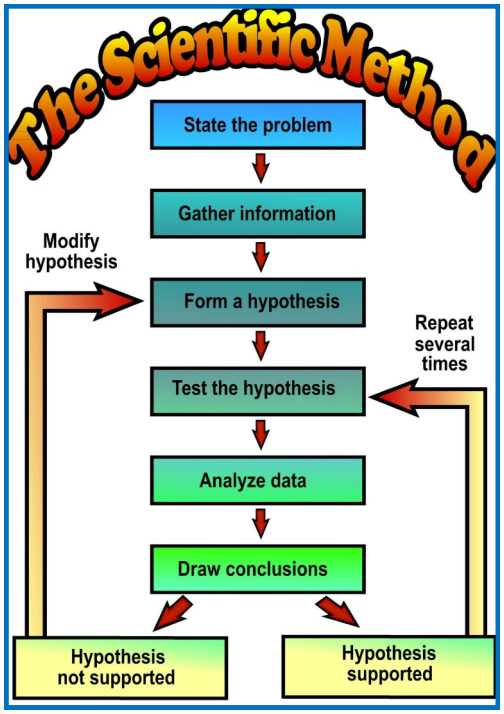
MITIGATION

Unit IV: How can we reduce our carbon footprint and reverse climate change?

According to the Intercontinental Panel on Climate Change (IPCC—established in 1988), there has been a consensus among scientists for at least the past two decades that the primary forcing for observed climate change today is human activity. In their 2001 assessment, the panel stated, "Human activities … are modifying the concentration of atmospheric constituents … that absorb or scatter radiant energy. Most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations." Today, over 97% of published scientists and institutes—including 13 U.S. government agencies and nearly 200 worldwide scientific organizations—agree that we are experiencing anthropogenic warming due to our carbon emissions. This, of course, was not always the case. Even among climatologists, there was skepticism that such a vast and complex system such as Earth's climate could be altered by humans. This is partly due to that very complexity and partly due to the iterative nature of the **scientific method**. Skepticism is a cornerstone of the process!



The scientific method is a defined series of steps to investigate a question or solve a problem. An observation gives rise to a question. The investigator researches the question until they can make an educated hypothesis about the nature or mechanisms driving the observed phenomenon. An experiment is constructed to control variables (or "controls") and test a limited scope of dependent variables to determine their effect. The results of the experiment are analyzed and a conclusion will either support the hypothesis or reject it. Either way, uncertainty in the controls and variables is used to reconfigure the experiment and retest the original hypothesis or a new one. The scientific community is encouraged by the principles of the scientific method to look to falsify the hypothesis in **peer review**—that is, they try to scrutinize the experimental set up and the analysis to look for issues in the original experiment that might cause ambiguity in the conclusions. The experiment should be repeatable, and often in retesting (either by the original investigator or their peers), the procedure is refined and improved to limit uncertainty. Over time, the retested hypothesis will gain strength only if it has it has some level of veracity. The fact that 97% of scientists from around the world are in consensus that we are causing the current warming with carbon emissions is substantial, and should not be dismissed.

So if human activity is at the root of the problem, and the consequences are global in scope and dire in significance, what can be done? The answer is more hopeful than it might seem. In just over 50 years, human innovation has put satellites into orbit and rovers onto the surface of Mars. We have developed

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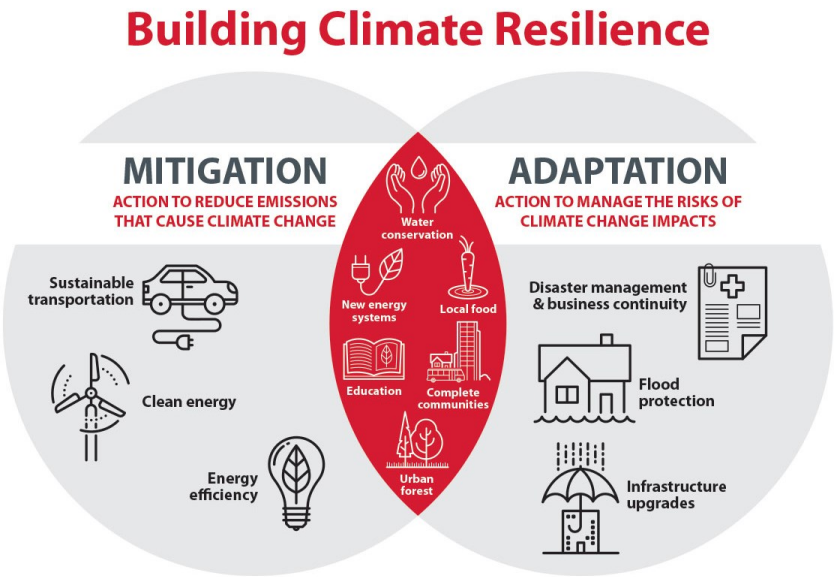
ways to reduce our carbon emissions through practical photovoltaics (solar panels), rechargeable batteries, and electric cars, as well as ways to sequester carbon emissions through geological carbon capture and storage (CCS) technologies. What is needed, now, is a *consensus of global citizens* from all sectors— agriculture, manufacturing, energy, transportation, science, public service, government, and education— that we *can and will* reduce our carbon footprint worldwide.

As highlighted in the last unit, we now know that even small increases in global air and ocean temperatures have had widespread implications for coastlines, marine habitat, storm intensity, freshwater resources, food production, forest cover, species ranges, and human health. Scientists warn that we must limit global warming to 2°C (3.6°F) above pre-industrial temperatures or face catastrophic and potentially irreversible consequences. According to NOAA, researchers predict that this would mean limiting our atmospheric carbon dioxide to 450 parts per million (ppm). We first exceeded 400 ppm in 2014 and the trend is still upwards, so there is work to be done! In **Unit IV: Mitigation** , we will explore what is being done on a global scale to curb emissions and ultimately prevent global warming from reaching the 2°C threshold, as well as what individuals can do at a local level to reduce energy demands.



Mitigation involves both *reducing* emissions *and enhancing* **carbon sinks** to remove CO_2 from the atmosphere. Carbon dioxide has a long lifespan in the atmosphere, so the CO_2 we emit today could have impacts for decades to come. As population increases, so does our total energy demand. That is why energy **efficiency** and **conservation** is critical to curbing future emissions. Even so, the true effect of past greenhouse gases will still be felt for years to come, due to the thermal inertia of the oceans (water's high specific heat means it takes longer to change in temperature in response to inc. heat energy). Therefore, it is essential that we enhance carbon sinks and create a resiliency plan for the future. Often, mitigation and adaptation strategies overlap. In the next unit, we will dive deeper into identifying and managing climate change risks.

IV.A: A Global Effort: The Paris Agreement

Key Concepts and Web-app Resources:

Climate change is a global crisis and therefore requires a global effort to remedy. However, industrialized countries, like the United States, are responsible for far greater emissions per capita than developing countries. The wealthiest countries represent only 20% of the world's population, but account for over 70% of cumulative CO_2 emissions since the Industrial Revolution. Still, if densely populated countries like India and China (each with populations over 1 billion people) continue to rapidly industrialize, they will quickly dwarf U.S. in future emissions. This very debate has stalled international negotiations on mitigating climate change for decades.

In 1992, the UN Earth Summit in Rio, Brazil adopted the United Nations Framework Convention on Climate Change (UNFCCC). With nearly global membership, it helped to create more dialogue between nations about monitoring and reducing human impact on the climate system. In 1997, UNFCCC parties met again in Kyoto, Japan to map out the first legally binding global treaty to curb carbon emissions. Though 150 nations were represented, it mandated the U.S. and European Union to cut emissions to 5% below 1990 levels in the next 15 years, while exempting China and India, and asking for voluntary commitment by other developing countries. Ultimately, despite thirty six developed nations succeeding in the 5% reduction goal, the United States failed to ever ratify the Kyoto Protocol and Canada withdrew from the agreement. Meanwhile, China and India doubled their greenhouse gases released in the past 20 years, pushing atmospheric CO_2 past 400 parts per million, a threshold scientists warned against.

In the period since the UNFCCC was first established in the early 1990's, the impact of the global warming on Earth's oceans, weather system, and living things has become hard to ignore. Guided by the recommendations of the 2014 report made by the International Panel on Climate Change (IPCC), the world came together in 2015 to sign a bold new treaty, committing all of its signers to specific actions (or "nationally determined contributions") to prevent a 2°C rise in global average temperature, with regular reporting on carbon mitigation. Furthermore, the "Paris Agreement" obligates wealthy nations to provide financial support to developing countries to create cleaner energy technology as well as to vulnerable countries to improve resiliency efforts. Though critics believe the Paris Agreement falls short of necessary goals, it is remarkable in being the first international treaty of the sort to receive unanimous support. By December 2017, every country in the world had signed the Agreement. (Though the Trump Administration has stated the U.S. intends to withdraw from the agreement, it cannot legally do so until Nov. 2019, 2 years after its ratification.)

Unit IVA. Web-app Resources:

>Adaptation and Resiliency

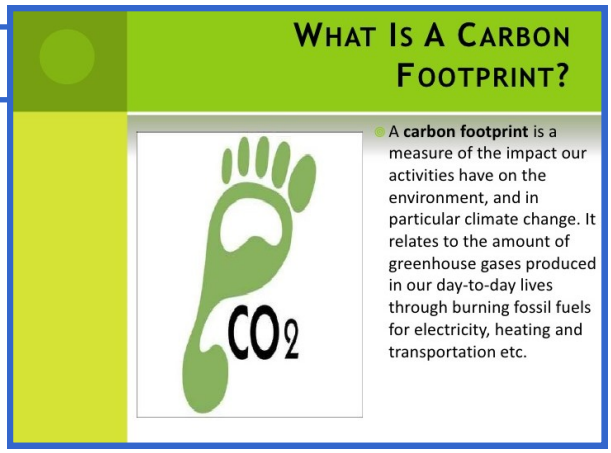
>>The Global Effort

>>>**The Benefits of Global Action** (EPA Video)

>>>**Paris Agreement Interactive** (CAIT Climate Data Explorer)

>>>**Meeting World Energy Lab** (The Habitable Planet)

IV.B: Your Carbon Footprint



Key Concepts and Web-app Resources:

Everything we purchase, use, eat, throw away, or transport can be associated with an ecological footprint—that is the amount of land required to sustain each actions use of natural resources. While a large factory, company, or power plant may utilize far more natural resources and put out far more pollution than the average person, as consumers of those goods, we are responsible for our own piece of the pie. When it comes to stemming climate change, we can attribute the size of our individual **piece** based on our energy **efficiency**, our energy/resource use or **conservation**, and our **lifestyle**. For instance, a newer car may have better fuel efficiency, a larger home likely costs more to heat, and a vegetarian diet requires fewer natural resources to support. Together, these choices make up a person's **carbon footprint**—a quantifiable estimate of the number of tons of carbon dioxide per year emitted as a result of that person's unique day to day life choices.

According to the World Bank, the average human on Earth has a carbon footprint of 5.4 tons (4.9 metric tons) of CO_2/year. Compare that to the United States, where the average American has a footprint of approximately 18 tons (16.4 metric tons) of CO_2/year. Americans live in larger homes, drive larger gas-guzzling vehicles, and consume more meat than people in any other country in the world! Clearly, our carbon footprint matters—and it matters more! Small changes in our lifestyles and a few investments in our homes can save a lot of energy and therefore carbon.

Many carbon footprint calculators exist online to help you begin to audit your individual or home energy consumption. A little research and math may be necessary, but once the work is done, you can determine which area of your life could stand to improve in sustainability the most. Generally, you can think of lowering your carbon footprint in three categories: improve efficiency (work smarter, not harder!), increase conservation efforts (waste not, want not), and simplify your lifestyle needs (go green). Some of the fastest ways to improve energy efficiency is to add insulation to your home ceiling, walls, and floors, weatherize your windows and doors, switch to a car with better gas mileage, like a hybrid, replace lightbulbs, appliances, and utilities with energy star rated ones, use a low-flow shower head, and make sure the refrigerator has a strong seal and clean coils. To save energy through conservation efforts, try using public transportation or carpooling, turn off lights and unplug electronics when they aren't in use, reduce—reuse—recycle to create less waste, get a programmable thermostat and set it to be 2°-10°F cooler In the winter and warmer in the summer when you aren't home. Finally, shifting larger lifestyle choices can require some bigger commitments, but can really shrink your footprint considerably. Some greener lifestyle choices include reducing meat consumption, shopping for local goods, buying second-hand, walking/biking more, and composting food waste.

Unit IVB. Web-app Resources:

>Adaptation and Resiliency

>>Thinking Globally, Acting Locally

>>>Carbon Mitigation

>>>>Your Carbon Footprint Calculator

IV.C: Thinking Globally, Acting Locally

Key Concepts and Web-app Resources:

Climate change, though global in its impact, will mean different things for different populations around the planet. Some areas may experience extensive drought, while others may experience more heavy rain events. Each population must adapt to their specific regional concerns. Similarly, carbon mitigation strategies can differ depending on the needs, resources, and share of the responsibility of each community. The key is to think globally and act locally. Community organizations and local governments of highly populated cities and states can have a collective impact that rivals smaller nations. Even large corporations can have tremendous reach in coordinated efforts to lower their carbon footprint. By adopting the Paris Agreement at a city-level, 407 U.S. mayors could help the U.S. meet its climate mitigation goals even if the U.S. withdraws at a national level.

For some communities, states, or countries, enhancing their forest cover to sequester more carbon may be the most effective effort. For others, creating better emission standards might make more sense. Developing areas could try to build more sustainably with renewable energy sources, recycled materials, and energy efficient designs. Rural areas could improve land use thereby preventing the need for more deforestation whilst retaining healthy soils that can hold more carbon. As the productivity of farmland increases and more people move into urban environments, suburban and rural zones can also encourage *reforestation*.

Human population is still growing exponentially, so our dependence on fossil fuels is unlikely to disappear overnight. Each community can and should reconsider its power-grid and create plans to divest from coal and oil, looking toward clean, renewable energy sources like solar, wind, geothermal, hydro, and tidal, power more and more. These technologies have improved significantly in the past few decades and have become much more affordable. Using a mapping tool like the NREL Renewable Energy Atlas, we can not only track national *progress*, but see untapped *potential* for energy grid changes. Another helpful resource, the U.S. Climate Resilience Toolkit was developed by NOAA to help determine your city's risks and readiness in addressing climate change. One of the tools is the Climate Explorer app that can chart or map your local climate observations as well as climate predictions in a higher or lower emission scenario. By linking mitigation and adaptation directly to *your* hometown or region, you begin to think about personal connections to climate change and you become more involved.

Unit IVC. Web-app Resources:

>Adaptation and Resiliency

>>Thinking Globally, Acting Locally

>>>Carbon Mitigation

>>>>Reforestation for Carbon Sequestration

>>>Tracking National Progress

>>>>National Renewable Energy Sources (NREL RE Atlas)

>>>NOAA Resilience Toolkit: Climate Explorer