



PK-12
EDUCATION
AS A PILLAR
OF THE
SOLUTION
FOR BENDING
THE GLOBAL
WARMING
CURVE

Author: V. Ramanathan

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Climate change is an urgent problem. Because it is causing new weather extremes and fatal catastrophes, climate change is better termed climate disruption.

Bending the curve to flatten the upward trajectory of pollution emissions responsible for climate disruption is essential for protecting billions of people from this global threat.

Education must become a pillar and an integral part of the solution.

V. Ram Ramanathan

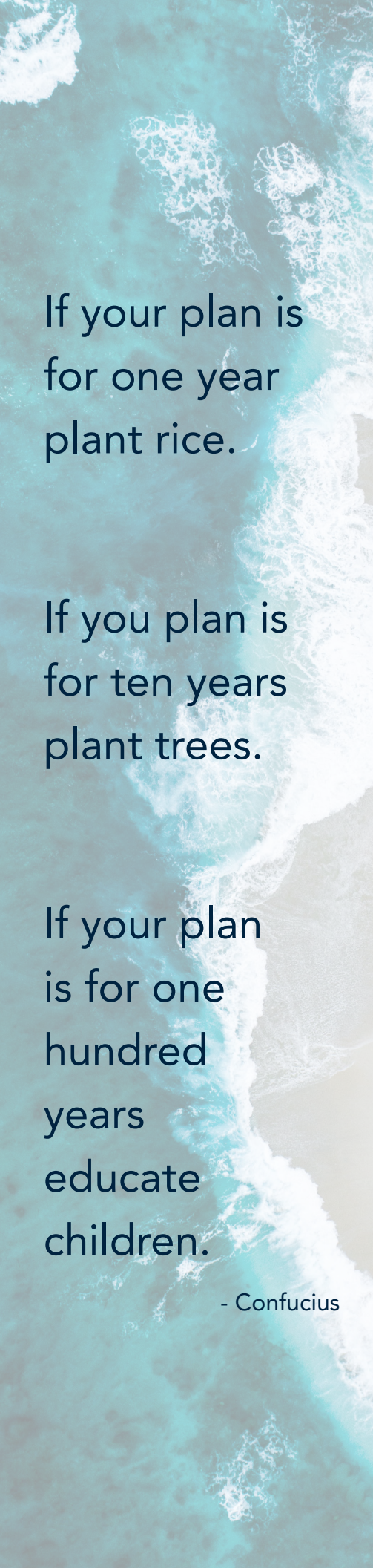
I started working in the field of climate change more than 45 years ago when I published a paper on the discovery that chlorofluorocarbons, or CFC's, are super-greenhouse gasses that are 10,000 times more potent than CO₂. Then in 1980 I published an article in the journal Science predicting that by the year 2000 we would detect warming due to CO₂. In 2001, the Intergovernmental Panel on Climate Change (IPCC) verified the 1980 prediction and published data showing "unequivocal" warming of the planet. Over the intervening years I have continued this work, collecting data on the infrared heat trapped by pollutant gases and on climate feedbacks using satellites, aircraft, ships, and drones. All of these measurements document humanity's increasing contributions to climate warming. We know that humans have added more than 2 trillion tons of CO₂ to the atmosphere since 1750, mainly through fossil fuel combustion, deforestation, and other industrial sources. We also have direct observations

of the ever increasing greenhouse effect, the effects of amplifying feedbacks, and the disruptions to the global and regional balance of heat energy and the hydrological cycle.

Based on analyses of these data collected over decades, a student of mine and I published a study in 2017 concluding that if we continue on the present course, there is a 5% probability that humanity will be facing extinction. This 5% probability, that is one in twenty odds, can happen 50

years from now. That's a mathematical way to say it, but what does it really mean? To me, this metaphor captures it. If someone tells us that there is a 1 in 20 chance that the airplane we are getting on is going to crash, none of us would get on it. Even if they tell us there is a 1 in 100 chance, we still wouldn't get on that plane. We wouldn't get on that plane for even a 1 in 1000 chance. But we are sending our children and grandchildren on that plane without a second thought. I have four grandchildren and that is the nightmarish prospect I am constantly worrying about.





If your plan is
for one year
plant rice.

If you plan is
for ten years
plant trees.

If your plan
is for one
hundred
years
educate
children.

- Confucius

Part of the problem today is that for most of us in the US, the impacts of the crisis are manifesting themselves in our everyday lives in ways that don't immediately cause us to fear for our survival. That's not true for everyone. We know that the more immediate impacts of climate change disproportionately impact the poorest members of our global society, many of whom are living on the edge of survival right now. These are the people who suffer first from the devastating consequences of climate change including drought, sea level rise, extreme weather, food insecurity and other climate catastrophes. To many in more affluent communities, those consequences seem a distant threat; however in the coming decades, unless drastic action is taken, we will all be suffering the consequences. We published a study in 2018 in *Nature*, showing that without changes in greenhouse gas emissions, the planet would reach 1.5 °C warming by 2030, which is ten years from now. That's a 50% amplification of the warming we have experienced up to 2015, which is 1°C. When that happens, and it will happen (my probability is at least 50% if not more), climate disruption won't be happening only to people on another continent, or one hundred miles away, it will be happening to all of us. Each of us will be impacted by those climate extremes in one way or another, just like the 2020 COVID pandemic has tied us to all our living rooms. By 2030, climate disruption will be in our living room.

The conclusion that the climate crisis is an urgent problem is irrefutable. So, how do I still continue working on this area? Because there is hope. There is still time. That is why in the last 10 years I have switched my interest from documenting the climate change problem to solving it, both scientifically and socially. Scientists continue to make inroads on a wide range of scientific solutions; however it is now crystal clear that this is insufficient and that the solutions to climate disruption must include a fundamental societal transformation, and as you'll read in the next two articles, climate justice has to be an integral part of the transformation. Such a transformation will require children, adults and entire communities to make real changes in their personal choices, cultural practices, and policy decisions. It will require a recognition that many resources are limited and must be protected for future generations, a widespread movement to protect and sustain vulnerable natural systems, and a will to work across national borders toward global sustainability. And that is where you come in. These changes will be impossible without dedicated support from you, our educators.

We as adults have collectively contributed to the crisis, and are now morally obligated to work tirelessly to provide the next generation with the tools they will need to meet the coming challenges and bend the global warming curve. The climate crisis is an urgent problem requiring urgent solutions. In addition to science and governance, education must be one of the pillars to solving this existential crisis.

As teachers, you are on the frontline in the fight against climate disruption. Education on the climate crisis and the multifaceted solutions necessary for a sustainable planet must start at pre-kindergarten (PK)-12 and continue through adulthood.

Every student must have the opportunity to become climate literate and to act on what they learn for the common good. Teaching students about climate change, especially environmental sustainability, must become a central goal of our education system. It must be woven seamlessly across the curriculum, and ultimately encourage youth to take an active part in the search for ways to limit and reverse environmental degradation.

None of this can happen without you. We must all work together to empower future generations with the tools they need to become good stewards of our planet. It is now inherent upon all of us to work together to ensure that you, as frontline educators, have the support, resources and learning opportunities that you need to be able to engage and inspire students to help achieve the societal transformation necessary to battle climate change. Students need to understand how science works and how it can inform decision making when it comes to climate disruption. They need to fully appreciate the relationship between human activities, including their own, and a sustainable planet. And they need to understand the actions that they can take to make a difference. We need climate warriors. When equipped and given the opportunity, our youth can be powerful change makers within their communities and around the globe.

To do this, we need your help to embrace and refine current efforts. We are not starting from scratch. Educational initiatives that focus on climate already exist to take on this work – such as the Education and the Environment Initiative, the Blueprint for Environmental Literacy, the California Regional Environmental Education Community Network and the California Association of Science Educators (CASE) Climate Summit project. We, at the University of California, also have launched Bending the Curve:

Climate Change Solutions, a multifaceted education project across all ten campuses of the UC system that is centered around curriculum designed to empower a million climate champions across the world to solve the climate change problem. This course is taught in campuses of the University of California, two and four year colleges in San Diego, Stockholm University, Taiwan and Nigeria. There is also a MOOC version that can reach out to students and adults all over the world.



And in 2019, the CSU and UC systems came together with key stakeholders to launch the Environmental and Climate Change Literacy Project and Summit (ECCLPS) to support the critical need to advance PK–12 environmental and climate change literacy by focusing on the preparation of current and future teachers to respond to these urgent issues.

Through all of this we must give young people not only the tools they need to confront this crisis, but most of all a sense of hope and agency, and that's perhaps where we need your expertise the most.

We need you.

BIOGRAPHY

Dr. V. Ram Ramanathan is a Distinguished Professor of Climate and Atmospheric Sciences, Scripps Institution of Oceanography, UC San Diego.

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Redcharlie
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Shifaaz Shamoan
Markus Spiske