Over two and a half years 650 people felt the same. So we had 650 arrests. And then the company decided to cancel its gas storage expansion plans.

[Applause]

There is something about 93-year old great-
grandmothers blocking your driveway that makes for really bad press. And I should say that that campaign involved a lot more than civil disobedience. It involved municipal ordinances. It involved the wine business coalition petitioning. A lot of things went on behind the scenes. The cinematic part of it, the part for which we got national/international media, were the arrests.

Civil disobedience is a powerful thing and I discovered I'm actually good at going to jail. I'm good at going to jail because I'm a good cancer patient. I know how to lie in an MRI machine motionless for 30 minutes. I know how to lie in bed with a Heparin lock and an IV drip with a backless blue cotton gown. I know how to push the IV drip down the hallway holding the back of my blue cotton gown shut with the other hand. And, thus, I'm good at shuffling up a set of stairs with ankle manacles and handcuffs. I'm good at being in a cell where the lights are on all night and the food is terrible because it's just like being in a hospital.

A hospital has a call button but they never answer it anyway. Jail cells don't but what's the difference, right? Probably the most relaxing two weeks I've ever spent.

So I want to ask you, What would you go to
jail for? Would you go to jail for water, to protect water, would you do that? Question for your discernment.

Now lastly I want to speak to you as a scientist. I've spoken to you as a writer. I have spoken to you as an activist. Now I just want to tell you some of the science of fracking and give you a flavor of this compendium of ours which has been submitted, by the way, as a testimony for the fracking tribunal. And here is how we talk about fracking in this document of ours.

Emerging trend No. 1. Growing evidence shows that regulations are simply not capable of preventing harm. Studies reveal inherent problems in the natural gas extraction process such as well integrity, failures caused by aging or the pressure of fracking itself and in the waste disposal process.

These issues can lead to water contamination, air pollution with carcinogens and other toxic chemicals, earthquakes and a range of environmental and other stressors inflicted on communities.

Some of fracking's many component parts, which include the subterranean geological landscape itself, are simply not controllable. Compounding the innate unpredictability of the fracking process, the number of
wells and their attendant infrastructure continue to proliferate, creating burdensome cumulative impacts. The size of individual wells keeps growing with the horizontal portions of a single well now exceeding as far as two miles or more underground. Fluid injections once typically three to five million gallons per fracked well can now easily reach 20 million gallons.

The injection of extreme volumes of fluids creates significant deformations in the shale that are translated upward a mile or more to the surface. Along the way these pressure bulbs can impact in unpredictable ways faults and fissures in the overlaying rock strata, including strata that intersect fresh water aquifers. Thus, pressure bulbs may mobilize contaminants left over from previous drilling and fracking and mining operations.

No set of regulations can obviate these potential impacts to ground water. No set of regulations can eliminate earthquake risks. Well sites leak far more methane and toxic vapors than previously understood and they continue to leak long after they are decommissioned. Abandoned wells are significant sources of methane leakage into the atmosphere. Based on findings
from New York and Pennsylvania they may exceed current
total leakage from oil and gas wells currently in
production.

Plugging abandoned wells does not always
reduce methane emissions and cement plugs themselves
deteriorate over time. Further, many abandoned wells
are unmapped and their locations unknown.

No federal or state agency routinely monitors
methane leakage from abandoned wells. Leakage rates
among abandoned wells are wildly variable. 4% of wells
nationwide are responsible for half of all methane
emissions from fracking operations. Predicting which
wells will become super-emitters is not possible.

Further much of this leakage is engineered
into the routine operation of fracking extraction,
processing and transport infrastructure as when vapors
are vented through release valves in order to regulate
pressure.

Here is another section. Emerging trend No.
4. Public health problems associated with drilling and
fracking include poor birth outcomes, reproductive and
respiratory impacts, cancer risks and occupational
health and safety problems.

Studies of mothers living near oil and gas
extraction operations consistently find impairments to
infant health, including elevated risks for low birth weight and pre-term birth.

A 2017 study that examined birth certificates for 1.1 million infants born in Pennsylvania found poor indicators of infant health and significantly lower birth rates among babies born to mothers living near fracking sites.

A 2015 study found a 40% increase in the risk of pre-term birth among infants born to mothers who live nearby drilling sites.

A 2014 Colorado study found elevated incidence of neural tube defects and congenital heart defects.

New studies in Texas and Colorado found associations with infant deaths, high risk pregnancies and low birth weight.

A 2017 pilot study in British Columbia found elevated levels of muconic acid, a marker of benzene exposure in the urine of pregnant women living near fracking sites.

An emerging body of evidence from both human and animal studies shows harm to fertility and reproductive success from exposure to oil and gas operations, at least some of which may be linked to a dozens of known endocrine disrupting chemicals used in hydraulic fracturing.
A 2017 Colorado study found a higher incidence of leukemia among children and young adults living in areas dense with oil and gas wells, while a Yale University research team reported that carcinogens involved in fracking operations had the potential to contaminate both air and water in nearby communities in ways that may increase the risk of childhood leukemia. The Yale team identified 55 known or possible carcinogens that may be released into the air and water from fracking operations. Of these 20 are linked to leukemia.

Other documented adverse health indicators among residents living near drilling and fracking operations variously include exacerbation of asthma, increased risk of hospitalization, ambulance runs, emergency room visits, self-reported respiratory problems and rashes, motor vehicle fatalities, trauma, drug abuse and gonorrhea.

Pennsylvania residents with the highest exposure to active fracked gas wells were nearly twice as likely to experience a combination of migraine headache, chronic nasal and sinus symptoms and severe fatigue. And it goes on.

So I have spoken to you as a scientist, as an activist and as a writer. And to close us out I'm going...
to do kind of a multi-media presentation and I am going
to go backwards starting with science and then activism
and then end with poetry.

For all of those listening around the world
who may be on the front lines we hope they're useful to
you.

So now I am going to show you -- that was me
as a scientist -- now I'm going to show you the trailer
for a new documentary film called Unfractured, which
just won a big award, by the way, as the best
documentary in a film festival in Dallas, Texas, Earth
X, which is actually interestingly partly sponsored by
the oil and gas industry.

And so I think I am impressed with the
independent mindedness of the jurors and the money
received by the filmmaker prompted her to turn around
and donate the prize money to front line communities
fighting fracking so that they can bring the film to
their communities for free. So she's doing 50 free
screenings with this.

And this documentary film tells the story of
how we won the fracking fight in New York state and it's
told through my eyes. It's just one person in a large
opera of people. So I'm the kind of through-line of the
story.
And during the time we were fighting fracking my husband suffered a series of strokes and is now disabled. I went to jail. And then there are our two children. So I was torn in a million pieces.

And at the same time I also traveled to Romania where a small impoverished community on the Moldavan border was fighting Chevron with all their hearts.

And then I was also a civil disobedient at Seneca Lake.

And I want to say that this film kind of braids together three stories, the fracking in New York, the story of the uprising in Romania, the story of civil disobedience at Seneca Lake, and in all three cases David beats Goliath and they end in victory for the people. So it's a film with a happy ending

[Applause].

So now, OK, I'm ready to show you.

[Playing of film and music].

And now I'm going to let poetry have the last word. In honor of the amazing music that we heard and the art that exists I would like to say biology and poetry are both about the mystery of being alive.

Biology likes to solve the mystery. Poetry simply says "Behold."
And Kathleen Dean Moore this is for you whose writing that I've learned so much from. It's a poem for the Marcellus. Marcellus is the name of my bedrock that I live above. And Marcellus, by the way, was named Marcellus because Marcellus is a Roman warrior who got too overconfident. Was actually run through by a spear on his own battlefield. And Marcellus also became, for Shakespeare, a character in Hamlet. He's the one that says, "There's something rotten in the state of Denmark." That's his line.

There's also a line in here from Shakespeare from Julius Caesar; "Oh pardon me thou bleeding piece of earth that I am meek and gentle with these butchers."

That's iambic pentameter but the rest of it is written in hip hop rhythm.

Marcellus below us.
Marcellus below us.
Marcellus, tell us who are you?
Older than fishes.
Older than spinal cord and bone and in the green day of trees.
Older than pollen dust, than seeds, bedrock of grief.
Subterranean coral reef.
Microbes and nanowires.
Electrically conductive hypersaline fires.
Marcellus our cellar.
Marcellus unlike us.
Fissured and fossilized sacrophagus of sea lilies and squid.
Ego and Id.
The whole periodic table and you; uranium, barium, radium, lead.
Marcellus home of the dead.
Toluene, mercury, benzene, brine, arsenic.
The River Styx 500-million years thick.
In you, Eurydice, Hades, Moloch, Charon's boat. Hades, Moloch, ransom note.
Marcellus deserved the name given him who waged war and gained fame for the sacking of Syracuse with the Battle of Gaul only to lose to an enemy and fall at home.

No exit plan.
Some say your success was embellished.
General Marcellus tell us who called you the sword of Rome?

Saudia Arabia below our feet.
A prolific monster says Wall Street.
A sure thing. A shale.

1           Place your bet.
2           Marcellus, a minor character who guides Hamlet
3      away from his father's ghost.
4           Here, sign this lease and let's make the most
5           of it.
6           Enter now Mark Anthony breaking bread with
7           Bobby Kennedy.
8           Jealous.
9           Et tu Marcellus.
10           Oh pardon me though bleeding piece of earth
11      that I am meek and gentle with these butchers.
12           Hades, Moloch, Charon's boat.
13           Oh pardon me though bleeding piece of Hades,
14           Moloch, ransome note.
15           Piece of earth that I am meek and gentle with
16           these butchers.
17           Marcellus who are we?
18           Drill, syringe, derrick vein.
19           Two junkies argue how many carbon atoms can
20      dance on the head of a pin?
21           Marcellus, quick, tell us.
22           I hear the trucks. They're not far.
23           The plan is to reduce you to rubble.
24           There is no Hubble telescope for you.
25           No 24-hour spill cam for us.

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Are you a box inscribed with the name Pandora
or a scroll on which is written the names of us
all?

Holy the rock and the fissure and the salt and
the diatoms fall.

Holy the unfractured.

Holy the wall between you and us, Marcellus.

Holy the cave.

Holy the soluble.

Holy the hall.

Holy the unmapped and abandoned well.

Hell, I know you're down there.

Mom always said don't blow up the basement.

Hades, Moloch Charon's boat.

Hades, Moloch, ransom note.

Let me love you from a long way up.

Holy the water.

Holy the cup.

Thank you.

[Applause].

You guys know how to clap. Thank you.

So I've been given the high sign for a few
comments and questions and I can't see you very well.

Is there a way to put the house lights up in here.

MS. CARLY LETTERO: If we can get the
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house lights up and I have a mic. If you would like to
raise your hand I can come to you if you have a
question.

MS. ALLISON MILLER: Thank you and thank
you for a wonderful evening and incredible, incredible
gift you've given all of us tonight.

My name is Allison Miller and I am a sister of
Tony Flagg. He's a CEO for United Grain, which is a
wheat company right out of Vancouver and it's owned by
the Japanese and they grow wheat in the northwest and
they have a rail car system that is all their own.

And one day my brother called me and says I
was so excited. I wrote a contract with a fracking
company allowing them to use our grain cars to hall
their fracking sand while we're not hauling grain.

Were you aware of that? I was floored.

DR. SANDRA STEINGRABER: No, I didn't
know that. Thank you.

I mean fracking turns things inside out, not
just our bedrock, right? I mean I can tell you that in
2011 when I went through Texas at the beginning of my
study on fracking there was a terrible heat wave and a
drought that summer. It was 109 degrees as I drove
through the panhandle and there were fracking trucks
full of water going to the fracking sites even as the
rest of the landscape they were driving through looked
like a moonscape of cracked earth with like dead cattle
and people had handwritten signs in their front yard
that said "I need water. You haul.. I pay." And yet
there was still water to take to the fracking sites.

So I think the reprioritization that fracking
has brought, you know, no grain, but sand. We're dying
from lack of water but there's water to blow a part the
beckrock. This is part of the human rights issue, the
abrogation that is fracking.

Thank you for telling us that.

What else?

AUDIENCE MEMBER: You're an amazing,
inspirational person and I've been just awed by you
tonight as I'm listening to you talk about fracking. I
work on nuclear history so I see a lot of resonance
between what you're saying about contamination and I'm
wondering if you connect -- the contamination that we're
seeing today does it start with nuclear weapons, that
allowing of radiation, that allowing of contamination?

It seems to have expanded and expanded from
that point but I just wondered what you thought about
those connections and because we're talking about
climate change and very often a solution to climate
change is given as nuclear power.
DR. SANDRA STEINGRABER: Yeah, we can talk about that a bit.

So that connection was certainly clear to Rachel Carson, right. So she herself had her eyes opened by the atomic age. And the way it was opened was that it was a new idea in the 1950s that you could detonate an above ground nuclear device three time zones away and then the radioactive strontium in baby teeth shed by children a few months later in the east coast would go up.

And so now we understand how that is connected. Radioactive strontium is released into the upper stratosphere. It's carried by the prevailing winds west to east. It sifts down into grass. The cows eat the grass. Strontium follows calcium into bone and into breast milk and so it ends up into the cows' milk, children drink the milk, it ended up in their skeleton including in their teeth. They shed them. They put them under their pillows.

And there was an initiative at the time of scientists who were collecting baby teeth that parents would send in, the Tooth Fairy Project or something like that, and they could see spikes in radioactivity among children following, you know, the appropriate time lags, following these explosions.
And that changed Rachel Carson's thinking because it was just a new idea that something that happened half a continent away could change the ecology here. And she began to apply that thinking to pesticide drift.

In fact I'll just read you -- Rachel Carson, by the way, was keeping two secrets. I'll probably need reading glasses for this. She was keeping two secrets while writing Silent Spring.

One, that she was dying of breast cancer and she did not want her enemies in industry to know that because she feared that her scientific objectivity would be called into question. Her science would be impeached and it would allow them to further discredit her.

And the other secret was that she loved a woman whose name was Dorothy Freeman. And they wrote love letters back and forth to each other. And Rachel tried out her ideas on Dorothy. And one of them was to tell Dorothy about how the atomic age had altered her thinking.

And that's the passage that I have in mind to just read to you because reading it she could -- I mean, well, see what you think. It seems to me that she could have written it today and it still has resonance for us with climate. So she writes this.
"I suppose my thinking began to be affected soon after atomic science was firmly established. Some of the thoughts that came to me were so unattractive that I rejected them completely.

"It was comforting to suppose that the stream of life would flow on through time in whatever course that God had appointed it. And to suppose that however the physical environment might mold life that life could never assume the power to change drastically or even destroy the physical world.

"These beliefs have almost been part of me for as long as I have thought about such things. To have them even vaguely threatened was so shocking that, as I have said, I shut my mind. I refused to acknowledge what I couldn't help seeing. But that does no good and I have now opened my eyes and my mind and may not like what I see but it does no good to ignore it.

"So it seems time that someone wrote of life and the light of the truth as it now appears to us."

So that's kind of what gave her the courage to write Silent Spring.

And as for your other question we don't need nuclear power to replace fossil fuels. I mean that's really clear. That's really clear.
If you -- you don't need to take my word for it check out the Solutions Project. The Solutions Project.org, which is an initiative, an on-line initiative that kind of does for renewable energy what we tried to do with the compendium. In other words, take a lot of complicated science and make it really easy to understand.

And in the case of the Solutions Project it's an on-line initiative with all kinds of visuals. And so one of the scientists involved is my colleague Mark Jacobson, a physicist at Stanford. And so he has worked out a proposal, a blueprint for how each state of the Union could entirely switch over and decarbonize and get off fossil fuels and go completely renewable, including transportation, and how you would do it. How you would finance it. How long it would take. How many jobs would be created. So the economics are all there.

And my state of New York, for example, would rely quite a lot on offshore wind. I haven't looked at what the portfolio is for Oregon but I commend it to you to take a look.

Mark is very clear that you don't need nuclear to get there. So that's a lot of good news.

And that doesn't mean that we have to rely on
batteries or things that haven't been quite -- that
aren't deployed yet. This is like on the shelf
technology that we have now that, of course, as we adapt
it it will get better as we go.

But, in other words, the good news is we don't
have to wait for technological breakthroughs.
Everything we need is right here and the economics all
work as well as the science.

So there is a lot of good news out there. So
it's our job, it's our life's work as the adults who
happen to be alive at this moment in history where we
have about ten years to get off of carbon before we hit
those runaway tipping points. And then no matter what
we do, you know, it's a runaway train. Then it becomes
a real tragedy. But we're not in that doom place yet.

So if we're not in it then it's ethically our
responsibility to make sure we don't -- you know, the
canoe doesn't go off the edge of the cliff. And so we
have to paddle as fast as we can.

So, again, I invite you all to think about
what you would go to jail for. What other skill sets do
you have that you can apply to this great historical
moment where we are going to divorce our economy from
its current ruinous dependency on fossil fuels.

And, I mean, the fossil fuel party is over.
It's just that those guys aren't leaving the stage, right? They're not going to self-deport. And so we have to get very creative at pushing them off and ushering the renewable energy in.

And I think there are many kind of ideas for how to do this but the Solutions Project is as good as any place to start. If you're new to this I would just Google that and see what you think.

MS. CARLY LETTERO: Thank you, Sandra, and thanks to every one for coming this evening. Sandra is going to be up here up front to sign books and Sierra is going to be at that table from Grassroots to sell books.

The show is still upstairs for a little bit so I invite you to check out the Pop Up Gallery if you haven't done that.

Thanks for coming everyone and thank you.

DR. SANDRA STEINGRABER: You're welcome.