Study Guide for “Losing Earth: The decade we almost stopped climate change”

The Antarctic Peninsula, where about three million pairs of penguins breed, is one of the most quickly warming areas on the planet; its average temperature has increased by five degrees Fahrenheit over the past 75 years. Many scientists believe that this warming will endanger some penguin colonies in two ways: dwindling food and loss of nesting habitats. On the rocky shores of Deception Island, where the penguins breed, they need cold, dry land for their eggs to survive, but rising temperatures have introduced rain and pools of water to nesting sites. And because of the rapid loss of sea ice, krill — the tiny crustaceans that serve as penguins’ main source of food — can’t sustain the large colonies they need to thrive. The penguin population of Baily Head, in the northern part of Antarctica, seems to have dropped from 85,000 breeding pairs in 2003 to 52,000 seven years later, a decline of almost 40 percent. Scientists fear that as warm water shifts farther south along other coastal regions, larger populations of penguins could face a similar decline. Image by George Steinmetz. Antarctica, 2017.

These materials were created to support “Losing Earth” by Nathaniel Rich and George Steinmetz, published in *The New York Times Magazine* August 1, 2018. You can find this and more educational resources at www.pulitzercenter.org/nytclimate

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A Brief Introduction to "Losing Earth"

The years from 1979 to 1989 were critical for climate action. At the start of this decade, scientific consensus about global warming was beginning to emerge. By the middle of the decade, the scientific community understood with unprecedented clarity that human activity was contributing to a rapid derangement of the natural world, one that would threaten economic and societal collapse if left unchecked. But efforts to marshal the political will and industry support to change course all failed.

In "Losing Earth: The decade we almost stopped climate change," an authoritative piece that takes up an entire edition of *The New York Times Magazine*, Nathaniel Rich reveals how the current narratives and arguments around climate change were formed, and why this problem has remained so difficult to solve. In this 5 minute video, Rich introduces the story and reflects on its central questions.

"Losing Earth" and these accompanying education resources enable teachers and students to have bold conversations about climate change, the media's role in shaping discourse about the issue, and the political willpower needed to enact critical environmental policy.

"Losing Earth" Full Text Summary

1.1: 'This Is the Whole Banana' (Spring 1979)

In spring 1977, Rafe Pomerance and Betsy Agle, coworkers at the non-governmental environmental organization Friends of the Earth, read an EPA publication where the author "noted that the continued use of fossil fuels might, within two or three decades, bring about 'significant and damaging' changes to the global atmosphere" (11). Pomerance was surprised that the two of them had not heard of this issue since they were environmental lobbyists. He contacted geophysicist Gordon MacDonald to learn more about the greenhouse effect.

In 1977 and 1978, MacDonald and other members of JASON, an elite team of scientists, wrote a report on the long-term impact of carbon dioxide on climate. This report indicated that as concentrations of carbon dioxide in the atmosphere increased, so would the global temperature, resulting in worldwide catastrophes. The report had been shared widely among U.S. government agencies, but no action was taken by scientists or policymakers. Pomerance and Gordon began presenting this information to government officials and members of the press to raise the profile of the issue. President Carter's Office of Science and Technology Policy decided to commission a group of scientists headed by Jule Charney to study whether the situation was as dire as MacDonald predicted.

1.2 The Whimsies of the Invisible World (Spring 1979)

James Hansen was a scientist at NASA's Goddard Institute for Space Studies in Manhattan who studied how the concentration of carbon dioxide impacted the surface temperature of Venus and other planets. As NASA expanded its study of earth's atmospheric conditions, Hansen utilized new data on Venus's atmosphere from the Pioneer spacecraft to create computer models of how humanity impacted the Earth's atmosphere.

1.3 Between Catastrophe and Chaos (July 1979)

Jule Charney and the group of scientists he selected to review all available science on the greenhouse effect met at Woods Hole, MA in July 1979. While researchers had raised the specter of global warming in the past, they had also emphasized the uncertainty of their predictions. Uncertainty is an integral part of climate science modeling since it relies on predictions and/or approximations. This is why the JASON prediction of global warming ranged from two to three degrees. "Charney's scientists were asked to quantify that uncertainty" (17).

Before the meeting, Charney asked Hansen to use computer simulations to model a future with double the amount of carbon dioxide in the atmosphere. Hansen's simulations predicted a four degree Celsius global temperature increase, twice as much as the prediction made by scientist Syukuro Manabe, who was the first to model the greenhouse effect. Another computer modeler at Woods Hole, Akio Arakawa, thought the best estimate lay between Manabe and Hansen's

models. He predicted that "global temperatures would increase between 1.5 and 4.5 degrees Celsius with the most likely outcome a warming of three degrees" (20).

The Charney report, "Carbon Dioxide and Climate: A Scientific Assessment," was published a few months later. It stated that when the amount of carbon dioxide doubled, the planet would most likely warm by three degrees Celsius. The report was accepted by the federal government, the scientific community, and the oil and gas industry as settled fact.

1.4: 'A Very Aggressive Defensive Program' (Summer 1979-Summer 1980)

After the release of the Charney report, multinational oil and gas corporation Exxon created its own carbon dioxide research program to understand how much of the problem the company could be blamed for and how future restrictions on carbon emissions could impact its business. Exxon had already been studying the carbon dioxide problem and its scientists had published a study on the relationship of fossil fuel consumption and concentrations of carbon in the atmosphere in 1957. The American Petroleum Institute also investigated the issue and concluded that the burning of fossil fuels led to global warming.

However, members of the oil and gas industry did not act on this information during the mid-twentieth century. They argued that people would learn to live with global warming and that if nobody in the U.S. government or the environmental movement worried about rising global temperatures, neither should they. These companies had other critical issues to worry about and people were concerned that reducing or halting energy production would slow economic growth. The acceptance of the Charney report changed the industry's perspective because companies feared that blame for warming would fall on them and new policies designed to combat the greenhouse effect would impact their business.

Government agencies, scientists, and politicians did begin to respond to the Charney report in 1980. The first congressional hearing on the greenhouse effect was held in April, President Carter directed the National Academy of Sciences to study climate change in June, and the National Commission on Air Quality invited climate experts to propose policy at a meeting in October. "It seemed that some kind of legislation to restrict carbon combustion was inevitable" (21).

1.5: 'We Are Flying Blind' (October 1980)

The meeting to create U.S. climate policy convened in Florida at a hotel locals call the Pink Palace. The group included policy experts, scientists, government officials, an Exxon senior researcher, and Rafe Pomerance. They had three days to create a policy addressing climate change from scratch. Everyone seemed to understand the urgency of the problem and the need to develop a solution at the meeting, but nobody could agree on what to do. How could you end fossil fuel production without the collapse of the economy? What energy technologies would

take the place of coal, oil, and gas? How much atmospheric carbon dioxide would be safe? Once policy was proposed, would the issue be politicized?

The EPA moderator running the meeting, Thomas Jorling, suggested that the group avoid proposing specific policy since they were having so much trouble agreeing on anything. Instead he suggested that others could worry about the specifics of climate and energy policies. Pomerance worried that if they did not suggest any concrete policies, nothing would ever happen, but most of the others seemed content with Jorling's idea: "If changes did not occur for a decade or more . . . those in the room couldn't be blamed for failing to prevent them. So what was the problem?"(26) As a compromise, Pomerance requested that the group consider modest ideas like a carbon tax or organizing an international summit on climate change before they began drafting the final statement.

When the experts regrouped to write their final statement, they could not even get past the first paragraph's language about the likelihood of climate change occuring. Despite agreeing on the existence of global warming, the role of atmospheric carbon dioxide, and that climate change would have profound effects on the earth and its inhabitants, they never drafted any policy proposals or even a second paragraph. The final product of the meeting was a weakly worded statement questioning whether enough was known about climate change to make policy recommendations. Only Jorling signed it. Pomerance left convinced that strong leadership was needed before anyone would act on the issue, and he hoped to find someone to fill that role.

1.6: 'Otherwise, They'll Gurgle' (November 1980-September 1981)

Four days after the Pink Palace meeting, Ronald Reagan was elected president and he began to roll back environment protections by appointing officials to the Interior Department and EPA who supported fossil fuel production and deregulation. Even moderate and liberal members of the Republican Party worried about the administration's aggressive deregulatory policies.

While the Reagan administration aimed at eliminating environmental protection laws and regulations, policy experts and the press continued to discuss the Charney report, though with little regularity. Pomerance knew that in order to push a legislative solution, climate change needed more news coverage. In August 1981, he read about a forthcoming paper on global warming by James Hansen and called to ask for a meeting.

During their meeting, Pomerance realized that Hansen had a talent for translating complex science into plain English. Hansen could be the voice that the climate change movement needed to raise the profile of the issue. He would also benefit from bringing visibility to his work.

The Reagan-appointed director of the Department of Energy's Carbon Dioxide Program, Fred Koomanoff, had already summoned Hansen to Washington to justify his departmental funding. Hansen was worried that his office would be defunded as part of the administration's effort to slash the federal budget and undermine federal environmental policy and research.

1.7: 'We're All Going to Be the Victims' (March 1982)

The White House's plan to eliminate the Carbon Dioxide Program gave a young congressman from Tennessee named Al Gore an opportunity to hold a congressional hearing on the greenhouse effect. Gore became interested in the greenhouse effect during college, and as the chairman of an oversight subcommittee in the Committee on Science and Technology, he could quickly put together a hearing designed to shame the White House into continuing to fund the program. Gore knew that political theater needed both a hero and a villain. He intended for Hansen to serve as the hero scientist while Koomanoff played the villain bureaucrat. Both were asked to testify at the hearing.

On March 25, 1982, Hansen testified for the subcommittee and a thinly populated audience. Both the Republicans and Democrats in attendance agreed that the greenhouse effect was a problem, but while Republicans pushed for action, the Democrats on the subcommittee argued for more studies. The invited experts sided with the Republicans because they believed that the longer politicians waited to act, the worse the outcome would be. Researchers could debate about whether observable climate changes would occur in one decade or in a few decades. However, from a geological perspective where time is often measured in intervals of million of years, the difference between ten and thirty years was negligible. The time for action was now.

1.8: 'The Direction of an Impending Catastrophe' (1982)

The hearing was a public relations success for Gore, but Hansen's carbon dioxide research remained unfunded. While he remained a government employee, Hansen was contacted by a possible source of external funding: Exxon. The oil company had committed more money to global warming research and offered to fund a climate change summit organized by Hansen. Edward David Jr., the president of Exxon's research division, gave the keynote address in which he "pledged that Exxon would revise its corporate strategy to account for climate change, even if it were not 'fashionable' to do so. As Exxon had already made heavy investments in nuclear and solar technology, he was 'generally upbeat' that Exxon would 'invent' a future of renewable energy" (32). Congressional Republicans rejected many of the White House's plans to roll back EPA regulations and expand fossil fuel production. In addition, public awareness of the carbon dioxide issue was increasing. Hansen hoped that all of these factors would force the Reagan administration to reexamine its energy and environment policies and lead to policies designed to combat climate change.

2.1: 'Caution, Not Panic' (1983-1984)

After the release of the Charney report in 1979, President Carter asked the National Academy of Sciences to conduct a comprehensive analysis of the greenhouse effect. Over the next three years, about 100 experts, including members of the Charney group, created a new report. The Reagan administration said it had not been ignoring the carbon dioxide problem, it had just been

waiting to consider climate policy until the report was published. Companies like Exxon and General Motors, and activists like Rafe Pomerance, also eagerly awaited the report.

The 496-page report, "Changing Climate," was distributed on October 18, 1983. While it was comprehensive, there was no significant new information in it. The report provided the same results and conclusions presented in the Charney report and other government publications on the greenhouse effect. In the document, committee chairman William Nierenberg, wrote that urgent action was needed, but in public, he downplayed the immediacy of the problem and argued that future generations would be better equipped to handle the challenges brought by climate change.

The press chose to focus on Niernberg's downplaying comments rather than the content of the report, so the message the American public received was that while global warming might be a problem in the future, nothing had to change in the present. The Reagan administration "used Nierenberg's optimism as reason to ignore the EPA's 'unwarranted and unnecessarily alarmist' report and warned against taking any 'near-term corrective action' on global warming" (38). The lack of response to the report also impacted the fossil fuel industry's stance on carbon dioxide research and energy development. Exxon reverted back to focusing on carbon-based fuels, as did other oil, gas, and coal companies and industry groups. Though "Changing Climate" concluded that the greenhouse effect existed and it would cause global temperatures to rise resulting in climate change, the messaging that nothing could be done at the present led politicians, the public, and companies to drop the issue or continue to ignore it.

2.2: 'You Scientists Win' (1985)

While concern about the greenhouse effect receded, a new atmospheric disaster emerged in the public consciousness. A group of British scientists wrote a paper about the decreasing concentration of ozone in the atmosphere, which could lead to a rise in skin cancer, a decline in agricultural products, and the end of the marine food chain. The alarming concept of a hole in the ozone layer (despite there being no specific hole) scared people. The accompanying visuals, including colored imaging that showed a dark void over the South Pole, cemented the concept that the atmosphere had been ripped or torn by man-made chlorofluorocarbons (CFCs) used in refrigerators and aerosol cans. Intergovernmental agencies like the United Nations Environment Program had already tried to reduce CFC emissions, but only after the public became concerned about the ozone hole were they successful. Despite protestations from companies that used CFCs in the U.S., the Reagan administration proposed a 95% reduction in CFC emissions as part of an international treaty. Public pressure had been successful in driving political action on the environment, even in the face of corporate resistance.

Many of those involved in the fight for ozone policy thought that they could use the momentum to fight for carbon dioxide reduction policy too. At one international meteorological meeting in 1985, those in attendance took the unusual step of discussing climate change policy in addition to the science of climate change. They wanted people to use their research to take action, not just sit by while the world warmed. The final report from the meeting warned that while some

warming would happen no matter what, aggressive national and international policies could prevent the worst consequences. The ozone problem and the international treaty to reduce CFC emissions could serve as a template for a global treaty to cut carbon emissions and limit global warming.

2.3 The Size of the Human Imagination (Spring-Summer 1986)

Rafe Pomerance, now with World Resources Institute, reluctantly decided to use the ozone issue to revive discussion of carbon dioxide policy. He was concerned that if both issues were presented together, people would conflate the two issues. Despite his concern, Pomerance persuaded Senator John Chafee to hold back-to-back hearings on ozone depletion and carbon dioxide in June 1986. A new animated simulation of the "ozone hole" over the South Pole provided a more powerful visual of the problem. If "earlier colorized images were crime-scene photographs, Watson's video was a surveillance camera catching the killer red-handed" (42). Despite the fact that ozone researchers used a simulation just like the Charney group had used to predict global warming, the visualization of the simulation made the results seem not only conclusive but of the utmost urgency.

As Pomerance suspected they would, people did conflate the two crises. However, their confusion actually worked in his favor. Despite the fact that the scientists' testimony did not present any new information on the greenhouse effect, the hearing was packed and the newspaper headlines the next day emphasized the urgency of the problem. In his opening statement, Senator Chafee urged governmental action on climate change and to reach out to the Soviet Union to craft an international treaty restricting carbon emissions. Other experts and politicians at the hearing echoed the need for immediate action. Pomerance marveled at the broad attitudinal shift and attributed it to the visualization of the ozone hole. The old saying is that people believe what they can see, and in this case, that seemed to be true.

2.4: 'Atmospheric Scientist, New York, N.Y.' (Fall 1987-Spring 1988)

After signing the Montreal Protocol of 1987, a treaty limiting the use of CFCs, most people believed that the next treaty to be signed would be a limit on carbon emissions. Congress held eight days of climate hearings across three committees in the Senate and the House and both bodies began deliberating on legislation. At a conference on climate change in October 1987, James Hansen noted that the event was sponsored by BP America, General Electric, and the American Gas Association. The 250-person audience included veteran climate scientists, politicians, activists from environmental organizations including Rafe Pomerance, executives from fossil fuel and energy companies, and officials including Fred Koomanoff and his counterparts from Western Europe and the Soviet Union. Speakers expressed the hope that these various stakeholders could work together to address climate change and researchers presented their latest work. A solution seemed possible.

However, Hansen's optimism was short-lived. He was scheduled to testify before the Senate Committee on Energy and Natural Resources in early November and he had submitted his formal statement for approval by the White House's Office of Management and Budget (OMB). Usually the agency rubber-stamped his document and sent it back, but this time the White House demanded he change his testimony, censoring scientific findings about global warming with no explanation. Hansen refused to make the changes, so a NASA administrator suggested he testify as a private citizen. The OMB could restrict a government witness but had no control over what a private citizen said.

At the hearing on November 9, 1987, Hansen was introduced as a scientist from New York and he was prepared to tell the committee that "although his NASA colleagues endorsed his findings, the White House had insisted he utter false statements that would have distorted his conclusions" (46). However, none of the senators asked him why he appeared as a private citizen rather than as a NASA scientist. While he was ultimately able to present his research, the censorship bothered Hansen. It was evidence that someone in the White House hoped to prevent a debate over climate change legislation even though the effort had broad support with politicians from both parties.

In March 1988, 42 Republican and Democratic senators demanded President Reagan call for an international treaty on carbon emissions. In May, the president signed a joint statement with the leader of the Soviet Union that included a vow to cooperate on global warming, but no specific policies were included. Despite all the hearings, the cooperative conferences, public support, and bipartisan calls for action, nothing had actually happened to change energy consumption and reduce carbon emissions.

2.5: 'You Will See Things That You Shall Believe' (Summer 1988)

The summer of 1988 was unbearably hot and dry. Wildfires spread across the country. Droughts left crops withered and riverbeds dry. Temperatures soared. On June 22, James Hansen told Rafe Pomerance that the most recent temperature data indicated that 1988 was on pace to be the hottest year ever. He planned to incorporate this information in his testimony the next day as proof that global warming was happening.

2.6 'The Signal Has Emerged' (June 1988)

Hansen believed that the heat was not random, but rather a signal of climate change. He planned to say as much at the Senate hearing on June 23, 1988. He was the first speaker and star witness at the hearing, and his statements were clear. He said that "the warming trend could be detected 'with 99 percent confidence,' and that the greenhouse effect 'is already happening now.' But he saved his strongest comment for after the hearing, when he was encircled in the hallway by reporters. 'It is time to stop waffling so much,' he said, 'and say that the evidence is pretty strong that the greenhouse effect is here'" (47).

2.7 'Woodstock for Climate Change' (June 1988-April 1989)

There was hope after the hearing that legislation with specific targets for reducing carbon emissions would be passed. Rafe Pomerance proposed a 20 percent reduction by 2000, which he believed was plausible based on current technology and knowledge. He brought up this proposal with everyone he met at Canada's Conference on the Changing Atmosphere a few days after the Senate hearing. By the end of the conference, all 400 scientists and politicians at the meeting signed the final statement calling for a 20 percent reduction in carbon emission by 2005.

As a result of Hansen's testimony and the conference statement, public awareness of the greenhouse effect increased. In Congress, action to determine the amount of carbon emitted by Americans and how it could be reduced by 20 percent was proposed. Global warming became an important subject on the presidential campaign trail and George H.W. Bush, the vice president and Republican presidential candidate, embraced it. Fossil fuel companies resigned themselves to the likelihood that new taxes or regulations were imminent. Thirty-two climate bills had been introduced by the end of 1988 and it seemed inevitable that one or more would be signed into law.

Other countries acted too, with either domestic legislation or calls for an international treaty on the atmosphere. The United Nations also got involved in the climate policy effort. At a meeting of the Intergovernmental Panel on Climate Change (IPCC), James Baker, the new Secretary of State, declared that the world "can probably not afford to wait until all of the uncertainties about global climate change have been resolved" (51). This urgency was shared by much of Congress. In April 1989, 24 Republican and Democratic senators asked President Bush to cut emissions in the U.S. and follow through on the promises he made about environmental policy on the campaign trail.

2.8: 'You Never Beat the White House' (April 1989)

While many American politicians had accepted the science presented on the greenhouse effect and climate change, not all of them had. John Sununu, Bush's chief of staff, had a distrust of scientists who mixed their work with politics. Sununu, who had a PhD in mechanical engineering from MIT, "still thought of himself as a scientist" (51). However, he "lacked the reflexive deference that so many of his generation reserved for the class of elite government scientists" (51) and opposed most climate change policy and regulations that limited carbon emissions, which he thought would stifle economic growth.

Sununu had an ally at the White House's Office of Management and Budget, Director Richard Darman, who alerted him to Hansen's upcoming testimony at a hearing called by Senator Gore. Just as before, Hansen submitted his prepared statement for clearance by the OMB and Sununu did not like what he had to say. At the same time, he was also battling with the EPA administrator about America's role in creating international climate change policy. The EPA

administrator leaked the argument to the press, further infuriating Sununu and making him even angrier about the effort to pass carbon emission policies.

2.9: 'A Form of Science Fraud' (May 1989)

In late April 1989, Hansen was preparing to testify at a new hearing called by Al Gore. He wanted to clarify that global warming would not just cause more heat waves, but also other extreme weather events such as floods. When he received his remarks back from the OMB, he was surprised to find that the editing and deletion was much more extensive than it had been on previous reviews. Hansen told the OMB liaison that he would let the White House have its way, but came up with a plan to let people know about the censorship. Hansen wrote a letter to Gore explaining that the edits "not only render[ed] his testimony meaningless but [made] him sound like a moron" (54). Gore shared the letter with the press, and when Hansen arrived in DC, the story was on the front page of the paper.

At the crowded hearing, Hansen read the edited statement and Gore asked him why it made no sense. Hansen said he had not written it. Gore then accused the Bush administration of science fraud for altering the content of the remarks. Another government scientist testifying also admitted that the White House tried to change his remarks with unscientific statements. After the hearing, the press swarmed Hansen and Gore. Gore told them that "they're scared that Hansen and the other scientists are right and that some dramatic policy changes are going to be needed, and they don't want to face up to it'' (55).

The censorship got more attention than Hansen's testimony would have on its own. The press attacked the White House for interfering with the presentation of scientific findings and for not addressing climate change. The White House blamed the censorship on a low level official and sent Darman to apologize personally to Gore. However, Gore suspected that neither the low level official nor Darman was responsible, but rather someone high up in the administration.

2.10: The White House Effect (Fall 1989)

The Bush administration tried to figure out whether there was a way to reverse the bad press that resulted from the censorship scandal. Sununu signed a statement endorsing a proposal for an international treaty and a workshop to improve understanding of the science and economic cost of emissions reduction. Rafe Pomerance was not convinced that this was a step toward actually doing something, but the press generally praised the statement.

Sununu still did not acknowledge the greenhouse effect. He decided to study the issue himself and concluded that the models were imprecise and the people warning about climate change were wrong. The relationship between Sununu and the head of the EPA soured to the point of open hostility. At the same time, President Bush was indifferent on the issue and he avoided briefings on science issues. Any time the issue of climate change arose, he deferred to Sununu.

Many EPA scientists believed this meant that they had lost their chance to create policy that would cut greenhouse gas emissions.

2.11: 'The Skunks at the Garden Party' (November 1989)

In November 1989, 400 officials from 65 countries met in Noordwijk, a Dutch resort town, to discuss the framework for a global treaty on greenhouse gas emissions. Most of the delegations were prepared to endorse the Dutch proposal to freeze emissions at 1990 levels by 2000. Rafe Pomerance had not been invited, but he showed up along with three other activists nonetheless. Their mission was to pressure those in attendance to endorse the proposal of a more ambitious target: a 20 percent reduction of emissions by 2005. The activist group was granted access by a sympathetic Dutch official.

While the Bush administration told the press that it wanted to play a leadership role in the proceedings, most expected that Bush's science advisor in attendance would oppose the idea of a binding international treaty. Pomerance planned to stage a publicity stunt each day in order to embarrass the American delegation and promote support for a treaty. However, he still worried that the battle was lost. The White House's opposition and the censoring of science was a bad sign. Recent reports indicated that the U.S. was by far the largest producer of carbon emissions. Further delay in action could push a climate treaty back to 1990 or 1991, and by then it might be too late to prevent catastrophic global warming.

The activist group was not let into the final negotiation meeting at the conference. All the scientists and staff were also asked to leave so only the environment ministers or directors from each country remained. The meeting lasted all night and into the morning the next day and in the end, the U.S. along with Japan, the Soviet Union, and Great Britain made the conference abandon its goal of freezing emissions. Instead, the final statement proclaimed that many countries supported emission stabilization, but it did not provide any hard limits or levels. Technically it was progress, but in reality it would make no impact on carbon emissions. As before, it was all talk and no real action to combat the greenhouse effect and climate change.

Epilogue

"More carbon has been released into the atmosphere since the final day of the Noordwijk conference, Nov. 7, 1989, than in the entire history of civilization preceding it" (64). Despite all of the investment in research on climate change and attempts to limit greenhouse gas emissions nationally and globally, the amount of greenhouse gas emitted each year continued to rise. Countries have either failed to follow through on their climate policy commitments, or have not made any binding commitments at all.

At the same time, many fossil fuel companies led the effort to suppress climate science and undermine it using a disinformation campaign that emphasizes uncertainty. Lobbying groups representing business associations, the fossil fuel industry, the electrical grid industry, and the

automobile industry worked with industry-friendly politicians and scientists skeptical of global warming to change the public narrative on climate change and weaken support for climate policy. Since the publication of the Charney report in 1979, climate science had been considered settled fact, but in the late 1980s and 1990s, these groups chipped away at the authority of climate scientists so that the public began to view climate change as a controversial hypothesis. While many industry groups have turned away from this strategy, the effects of it still damage the credibility of climate scientists and hamper the conversation around climate policy.

Recently, there have been efforts to assign blame for the effects of global warming to the government or oil companies. The concept behind these lawsuits and investigations is that someone knew about the greenhouse effect and did nothing. These lawsuits are critical. But we have failed to understand why we did not solve the climate problem when we had a chance, before industry began its campaigns to suppress science and thwart climate policy.

The consequences of climate change are no longer in the future. They are upon us. Without a significant economic, technological, and political investment in stabilizing carbon emissions and reducing atmospheric carbon dioxide, the planet will continue to warm to catastrophic levels. Only if people are willing to invest in the issue is it possible to keep planetary warming to two degrees. The only question is whether we are ready to make that commitment.

Cast of Characters

Jule Charney - Physicist and MIT faculty member who was a pioneer in modern meteorology and a leading American scientist-statesman.

Exxon - An oil and natural gas company that formed when Standard Oil of New Jersey merged with Humble Oil and now known as ExxonMobil due to a merger with Mobil Oil. It is one of the companies that dominates the global petroleum industry.

Albert Gore, Jr. (Al Gore) - Democratic congressman and senator from Tennessee in the 1980s.

Jim Hansen - NASA climate scientist at the Goddard Institute for Space Studies who used computer modeling to simulate the impact of climate change.

Fred Koomanoff - Program Director of the Carbon Dioxide Research Division at the Department of Energy during the Reagan administration.

Gordon MacDonald - Geophysicist, member of JASON, and chief scientist of MITRE Corporation, a think tank funded by the Pentagon.

Syukuro Manabe - Meteorologist and climatologist who used computer modeling to simulate the impact of climate change while working at NOAA's Geophysical Fluid Dynamics Laboratory.

Rafe Pomerance - Activist and lobbyist who was deputy legislative director of Friends of the Earth and then joined World Resources Institute.

William Reilly - Director of the Environmental Protection Agency during the George H.W. Bush administration, former staff member of Nixon's Council on Environmental Quality and former president of the World Wildlife Fund.

Roger Revelle - Oceanographer, University of California San Diego faculty member, and science advisor for the Kennedy Administration.

Henry Shaw - Senior researcher and manager of the Environmental Area in Exxon Research & Engineering's Technology Feasibility Center. Convinced Exxon to create its own carbon dioxide program.

John Sununu - George H.W. Bush's chief of staff and former governor of New Hampshire who had a PhD in mechanical engineering.

Glossary of Terms

Scientific Terms

carbon dioxide (CO_2) - A colorless gas formed in fermentation, animal respiration, and combustion of carbon-containing materials including fossil fuels.

chlorofluorocarbons (CFCs) - Also known as Freons, these organic compounds made of carbon, fluorine, and chlorine were used as refrigerants, aerosol-spray propellants, solvents, and foam-blowing agents. Because CFCs contributed to ozone depletion, countries agreed to stop making them as part of the Montreal Protocol.

climate change - Locally, the change to the typical weather in a place over a long period of time including more rain or different temperatures. Globally, the change to the global climate including the global temperature (global warming).

fossil fuels - Non-renewable carbon-containing energy sources formed when temperature and pressure are applied to plant and animal matter buried in the earth. Commonly used fossil fuels include oil, natural gas, and coal.

greenhouse effect - The main causes of global warming, the greenhouse effect refers to the process where solar radiation is retained and converted into heat that warms the surface and lower atmosphere of a planet. An increase in greenhouse gases including carbon dioxide and methane causes this process.

geophysics - The branch of science that deals with the earth's physical properties and processes including atmospheric chemistry, oceanography, meteorology, polar studies, and seismology. Geophysics is used to study many aspects of the earth and its environment including the earth's crust, gravity, earthquakes, mineral and oil mining, and climate change.

ozone - A naturally occurring gas in the atmosphere that shields the earth from a portion of solar radiation that has been linked to human skin cancer and other harmful effects on plants and animals.

Treaties, Laws, and Reports

Changing Climate - A comprehensive 1983 report on the causes, effects, and geopolitical consequences of climate change by the National Academy of Sciences.

Charney report - The 1979 publication by Jule Charney and others, officially titled "Carbon Dioxide and Climate: A Scientific Assessment," which established the greenhouse effect and global warming as settled fact.

Clean Air Act - The 1970 federal law that regulated air emissions including hazardous air pollutants.

Montreal Protocol - The 1987 international treaty that limits the production of ozone depleting substances including chlorofluorocarbons. It is seen as a model for international cooperation on environmental policy.

U.S. Government Agencies and Intergovernmental Agencies

Central Intelligence Agency (CIA) - The federal civilian agency that collects and analyzes foreign intelligence to protect U.S. national security.

Council on Environmental Quality - The division of the Executive Office of the President that interprets environmental regulations and coordinates with other federal agencies on environmental regulations, assessments, and procedures.

Department of Energy - The cabinet-level department that deals with energy, environmental, and nuclear policies and challenges in the United States.

Environmental Protection Agency (EPA) - The independent agency of the United States federal government that conducts federal research and monitoring of the environment and sets and enforces standards to ensure environmental protection.

Intergovernmental Panel on Climate Change (IPCC) - The international body for assessing the science of climate change and its political and economic impact. It was established by the United Nations Environment Program and the World Meteorological Organization in 1988.

National Aeronautic and Space Administration (NASA) - The independent agency of the United States federal government that operates the civilian space program and aeronautics and aerospace research.

NASA's Goddard Institute for Space Studies - A laboratory in the Earth Sciences Division of the National Aeronautics and Space Administration's Goddard Space Flight Center. It became a leading center of atmospheric modeling and climate change by using data collected by satellites and space probes.

National Oceanic and Atmospheric Administration (NOAA) - The federal scientific agency in the Department of Commerce that researches waterways, marine ecosystems, weather, and the atmosphere and provides the government and the public with that information.

Office of Management and Budget (OMB) - The office of the Executive Office of the President that deals with the budget, legislative coordination, regulating policy, and management.

United Nations (UN) - An intergovernmental organization that promotes peace and security, human rights, sustainable development, climate change, and other issues confronting humanity and enables dialogue between member nations.

Non-profits, NGOs, and Trade Groups

American Petroleum Institute (API) - The largest oil and gas trade industry group in the United States.

JASON - An independent scientific advisory group that consults for the United States government on defense science and technology issues.

National Academy of Sciences - An non-profit society of scientists who provide independent scientific and technological advice to the United States government.

World Resources Institute (WRI) - A global research organization that promotes policies and programs that protect the climate, natural resources, and human health.

"Losing Earth" Comprehension Questions

Prologue

1. How much has the world warmed in the last century? What will be the consequences if it continues to warm?
2. Why did Nathaniel Rich choose to write about 1979-1989 instead of some other time period in the climate change saga?

Part One: 1979 - 1982

1.1: 'This Is the Whole Banana' (Spring 1979)

1. Who is Rafe Pomerance and why did he care about the global atmosphere?
2. How did Pomerance learn about the greenhouse effect?
3. Who is Gordon MacDonald and why did Pomerance want to speak with him?
4. The initial report on the greenhouse effect did not generate a response in the government. What did Pomerance and MacDonald do to get the message to government officials?
5. How did the Carter administration respond to the information presented to them by Pomerance and MacDonald?

1.2: The Whimsies of the Invisible World (Spring 1979)

1. Who is James Hansen and what does he study?
2. What can the climates of other planets tell us about Earth's climate?

1.3: Between Catastrophe and Chaos (July 1979)

1. Who was Jule Charney and why did he gather a group of scientists together at Woods Hole, MA in July 1979?
2. Who was included in the group and who was not? Why were these people included while others were excluded?
3. What is the "Mirror Worlds" computer program and how was it used by the Charney group?
4. What are the conclusions of the Charney report? How did the group come to this conclusion?
5. What was the response to the Charney report? How did government officials, scientists, and fossil fuel industry members view it?

1.4: 'A Very Aggressive Defensive Program' (Summer 1979-Summer 1980)

1. Why did Exxon create a carbon dioxide research program?
2. When did Exxon start studying the carbon dioxide problem and what did they already know?

3. What other companies or industry groups were already involved in carbon dioxide research before the publication of the Charney report?
4. Why didn't the oil and gas industry act on their research findings?

1.5: 'We Are Flying Blind' (October 1980)

1. What was the purpose of the Pink Palace meeting?
2. Why did Anthony Scoville state that the problem was not atmospheric but political?
3. Why did the Pink Palace group not make any policy recommendations in its final statement?
4. What role did uncertainty play in the drafting of the final statement?

1.6: 'Otherwise, They'll Gurgle' (November 1980-September 1981)

1. What event in November 1980 changed the climate policy landscape in the U.S.?
2. What steps did the Reagan administration take to reverse environmental regulations?
3. Did other Republican politicians agree with the White House's positions? What did they do to push back?
4. How did Rafe Pomerance plan to raise the public profile of climate science?
5. Why was James Hansen a good candidate to be the leading voice on global warming?

1.7: 'We're All Going To Be the Victims' (March 1982)

1. Why was congressman Al Gore interested in climate change?
2. What does it mean that health and environmental stories had elements of "narrative drama"? What are those elements and why does it make a story more interesting to the public?
3. Who did Al Gore see as the hero, villain, and victims of the climate change story for his March 1982 hearing? Why did he view each person or group that way?
4. What was the partisan divide at the hearing? What was the viewpoint of each side? Who did the experts side with on the issue?
5. What information did James Hansen present to the subcommittee?

1.8: 'The Direction of an Impending Catastrophe' (1982)

1. How was Al Gore's hearing successful? How was it unsuccessful?
2. In 1982, what was Exxon's response to the global warming problem?
3. Why did James Hansen think that the Reagan administration might reassess its approach to the carbon dioxide issue?

Part One Review: 1979-1982

1. Who was concerned about the greenhouse effect in 1979 and why were they concerned?
2. During this time period, did the scientific understanding of the greenhouse effect and its impact on the environment change? If so, how?
3. What stakeholders (groups of people) played a role in climate change policy during this time period? List each one and summarize their role.

Part Two: 1983 - 1989

2.1: 'Caution, Not Panic' (1983-1984)

1. What was the significance of the National Academy of Sciences analysis of the carbon dioxide problem?
2. What was the conclusion of the "Changing Climate" report?
3. What did chairman William Nierenberg say to the press after the publication of the report?
4. Why did the press focus on Nierenberg's verbal statements rather than the written report?
5. How did the press coverage of "Changing Climate" impact the climate policy of
    - The Reagan administration
    - Exxon

2.2: 'You Scientists Win' (1985)

1. The "ozone hole" is not actually a hole in the atmosphere. What is it?
2. What caused the depletion of atmospheric ozone? Did these chemicals also play a role in the greenhouse effect?
3. What factors led to the swift public and political response to the ozone problem?
4. How was the response to the ozone problem like the response to the carbon dioxide problem? How was it different?

2.3 The Size of the Human Imagination (Spring-Summer 1986)

1. Why did Curtis Moore, a Republican staff member for the Committee on Environment and Public Works, want to use the ozone debate to revive the climate debate? Why was Rafe Pomerance reluctant to do so?
2. What were the positive and negative effects of combining the hearings and publicity campaigns on the ozone and carbon dioxide issues?
3. Did people still think that more research on global warming was needed before policy could be implemented?
4. Consider the role visualization played in the ozone issue. The animation of the ozone hole was a computer simulation just like climate change modeling. Why was this visual model more compelling than the numbers-based model?

2.4 'Atmospheric Scientist, New York, N.Y.' (Fall 1987-Spring 1988)

1. Why did people think that climate change policy would follow the same trajectory as ozone policy?
2. Who was in attendance at the "Preparing for Climate Change" conference?
3. Why did people think the event represented positive progress in getting climate change policy passed?
4. Why did James Hansen have to submit his testimony to the White House Office of Management and Budget? What normally happened when he did this and what was different this time?
5. How did Hansen get around the censorship of his testimony?

6. Why did the White House censor Hansen's testimony and why did it make him pessimistic about the future of climate change policy?

2.5 "You Will See Things That You Shall Believe' (Summer 1988)

1. In the summer of 1988, how did record heat affect wildlife across the United States? How did it affect life in major U.S. cities?
2. What global temperature data did James Hansen receive in June of 1988? What was his response?

2.6: 'The Signal Has Emerged' (June 1988)

1. What major statement did James Hansen plan to make during the June 23, 1988 Senate hearing?
2. Why did Senator Wirth want Hansen to testify at the hearing?
3. Why was news coverage about the greenhouse effect important at this moment? How did Senator Dale Bumpers of Arkansas explain this importance?

2.7: 'Woodstock For Climate Change' (June 1988-April 1989)

1. What number did Rafe Pomerance and his Capitol Hill allies choose as the target for carbon emission reduction? How did they justify this number?
2. What did the World Conference on the Changing Atmosphere final statement demand?
3. During the summer 1988 presidential campaigns, what was George H.W. Bush's position on environmental policy?
4. What was included in the National Energy Policy Act of 1988?
5. How did other countries respond to the threat of climate change during this period?
6. What recommendation did senators make to the Bush administration on April 14, 1989? Why was this an advantageous moment to make this recommendation?

2.8: 'You Never Beat The White House' (April 1989)

1. Name at least three major policies/initiatives that John Sununu supported or passed as governor of New Hampshire or White House chief of staff.
2. What concerns did Sununu have about how scientific knowledge was being used in the post-WWII era?
3. How did Sununu feel about the science of the greenhouse effect? What made him feel qualified to critique the government scientists' models?
4. What were the pros and cons of supporting a global treaty to reduce carbon emissions for the Bush Administration? Why didn't Sununu support President Bush in demanding such a treaty at the Intergovernmental Panel on Climate Change (IPCC) meeting in Geneva?

2.9: 'A Form of Science Fraud' (May 1989)

1. What scientific point did James Hansen want to clarify in the May 1989 Senate hearing organized by Senator Gore?

2. What changes did the Office of Management and Budget (OMB) want Hansen to make to his Senate hearing testimony? How would these changes alter the meaning of his testimony?
3. How did Senator Gore and Hansen tell the press about the changes the OMB made to Hansen's testimony?
4. Following the May 1989 Senate hearing, who became a "villain" in the press?

2.10: 'The White House Effect' (Fall 1989)

1. What did Senator Gore do in response to the OMB's censorship of scientists like James Hansen?
2. What climate change policies and initiatives did the Bush White House promise to pursue in response to the May 8, 1988 hearing? How did Rafe Pomerance respond to these promises?
3. What did John Sununu think about the scientific findings presented by Hansen at the May 8, 1988 hearing?
4. How did Sununu attempt to block climate change policies in the Bush administration? What other officials within the Bush administration influenced the prominence of climate change policy proposals?

2.11: 'The Skunks at the Garden Party' (November 1989)

1. What was the goal of the Noordwijk Ministerial Conference in the Netherlands?
2. What mission did Rafe Pomerance, Daniel Becker, Alden Meyer, and Stewart Boyle have at the conference?
3. What was the first publicity stunt that the unofficial American delegates at the conference staged? What was the message behind this stunt?
4. How did the official from Kiribati, an island in the Pacific Ocean between Hawaii and Australia, demonstrate the impact of climate change on his nation?
5. Why was the proposed commitment to freeze greenhouse gas emissions abandoned at the conference?

Part Two Review: 1983-1989

1. What strategies did activists, politicians and scientists use to increase public and political concern about climate change from 1983-1989?
2. How did the U.S. government's position on climate change research and action evolve throughout the Carter, Reagan and Bush administrations?
3. How did the U.S. government's response to climate change research compare to responses from governments of other countries?

Epilogue

1. To what degree have carbon emissions increased since 1989?
2. How have fossil fuel companies and other corporations discussed in the story responded to the increased carbon emissions since 1989?

3. What does Nathaniel Rich mean when he writes that many economists think of climate change as “the perfect economic disaster”?
4. What does Rich and James Hansen propose to ensure that the planet’s temperature does not rise above two degrees Celsius? What role does the public play in this plan?

"Losing Earth" Discussion Questions

1. Before you read this story, what did you think about climate change?
    - Did you think it was a settled scientific theory? Why or why not?
    - Has your opinion changed or shifted after you did the reading?

2. Al Gore assembled his first climate change hearing as a dramatic story with a hero, villain, and victim. Did Nathaniel Rich do the same thing in the piece? Can you identify the characters and institutions neatly into one category or another?

3. Who did you notice was consistently involved in discussions about climate change policy throughout the story? In your opinion, who was missing from those discussions? Who would you invite to a meeting about addressing global climate change in 2018?

4. Who did you empathize with in the story, and why? Of the many roles that people took in the story to research and share the impacts of global warming (politicians, scientists, activists, journalists), which role most interests you? If you were a subject in this story, who might you be and why?

5. When a government employee testifies before Congress, they are speaking as an agent of the government. Do you think that government officials should have the ability to censor or change what that person will say? Does it make a difference if it is a policy statement or a scientific statement?

6. Throughout "Losing Earth," there are two perspectives presented about the timeliness of taking action. One is that immediate action on climate change was needed and overdue; the other was that climate change was a problem for the future to solve. Do you think now is the time to act, or can action on climate change still wait?
    - How can you convince someone to act in the present when the consequence will not be evident until the future?

7. Nathaniel Rich includes details such as an architectural description of the Pink Palace (21) and background such as why Hansen joined NASA (16) in the story. What role do these elements play in the story?

8. Look at George Steinmetz's photography from the magazine. How does he visualize climate change?
    - How do you feel when you look at the photos? Why?
    - How would you visualize climate change? What would you show to provoke an emotional response or connection to the issue?