

## **Our Ocean in a Changing Climate**

### LEARNING GUIDE

#### **Introduction**

In this guide, which is appropriate for middle and high school learners, students will begin to learn about the causes of climate change, and how oceans, marine life, and human communities are impacted. Students will investigate solutions and read stories of action taking place around the world, and be introduced to activists, artists, and writers whose work explores climate change. Through a variety of reading, writing, and visioning activities, students will practice communicating what they have learned through a creative project. Finally, students will learn more about submitting work to Bow Seat's global arts Contest to raise awareness about oceans and climate change!

#### **Overview**

- Part 1: Self Pre-Assessment
- Part 2: What is Climate Change?
- Part 3: Creative Activity: Color, Symbol, Image
- Part 4: Diving Deeper into Our Changing Ocean
- Part 5: Creative Activity: Looking Closely
- Part 6: Solutions
- Part 7: Inspiration: Meet Climate ARTivists
- Part 8: Creating Your Final Project

#### **Learning Resources**

To supplement the resources and articles in this guide, you can find additional readings, activities, and multimedia in Bow Seat's Resource Studio: [bowseat.org/resources](http://bowseat.org/resources). For a complete list of the resources and articles included in this guide, see the References page.

## We Are All Connected to the Ocean

Earth is a blue planet, with oceans covering more than 70% of its surface. While we may not live near an ocean or even ever visit it, we are connected to the ocean through the air we breathe and the water we drink. From food and economies to recreation and culture, our oceans sustain, nourish, and support human life.

Oceans play a central role in regulating Earth's climate and act as a buffer that protects us from human-caused global warming, but oceans are feeling the heat. Climate change—primarily caused by the burning of fossil fuels such as coal, oil, and gas—is changing water temperature and chemistry, altering marine habitats, and threatening marine life. Rising sea levels and extreme weather events are endangering and displacing millions of people who live on the coast.

It's critical for all of us to take care of the ocean that takes care of us all. By building an awareness of how our actions on land directly impact life below the surface, we can all be caretakers and advocates for a healthy, living ocean no matter how far from the coast we may live.

The good news is, there is much cause for hope: individuals, communities and cities, organizations and movements (largely youth-led!) around the globe are already working to slow the climate crisis and drive the transition away from destructive, polluting, and unjust practices to systems that respect, value, and protect the diversity of life on Earth. From how we get around to how we eat to how we power our lives, transformative solutions to the climate crisis are rooted in imagination and energized by having hope that what we create matters.

### 2020 Ocean Awareness Contest

The 2020 Contest theme is **Climate Hope: Transforming Crisis**, which invites students to learn about the climate crisis and its impact on oceans; discover or imagine solutions at personal, local, national, or global scales; and create work that explores hope in action. We accept submissions in Visual Art, Film, Interactive & Multimedia, Music, Poetry, and Prose. Students can earn awards of up to \$1,500, and winners have special opportunities for exhibiting, publishing, and participating in international conservation campaigns.

For complete details on how to submit to the Ocean Awareness Contest, visit [bowseat.org/contest](https://www.bowseat.org/contest) or download the [2020 Contest Information Packet](#).

## Part 2: What is Climate Change?

### Definition of Climate Change

Source: NASA Kids

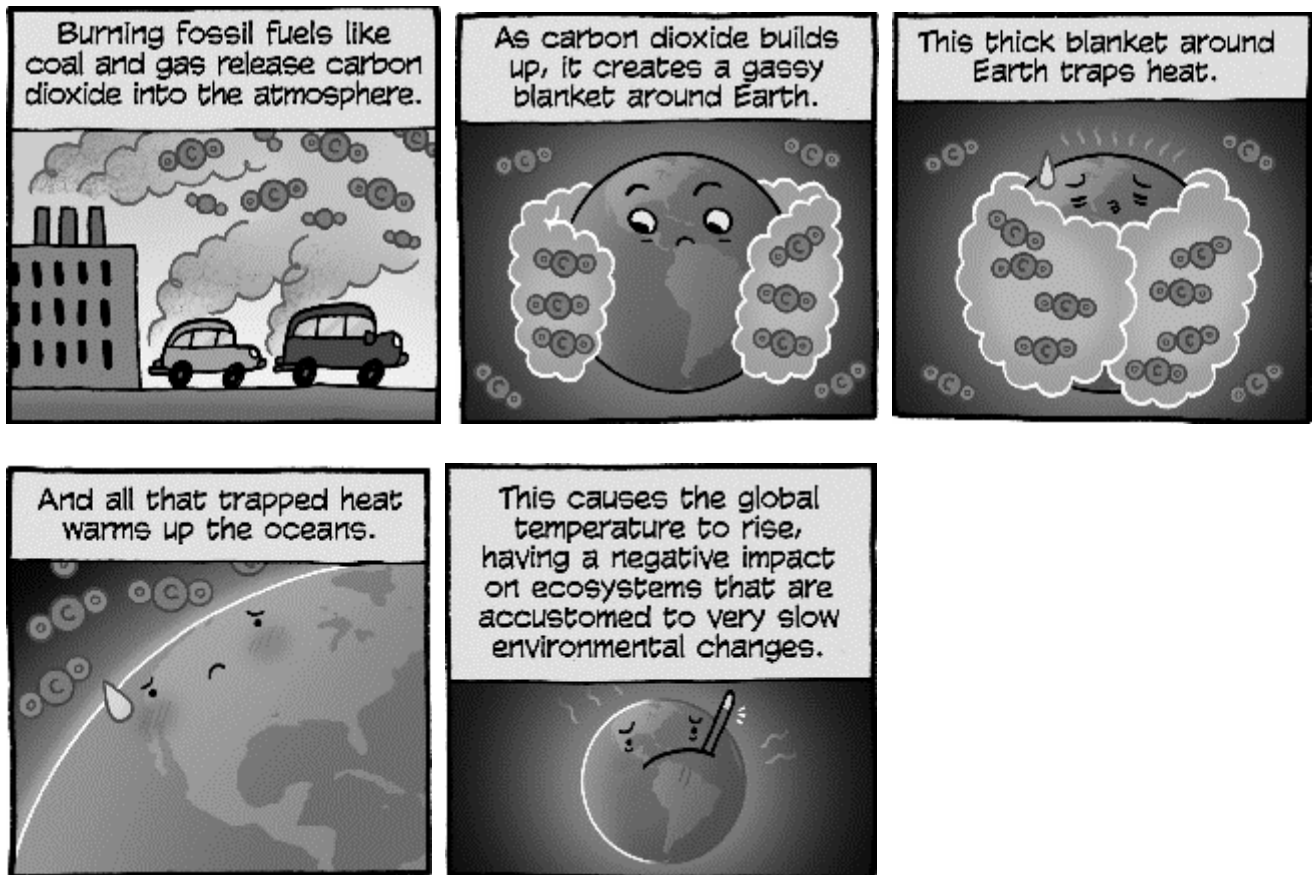
"Climate change describes a change in the average conditions – such as temperature and rainfall – in a region over a long period of time. NASA scientists have observed that Earth's surface is warming, and many of the warmest years on record have happened in the past 20 years."

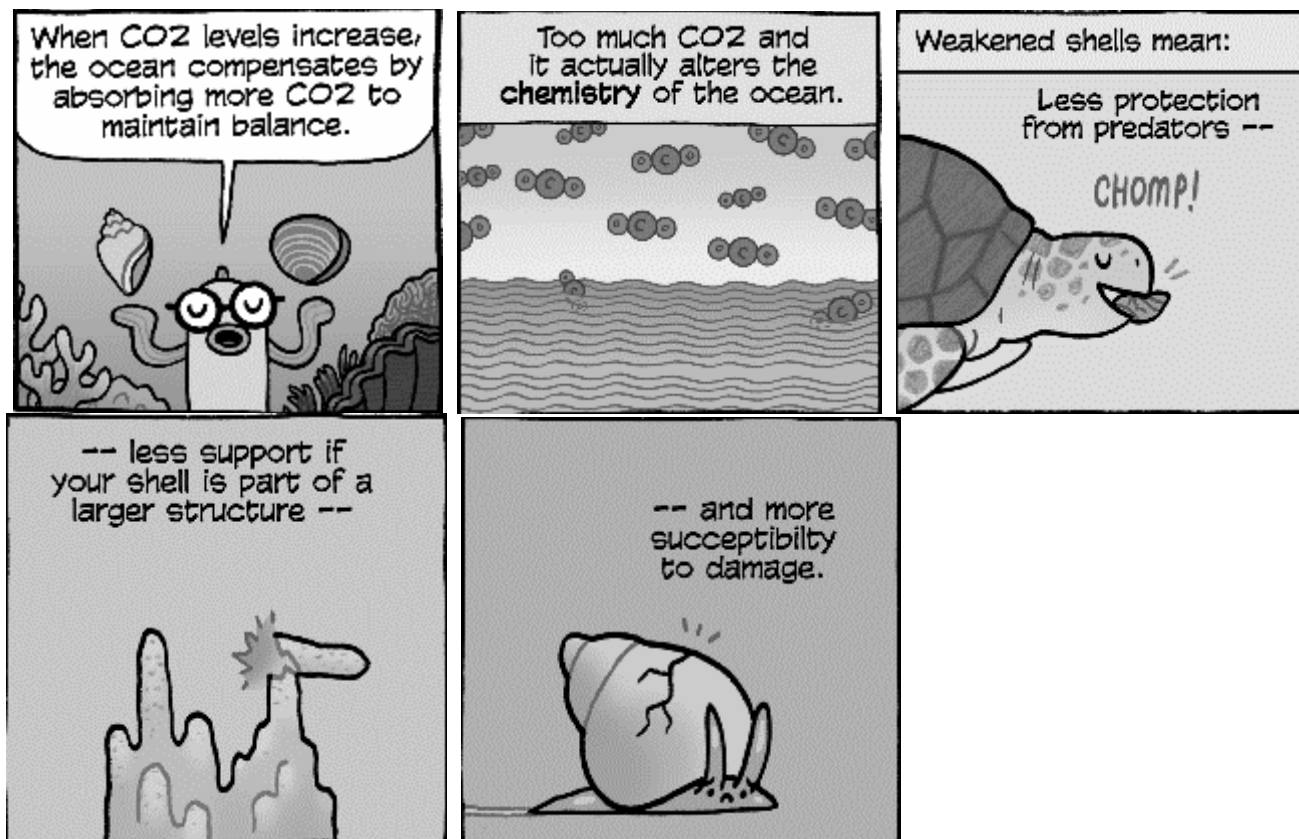
#### Directions:

1. Look through Resource 1: science illustrator Maris Wicks' comic series from the New England Aquarium.
2. Read Resource 2 from the Monterey Bay Aquarium.
3. Use Worksheet #2 to reflect on what you've learned about climate change and its impacts.

### Resource 1: Climate Change and Our Ocean

Source: New England Aquarium, Comics by Maris Wicks





## Resource 2: How is Climate Change Affecting the Ocean?

Source: Monterey Bay Aquarium

### Human Activities are Changing Our Climate

When we burn fossil fuels, destroy forests or raise crops and livestock, carbon dioxide and other greenhouse gases are released into our atmosphere. These gases trap heat within our atmosphere, warming our planet. In fact, we've already caused the temperature of the Earth to rise by 1.8 degrees Fahrenheit (1.0 degree Celsius) above pre-industrial levels. At the current rate, this warming is likely to reach 1.5 degrees Celsius between 2030 and 2052, and could reach 3 degrees Celsius by the end of this century, greatly impacting life on Earth. This change in our climate is also driving big changes in our ocean.

#### The ocean is getting warmer

The ocean has absorbed more than 90 percent of the extra heat caused by our greenhouse gas emissions, causing the temperature of the ocean to rise. This contributes to coral bleaching, more toxic algae blooms and disruptions to the marine food web. Warmer ocean temperatures also contribute to significant changes like extreme weather events and sea-level rise.

#### The ocean is getting more acidic

The ocean doesn't just absorb heat as a result of excess carbon dioxide in the atmosphere – it also absorbs carbon dioxide itself. The Intergovernmental Panel on Climate Change (IPCC) reports that since the start of the

Industrial Revolution, the ocean has absorbed about 25 percent of all of the carbon dioxide we've emitted by burning fossil fuels and degrading habitats that sequester carbon. This process is changing the chemistry of the ocean. When carbon dioxide is absorbed by the ocean, it triggers chemical reactions that reduce the water's pH — a measure of how acidic seawater is. This process is known as ocean acidification.

The ocean is already 30 percent more acidic than it was before people started burning fossil fuels. This increased acidity makes calcium carbonate molecules — the building blocks of shells, skeletons and coral reefs — harder to come by. Animals that rely on calcium carbonate need to work harder to build and maintain strong shells — which leaves them with less energy to feed, grow and reproduce. It can also cause their shells to become thinner and more brittle. These disturbances can ripple through ocean food webs, affecting animals and ecosystems in ways scientists are just beginning to decipher.

### **The ocean is losing oxygen**

Just like us, ocean animals need oxygen to survive. But as our planet warms, the ocean is losing oxygen and creating dead zones where nothing can live. As ocean water warms, it is less able to hold oxygen and becomes more stratified (which means less mixing of deep and surface waters). Warm water also ramps up the metabolism of animals and microbes, which increases their need for oxygen. All of these factors are contributing to oxygen loss in the ocean.

Dead zones are expanding along our coasts and in the deep open ocean — sometimes covering areas thousands of miles long. Animals that once lived there may find it hard to survive and may change where they live — often moving into shallower waters. For fish that normally dive deep to avoid predators, moving to shallow waters can be dangerous.

## **The Link Between the Ocean and Our Climate**

### **The ocean circulates heat and moisture**

The ocean is the heart of the Earth's climate system — its currents and winds circulate heat and moisture around our planet. The weather patterns we associate with different regions of the world have been relatively stable throughout human history, thanks to the ocean. But when the ocean absorbs excess heat — like it has over the past several decades — it can affect how the ocean circulates heat and moisture around our planet. Some regions of the world get more heat or moisture, and others get less. These changes also alter ocean currents and wind patterns, which increase the likelihood of certain extreme weather events like hurricanes, floods, droughts and wildfires.

### **The ocean absorbs carbon and heat**

Climate change is already making our planet warmer and our weather more destructive. But without the ocean's help, it would be much worse. To date, the ocean has absorbed more than 90 percent of the excess heat and 25 percent of the carbon dioxide we've produced by burning fossil fuels and degrading habitats. Ocean and coastal habitats like coral reefs and estuaries help protect coastal communities from the impacts of storm surges and flooding. Destroying these critical ecosystems puts coastal communities at greater risk. Restoring and conserving them, on the other hand, can help us prepare for the impacts of climate change already underway.

## **How Does Climate Change Affect Ocean Animals?**

### **Coral Bleaching**

Coral reefs are some of the most diverse and important habitats in the ocean. But over the last few decades, reefs worldwide have been devastated by bleaching events. Rising sea temperatures cause corals to expel their symbiotic algae — a process called coral bleaching — often resulting in the death of the coral reef. On top of warming, changing ocean chemistry (ocean acidification) is slowing the growth rate of coral reefs, with impacts throughout the food web.

### **Changes in growth rate, physiology, and survival**

Animals are conditioned to live at certain temperatures, acidity (pH) and oxygen levels. Changes to these levels can force animals to expend more energy just to survive. This can result in slower growth, lower reproduction rates and higher vulnerability to predators.

### **Range Shifts**

Climate change is changing where ocean wildlife lives. As waters warm, many fish and invertebrate populations move toward the poles or farther offshore, seeking cooler waters. Others are getting squeezed vertically, forced to move up or down the water column as warming surface water causes low-oxygen zones to expand.

### **Effects on Fisheries and Aquaculture**

The changing climate is affecting the global seafood supply and the billions of people who rely on fishing and aquaculture for nutrition and their livelihoods. As warming waters drive wild fish into new habitats, fishermen are seeing changes in the type and amount of seafood they are able to catch. Ocean warming can also lead to smaller, skinnier fish because higher temperatures cause an increase in their metabolic rates. As carbon levels build in the atmosphere, the resulting changes in ocean pH have resulted in high mortality of juvenile-farmed shellfish. By 2100, the global annual costs of shellfish loss from ocean acidification alone could be over US \$100 billion.

## **Coastal Communities Feel the Impact of Climate Change**

Climate change is already negatively affecting coastal communities and economies around the world. These impacts will become more severe unless we take action to significantly reduce emissions.

### **Sea Level Rise**

Over the past 100 years, global sea level has risen between seven and eight inches, on average. California's coastal communities are already dealing with the related erosion and flooding, and experts say it will only get more severe in the coming decades. Scientists project that sea level could increase along California's coast as much as three feet by the year 2100, putting as many as 600,000 people and \$150 billion in property in the state at risk of coastal flooding.

### **Extreme Weather Events**

Climate change is causing more frequent and intense extreme weather events. Warmer global temperatures are contributing to record temperatures around the world, as well as to more intense droughts and wildfires. But climate change also increases the amount of moisture in the atmosphere — warmer temperatures cause more evaporation, and warmer air can hold more moisture. This can inundate some regions with heavier than usual rainfall and snow, and contribute to more intense tropical storms.

## Part 4: Diving Deeper into Our Changing Ocean

### Directions:

1. Read the following article excerpts from *Scientific American* and *CNN*.
2. On Worksheet #4, answer questions about the readings in Boxes 1-3. Answer the question in Box 4 from the perspective of the ocean.

### **Resource 3: “Oceans are Warming Faster than Predicted” | Scientific American**

Up to 90 percent of the warming caused by human carbon emissions is absorbed by the world’s oceans, scientists estimate. And researchers increasingly agree that the oceans are warming faster than previously thought.

Multiple studies in the past few years have found that previous estimates from the Intergovernmental Panel on Climate Change (IPCC) may be too low. A new review of the research, published yesterday in *Science*, concludes that “multiple lines of evidence from four independent groups thus now suggest a stronger observed [ocean heat content] warming.”

Taken together, the research suggests that the oceans are heating up about 40 percent faster than previously estimated by the IPCC. Since the 1950s, studies generally suggest that the oceans have been absorbing at least 10 times as much energy annually, measured in joules, as humans consume worldwide in a year.

While much of the human concern about climate change focuses on its effects over land—rising air temperatures, changes in weather patterns and so on—accurate estimates of ocean warming are deeply important to scientists’ understanding of global warming. Determining how fast the oceans are warming helps scientists calculate how sensitive the planet is to greenhouse gas emissions and how quickly it may warm in the future.

“The ocean, in many ways, is the best thermometer we have for the planet,” said Zeke Hausfather, a climate scientist at the University of California, Berkeley, and a co-author of the new analysis.

Accelerated warming is also a big concern for ocean ecosystems, driving mass coral bleaching events all over the world and forcing some species to migrate to cooler waters. Warming also causes ocean water to expand in volume, which can contribute to sea-level rise.

For nearly two decades, scientists have used a network of floats distributed throughout the ocean to constantly monitor water temperatures worldwide. But before the early 2000s, when the network was launched, scientists mainly relied on measurements taken from passing ships as they made their way across the seas. This meant ocean temperature observations, worldwide, were sparser and that scientists had to use statistical methods or models to fill in the gaps.

In recent years, improved data from the float network and improvements in the models and statistical tools used to analyze previous measurements have helped scientists develop more accurate reconstructions of ocean warming over the past century.

As the new review reports, multiple studies now agree that the oceans are warming at a faster rate than older estimates suggested. And these revised calculations also match up better with climate model simulations than previous estimates, giving scientists more confidence that model projections for the future are on track.

And if the models are accurate, continuing to emit greenhouse gases at the current rate could result in dire consequences for the global oceans. As the new analysis points out, models suggest that a business-as-usual climate scenario could cause nearly 1.5 degrees of ocean warming—the equivalent of nearly a foot of sea-level rise by the end of the century. Meeting the Paris Agreement’s climate goals, on the other hand, could cut that warming in half.

Scientists aren’t only interested in how much heat the oceans are soaking up. How that heat moves around the planet can reveal important clues about how high the seas might rise in different locations, for instance.

Another study, published earlier this week in *Proceedings of the National Academy of Sciences*, also concluded that the oceans are taking up at least 90 percent of the excess heat in the atmosphere. It also found that they’ve been warming since at least the late 1800s, although its estimates for the rate of warming may be a bit lower than what some of the other recent studies have suggested.

The study suggests that the oceans’ large-scale currents and circulation patterns have been changing in recent decades—for reasons scientists are still investigating—and that these changes are affecting the places where ocean heat ends up.

The study suggests that up to half the extra heat stored up in the midlatitude regions of the Atlantic Ocean since the 1950s was actually transported there from other parts of the ocean. This means that heat-related sea-level rise in this part of the ocean is being influenced by changing circulation patterns.

That’s important to pay attention to, the researchers note, because future climate change may cause even bigger shifts in ocean currents, many of which are heavily influenced by winds and atmospheric patterns that may be affected by global warming. Monitoring these changes could help scientists predict which parts of the ocean will warm—and expand—the fastest in the future.

“Future changes in ocean transport could have severe consequences for regional sea-level rise and the risk of coastal flooding,” the authors write.

## **Resource 4: “‘Climate apartheid’ will push 120 million into poverty by 2030, UN says” | [CNN](#)**

The world is facing a “climate apartheid” between the rich who can protect themselves and the poor who are left behind, the UN has warned.

A new report published on Tuesday estimated that more than 120 million people could slip into poverty within the next decade because of climate change.

As extreme weather events such as droughts, floods and hurricanes become more frequent, the world’s poorest people will be forced to “choose between starvation and migration,” the report warned.

“We risk a ‘climate apartheid’ scenario where the wealthy pay to escape overheating, hunger and conflict while the rest of the world is left to suffer,” said Philip Alston, the UN Special Rapporteur on extreme poverty and human rights.

Alston said the difference between how climate change affects the wealthy and the poor is already apparent.



One example he gave in the report was the aftermath of the 2012 Hurricane Sandy in New York City. While thousands of low-income people were left without power and healthcare for days, the Goldman Sachs headquarters on Manhattan was kept safe by tens of thousands of sandbags and powered by a private generator.

Researchers from Stanford University have previously warned that climate change is making poor countries poorer, widening global inequality between nations.

But extreme weather events fueled by climate change are also deepening disparities within countries.

Research published in 2017 in *Science* projected that the poorest counties in the United States will see the most economic damage from events like droughts and hurricanes.

Poor communities and women are more vulnerable, because they tend to be more reliant on agriculture.

The livelihoods of the world's poorest are most exposed to climate change disasters, because poverty makes it impossible to escape, says the research. When extreme weather hits, the poorest lack the resources necessary to recover, and become even poorer, creating a vicious circle.

"Perversely, while people in poverty are responsible for just a fraction of global emissions, they will bear the brunt of climate change, and have the least capacity to protect themselves," Alston said.

The UN has also warned that just slowing down the rise in temperature as outlined by the 2015 Paris Agreement won't be enough to save millions of people who are already suffering.

"Even the unrealistic best-case scenario of 1.5 (degrees Celsius, or 2.7 degrees Fahrenheit) of warming by 2100 will see extreme temperatures in many regions and leave disadvantaged populations with food insecurity, lost incomes, and worse health," the report said.

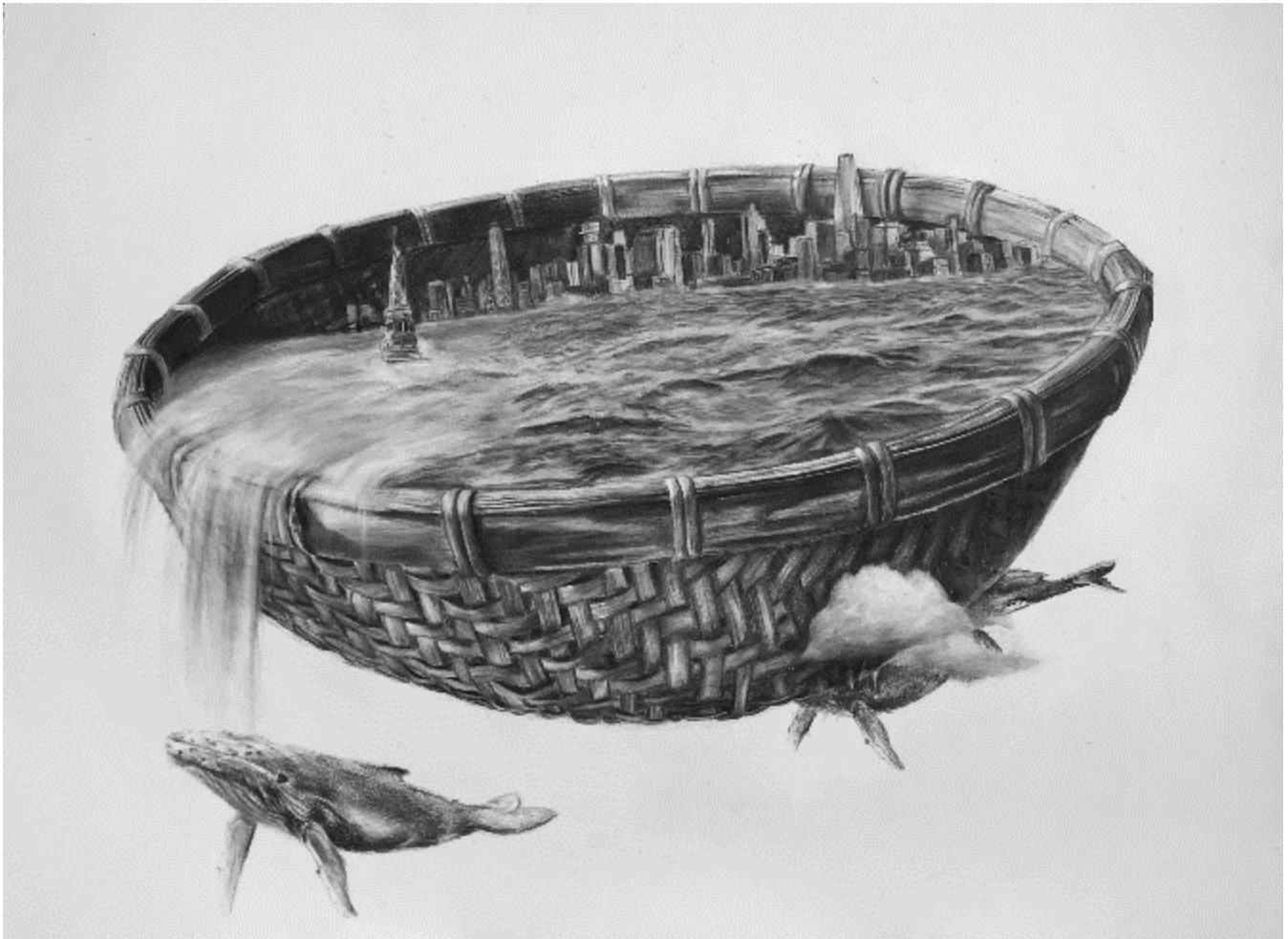
### **What does "apartheid" mean?**

Apartheid means segregation, or a separation, of people. Historically, apartheid relates to a system of racial segregation in the country of South Africa. In this article, "climate apartheid" is being used to describe a situation where people are separated by their wealth level. Wealthy people's ability to recover from natural disasters, like hurricanes and rising sea levels, will be much greater than that of poorer people.

## Part 5: Creative Activity: Looking Closely

*Directions:* Look closely at the following artwork, then fill in Worksheet #5. This artwork was created by youth participants in Bow Seat's annual Ocean Awareness Contest.

### "2030" by Emily Guo (Age 16, Massachusetts)



#### Student Reflection:

Our mother earth is represented by the basket. It is overflowing. Once the greenhouse gases in the atmosphere reach a certain level (predicted to be the year 2030 if we don't do anything), the Earth will tilt over like the basket. The sea level is rising. Waves submerge the major economic center and destroy civilization. People hurt the Earth for money, and in return, nature hurts the overall economics back. I included three whales in the bottom of the drawing to show that marine populations are migrating because their habitats are destroyed by the warming climate.

**“Lost Homes: Climate Refugees in the Near Future” by Natali Kim (Age 17, California)**



**Student Reflection:**

I was inspired to design and produce this print because I believe that there has not been enough advocacy for climate refugees. Climate refugees are displaced people whose communities have been impacted by climate change. I think that people tend to focus on how climate change may impact themselves and do not consider who else may be affected. The majority of climate refugees originate from West Africa and Central Asia and are forced to relocate either to a new country or more inland. Climate refugees also exist in large numbers near the United States. For example, because of Hurricane Maria, 2,300 families in Puerto Rico are still displaced. Unfortunately, anti-immigration trends have helped to generate negative reactions towards refugees.

**“Changing Climate: Effects on Oceans and Living Things” by Meghna Unnikrishnan  
(Age 14, India)**



**Student Reflection:**

Oceans in the badly changing climate are becoming a bad habitat for their life forms. Rising sea temperatures are causing extinctions. Rising sea levels are causing many coastal areas to be taken up by the sea. Hurricanes and floods are causing vast destruction to human life, too. Let's hope something constructive is done by countries all around the world to contain climate change and save our planet.

**“Unlocking the Hope” by Alyssa Jieun Kim (Age 13, California)**



**Student Reflection:**

Our ocean and sea creatures have been suffering for many years. However, I see a light of hope for healing and preserving the ocean life through educating and raising awareness. Especially through such organizations like Bow Seat, we can educate future generations of the importance of living together with nature. My painting shows unlocking nature that was once provider to us. Now is the time to help heal it. As we all work together to preserve and heal what's left, I do believe there is still big hope for our Mother Nature.

## Part 6: Solutions

### Directions:

1. Read the five featured stories that highlight examples of climate solutions around the world. Take notes on the details and helpful aspects of each solution to help you complete Worksheet #6.
2. Complete the Visioning Activity, which asks you to imagine your hometown in the year 2040.

“To underline the crucial importance of visioning, consider how many aspects of our present reality started out as someone’s dream. There was a time when much of America was a British colony, when women didn’t have the vote, and when the slave trade was seen as essential to the economy. To change something, we need to first hold in our mind and heart the possibility that it could be different... Our imagination is essential in formulating creative responses to new challenges.”

—From *Active Hope* by Joanna Macy & Chris Johnstone

## Featured Solutions

The climate crisis can’t and won’t be solved overnight, but there are many solutions, innovations, and movements to stop global warming and transform our planet for the better—this list has just a few!

### Renewable Energy

#### Source: Think Progress

The myth that a very high level of renewables can’t be integrated into the electric grid is being demolished by the clean tech and battery storage revolution. “By 2040, renewables make up 90% of the electricity mix in Europe, with wind and solar accounting for 80%,” predict the experts at Bloomberg New Energy Finance (BNEF) in their annual energy outlook released this week.

“Cheap renewable energy and batteries fundamentally reshape the electricity system,” explains BNEF. Since 2010, wind power globally has dropped 49% in cost. Both solar and battery prices have plummeted 85%. In fact, many countries are already at very high levels of renewable power: Iceland (100%), Paraguay (100%), Costa Rica (98%), Norway (97%), Uruguay (96.5%), Kenya (91%), New Zealand (84%), Austria (80%), Brazil (80%), Austria (74%), Canada (65%) and Denmark (61%). The main renewables in these countries are hydropower, wind, geothermal, and solar.

This trend is spreading as rapidly as the prices for solar, wind, and batteries are dropping. In fact, prices are dropping so fast that BNEF projects that the power from batteries combined with renewables becomes “cost-competitive with new coal and gas for dispatchable generation” — which is power that can be used when it is needed by the grid operators, even if the wind isn’t blowing or the sun isn’t shining.

Overall, Europe transitions the fastest, with Germany in the lead. BNEF projects that over the next decade, Germany will phase out coal and nuclear — and renewables will provide more than 82% of the country’s power. “By 2050, renewables provide 96% of generation,” reducing Germany’s emissions by 97% compared to today. Meanwhile, according to BNEF’s projections the United States will be a laggard, with only 43% renewables in 2050. Much more is clearly possible, but that will take a very different kind of political leadership than we currently have.

## **Coastal Wetland Restoration**

### **Source: Project Drawdown**

Along the fringes of coasts, where land and ocean meet, lie the world's salt marshes, mangroves, and sea grasses. These coastal wetland ecosystems are found on every continent except Antarctica.

They provide nurseries for fish, feeding grounds for migratory birds, a first line of defense against storm surges and floodwaters, and natural filtration systems that boost water quality and recharge aquifers. Relative to their land area, they also sequester huge amounts of carbon in plants aboveground and in roots and soils below.

Coastal wetlands can store five times as much carbon as tropical forests over the long term, mostly in deep wetland soils. The soil of mangrove forests alone may hold the equivalent of more than two years of global emissions—22 billion tons of carbon, much of which would escape if these ecosystems were lost.

Wetlands face a myriad of threats, but thanks to research and advocacy efforts, awareness is growing about the role they play in curbing climate change and coping with its impacts. It is vital to preserve healthy coastal wetlands—keeping a lid on the carbon they contain—while also rehabilitating and restoring those that already have been degraded.

## **Climate Justice**

### **Source: Newsweek**

Young people of color have a lot to worry about these days... With an already long list of serious and even life-threatening issues, environmental justice and the impacts of climate change on our communities seem like just one more existential threat. But this one is different—and while it affects people around the world, it is low-income communities and communities of color who are acutely susceptible to the larger consequences of climate change. Making matters worse, the particular issues that plague our communities, and our solutions to them, are often overlooked in favor of the focuses of well-meaning wealthy white activists. And their remedies often fail to help our communities at all.

Sea-level rise is just one of the issues threatening our communities first and foremost. From the Caribbean and the Gulf Coast to the Maldives and Southeast Asia—our communities are literally the first underwater. The increasing strength of hurricanes and the fact that poor black and brown communities are often centered in low-lying areas have meant that our houses are the first to flood. Meanwhile, the fact that many of these countries and communities contribute comparatively little to climate change, but experience the brunt of the sea-level rise, is unfair yet hardly surprising.

In addition, oil and gas infrastructure, like drilling sites, pipelines and refineries—which have proven negative impacts on health and drive climate change—are typically located in low-income communities and communities of color. From Katrina to Detroit to Standing Rock to Puerto Rico, we have seen that when we resist, we are met with violence, oppression and displacement. And this burden of polluting infrastructure falls on communities of color not only in the U.S., of course, but across the world.

With much attention turning this week to the upcoming U.N. Climate Action Summit and Greta Thunberg's involvement as a youth leader, the time is long overdue to listen to young voices from these disproportionately impacted communities of color. The time has come for us to be recognized as leaders in climate advocacy and solutions.

The environmental justice movement, after all, has its roots in the civil rights, Black Power and Indigenous movements and was initially a response to environmental racism. Communities of color and low-income communities have long been disproportionately exposed to and negatively impacted by hazardous

pollution and industrial practices. The mainstream environmental movement, meanwhile, has failed to understand or address this injustice.

The environmental justice movement emphasizes bottom-up organizing, focusing on the voices of those most impacted, and shared community leadership. It is led by an intergenerational army who recognize these threats as existential.

...We must build a visionary economy that is very different than the one we now are in. This requires stopping the bad while at the same time building the new. We must change the rules to redistribute resources and power to local communities.

Just Transition initiatives are shifting from dirty energy to energy democracy, from funding highways to expanding public transit, from incinerators and landfills to zero waste, from industrial food systems to food sovereignty, from gentrification to community land rights, from military violence to peaceful resolution, and from rampant destructive development to ecosystem restoration.

As frontline youth, we have been raised to be flexible and adaptable to survive. This allows us to understand that the solutions to our climate emergency may not look the same everywhere, but we know that these solutions should be rooted in the communities that are affected by them. They should be rooted in repairing rather than exacerbating historical harm. They should be rooted in building a future for our communities. A future where we will all thrive.

## **Food and Farming**

### **Source: Project Drawdown**

Shifting to a diet rich in plants is a demand-side solution to global warming that runs counter to the meat-centric Western diet on the rise globally. That diet comes with a steep climate price tag: one-fifth of global emissions. If cattle were their own nation, they would be the world's third-largest emitter of greenhouse gases.

Plant-rich diets reduce emissions and also tend to be healthier, leading to lower rates of chronic disease. According to a 2016 study, business-as-usual emissions could be reduced by as much as 70 percent through adopting a vegan diet and 63 percent for a vegetarian diet, which includes cheese, milk, and eggs. \$1 trillion in annual health-care costs and lost productivity would be saved. Bringing about dietary change is not simple because eating is profoundly personal and cultural, but promising strategies abound. Plant-based options must be available, visible, and enticing, including high-quality meat substitutes. Also critical: ending price-distorting government subsidies, such as those benefiting the U.S. livestock industry, so that the prices of animal protein more accurately reflect their true cost.

## **Transportation**

### **Source: NRDC**

Given that transportation is one of America's leading sources of climate-warming pollution, there is no question that we must transition to low-carbon modes of travel to avoid the worst impacts of climate change. That's also one of the key messages from a new NRDC report, *"America's Clean Energy Frontier: The Pathway to a Safer Climate Future,"* which concludes that we can do it with known technologies.

The report outlines a cost-effective pathway to reduce America's greenhouse gas emissions 80 percent by 2050—which scientists say is necessary to keep the increase in global warming below 2°C—using today's proven clean energy solutions. The big news is not just that we *can* do it. It's *how*—with a bold and rapid expansion of energy efficiency and renewable energy, all supported by a modernized grid and with



rapid progress to get the carbon out of the transportation sector. We don't need to wait for new breakthroughs, or rely on risky or costly strategies like new nuclear or unsustainable levels of biomass. Instead, we need to keep pushing forward—hard—on existing clean energy solutions.

### **Three Strategies to Clean Transportation**

1. *Make vehicles as efficient as possible.* Automobiles and freight trucks emit 80 percent of transportation carbon pollution. Applying technologies that take them farther on a gallon of gasoline or diesel will immediately cut their emissions.
2. *Shift to clean, non-petroleum fuels such as electricity to power vehicles.* Today, more than 95 percent of energy in transportation comes from oil. A clean energy future fuels our cars and buses with electricity, increasingly produced from pollution-free renewable power like solar and wind.
3. *Reduce demand for vehicle travel by expanding personal mobility choices.* Today our vehicles are becoming more efficient and less polluting, but those gains are being offset by increasing vehicle activity. By providing alternatives to individual car use such as convenient and reliable transit options, infrastructure to support safe walking and cycling, as well as newer mobility choices like carsharing, bikesharing and on-demand, flexible transit options, we can dramatically reduce solo-driving.

### **Climate “Change” vs. Climate “Crisis”**

You may have heard the terms “climate change,” “global warming,” and “climate crisis” all used to describe the rapid changes taking place to our Earth because of an increase of greenhouse gases in the atmosphere, due to the burning of fossil fuels, deforestation, and other human activities. All of these terms are correct, but the term “climate crisis” emphasizes the seriousness of these global changes and urges us to take action to fight this present-day planetary emergency (not a future problem!).

## Part 7: Inspiration: Meet Climate ARTivists

Art is a universal and powerful means of communication. Its many forms—writing, design, sculpture, photography, film, painting, music, and much more—can educate, inspire, and empower individuals, and ultimately unite people into taking positive action. Check out these artists whose work explores climate, oceans, and humans’ connection to the environment.

### Zaria Forman

Zaria Forman has traveled to the Arctic and Antarctic with NASA, and turns her photographs into large-scale pastel drawings of Earth’s polar regions. By capturing the beauty of these threatened places, Forman believes that people will feel inspired to protect and preserve them. See more of her work at [zariaforman.com](http://zariaforman.com).



**“Greenland no. 50”**



**“Whale Bay, Antarctica no.4”**

## Amanda Gorman

Amanda Gorman is the United States' first-ever Youth Poet Laureate. She writes: "When Al Gore's Climate Reality Project approached me, all the world fell into place as I did research on 'Earthrise', our planet's most famous photo. In this poem, I hope that, like the photo, we can look back on ourselves and our planet and be inspired to protect it, and in so doing, protect ourselves."

### "Earthrise"

On Christmas Eve, 1964, astronaut Bill Anders  
Snapped a photo of the earth  
As Apollo 8 orbited the moon.  
Those three guys  
Were surprised  
To see from their eyes  
Our planet looked like an earthrise  
A blue orb hovering over the moon's gray horizon,  
with deep oceans and silver skies.

It was our world's first glance at itself  
Our first chance to see a shared reality,  
A declared stance and a commonality;

A glimpse into our planet's mirror,  
And as threats drew nearer,  
Our own urgency became clearer,  
As we realize that we hold nothing dearer  
than this floating body we all call home.

We've known  
That we're caught in the throes  
Of climactic changes some say  
Will just go away,  
While some simply pray  
To survive another day;  
For it is the obscure, the oppressed, the poor,  
Who when the disaster  
Is declared done,  
Still suffer more than anyone.

Climate change is the single greatest challenge of our time,

Of this, you're certainly aware.  
It's saddening, but I cannot spare you  
From knowing an inconvenient fact, because  
It's getting the facts straight that gets us to act and not to wait.

So I tell you this not to scare you,  
But to prepare you, to dare you  
To dream a different reality,

Where despite disparities  
We all care to protect this world,  
This riddled blue marble, this little true marvel  
To muster the verve and the nerve  
To see how we can serve  
Our planet. You don't need to be a politician  
To make it your mission to conserve, to protect,  
To preserve that one and only home  
That is ours,  
To use your unique power  
To give next generations the planet they deserve.

We are demonstrating, creating, advocating  
We heed this inconvenient truth, because we need to be anything  
but lenient  
With the future of our youth.

And while this is a training,  
in sustaining the future of our planet,  
There is no rehearsal. The time is  
Now  
Now  
Now,  
Because the reversal of harm,  
And protection of a future so universal  
Should be anything but controversial.

So, earth, pale blue dot  
We will fail you not.

Just as we chose to go to the moon  
We know it's never too soon  
To choose hope.  
We choose to do more than cope  
With climate change  
We choose to end it—  
We refuse to lose.  
Together we do this and more  
Not because it's very easy or nice  
But because it is necessary,  
Because with every dawn we carry  
the weight of the fate of this celestial body orbiting a star.  
And as heavy as that weight sounded, it doesn't hold us down,  
But it keeps us grounded, steady, ready,  
Because an environmental movement of this size  
Is simply another form of an earthrise.

To see it, close your eyes.  
Visualize that all of us leaders in this room  
and outside of these walls or in the halls, all  
of us changemakers are in a spacecraft,  
Floating like a silver raft  
In space, and we see the face of our planet anew.  
We relish the view;  
We witness its round green and brilliant blue,  
Which inspires us to ask deeply, wholly:  
What can we do?  
Open your eyes.  
Know that the future of  
this wise planet  
Lies right in sight:  
Right in all of us. Trust  
this earth uprising.  
All of us bring light to exciting solutions never tried before  
For it is our hope that implores us, at our uncompromising core,  
To keep rising up for an earth more than worth fighting for.

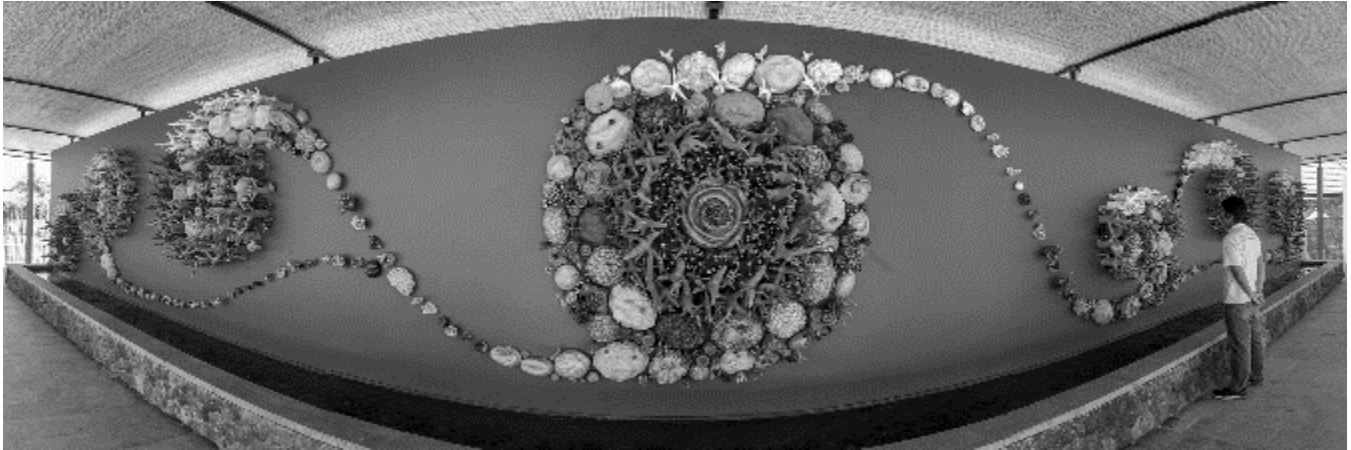
## Justseeds

Justseeds is a network of artists committed to social, environmental, and political engagement, who believe in the transformative power of personal expression to amplify collective action. Justseeds artists contributed graphics and posters for the People's Climate March in 2014. Nearly 400,000 people gathered in New York City to demand that world leaders take action on the climate crisis, while thousands of companion events took place around the globe.

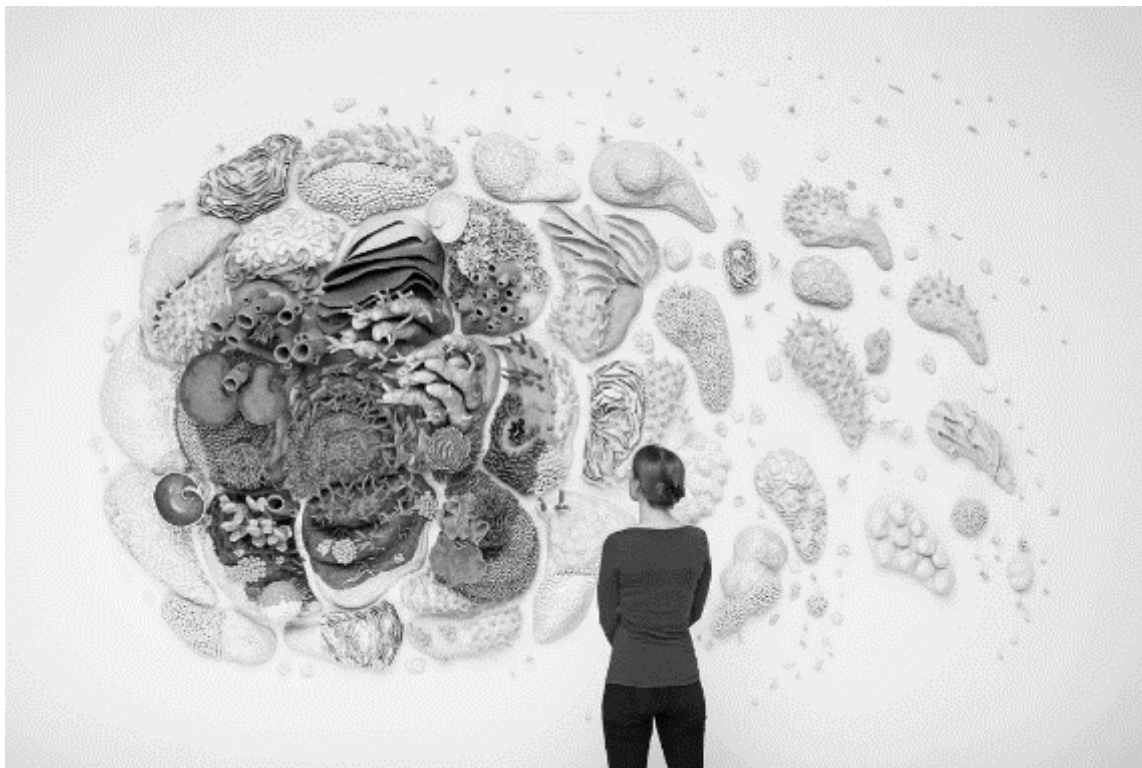


## Courtney Mattison

Courtney Mattison is an artist who creates detailed ceramic sculptural works and large-scale installations that illustrate the fragile beauty of coral reefs and highlight threats they face from human activities. Mattison's work aims to instill appreciation for the beauty and value of coral reefs and inspire protection and conservation of these critically important and biodiverse ecosystems.



**"Semesta Terumbu Karang-Coral Universe"**



**"Our Changing Seas III"**

## Part 8: Final Project

For your final project, you will take what you have learned to make a creative piece that addresses Bow Seat's 2020 Ocean Awareness Contest theme, **Climate Hope: Transforming Crisis**.

You can make a piece of visual art (drawing, painting, digital art, etc.), poetry, music, film, prose (essay or short story), or interactive & multimedia (game, app, podcast, etc.). You will also write a Reflection, which is like an artist's statement.

### What does *Climate Hope* mean?

If you don't think "climate" and "hope" should be in the same sentence, we understand! But we encourage you to imagine a future where humanity does work together to create a society that allows us to live in harmony with nature and with each other.

*Directions: Choose at least 3 of the questions below that grab your attention and take notes on Worksheet #7. Once you have narrowed down your ideas, use Worksheet #8 to plan your final project.*

### Questions to Guide Research & Spark Inspiration

1. How do human systems affect the ocean? How does the ocean affect life on land? How are ocean health and human health connected?
2. How do your daily actions connect you to the ocean?
3. How will climate change impact your school, neighborhood, town, city, or state? What local solutions are already in motion? What solutions would you like to see created or put into action?
4. What will the planet look like in 2100 if we continue with "business as usual"? What will the planet look like in 2100 if we take meaningful action to reduce greenhouse gas emissions?
5. Who is responsible for climate change?
6. What is your personal definition of hope?
7. Why is being hopeful important when facing crises?
8. Who are your climate heroes?
9. What strategies do artists use to help us understand climate change as well as to move us to feel something about it?
10. How can we communicate stories about our ocean and the climate crisis that make an impact on others and inspire them to act?

## References

- "Climate Change." *Monterey Bay Aquarium*, <https://www.montereybayaquarium.org/act-for-the-ocean/climate-change/the-challenge>.
- "Climate Change and Our Ocean." *New England Aquarium*, <https://www.neaq.org/blog/ipcc/>.
- "Coastal Wetland Restoration." *Project Drawdown*, <https://www.drawdown.org/solutions/coastal-wetland-restoration>.
- "Earthrise." *Untold Possibilities at the Last Minute*, [www.untoldpossibilities.org/earthrise](http://www.untoldpossibilities.org/earthrise).
- Harvey, Chelsey. "Oceans are Warming Faster than Predicted." *Scientific American*, 11 Jan. 2019, <http://www.scientificamerican.com/article/oceans-are-warming-faster-than-predicted>.
- Kottasová, Ivana. "'Climate apartheid' will push 120 million into poverty by 2030, UN says." *CNN*, 27 June 2019, <http://www.cnn.com/2019/06/25/world/climate-apartheid-poverty-un-intl/index.html>.
- Macy, Joanna, and Chris Johnstone. *Active Hope: How to Face the Mess We're in without Going Crazy*. New World Library, 2012.
- Mallet, Nyiesha, and Asli Mwaafrika. "Want to Fight Climate Change? Listen to Young People of Color: Opinion." *Newsweek*, 20 Sept. 2019, [www.newsweek.com/lasting-climate-change-solutions-its-time-listen-young-people-color-opinion-1460268](http://www.newsweek.com/lasting-climate-change-solutions-its-time-listen-young-people-color-opinion-1460268).
- "People's Climate March: Downloadable Posters." *Justseeds*, 1 July 2014, <http://justseeds.org/graphic/peoples-climate-march-downloadable-posters/>.
- "Plant-Rich Diets." *Project Drawdown*, <https://www.drawdown.org/solutions/plant-rich-diets>.
- Romm, Joe., "A 100% renewable Grid isn't just feasible, it's in the works in Europe." *Think Progress*, 21 June 2019, <https://thinkprogress.org/europe-will-be-90-renewable-powered-in-two-decades-experts-say-8db3e7190bb7/>.
- "Semesta Terumbu Karang-Coral Universe." Courtney Mattison, <http://courtneymattison.com/coral-universe/>.
- Tonachel, Luke. "A Roadmap to Low-Carbon Transportation." *NRDC*, 26 Sept. 2017, <https://www.nrdc.org/experts/luke-tonachel/roadmap-low-carbon-transportation>.
- "What Is Climate Change?" *NASA*, NASA, [climatekids.nasa.gov/climate-change-meaning/](http://climatekids.nasa.gov/climate-change-meaning/).
- "Zaria Forman." *Zaria Forman*, <http://www.zariaforman.com/>.