

# Climate Change - What can YOUTH do?

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## ABSTRACT

Climate change has not only been proven by scientific data globally but also by the changes we are experiencing in our local states and even local counties. The cause of climate change is believed to be anthropogenic (caused by humans), including transportation, electricity generation, manufacturing industries, agriculture, and buildings, which emit excess greenhouse gasses. Combating climate change is not the responsibility of just one country, industry or organization; it is the responsibility of all people on earth because our demands and needs both directly and indirectly boost greenhouse gas emissions from different aspects. As the future stewards of the planet, we, the Youth, need to take action, not only to be more environmentally conscious ourselves but also to take the lead on different forms of environmental education to supplement the school curriculum and ensure environmentalism is a part of the way we do things as a society. Besides, youth should advocate for resilience and adaptation to climate change to reduce the harm of hazardous events due to climate change. The climate is changing, but we have the energy and passion to help create a real, sustainable world for ourselves and future generations.

## **Introduction**

Climate change and global warming are appearing more frequently in global news, local news, and social media. The terms are often used interchangeably, but they are different.

- Global warming is only a part of the changes to our climate, and it implies a specific metric, global average temperature, and its warming or positive trend, which is believed to be caused by the increasing concentration of greenhouse gasses, including water vapors, carbon dioxide, methane, nitrous oxide, and ozone <sup>1-2</sup>. The global temperature has increased by 1°C since 1900, and it will increase by 4°C in 2050 if greenhouse gas emissions continue increasing based on current trends <sup>3</sup>. Though the degree of contribution of greenhouse gasses from each source can vary, the fact that anthropogenic factors (human activities) contribute majorly to climate change is solid. In the year 2022, the greenhouse contribution was 28% from transportation, 13% from buildings, 23% from manufacturing, 25% from electricity generation, and 10% from agriculture <sup>4</sup>.
- Climate change is the altering distribution of weather states in different places, which refers to the various measures of climate, including temperature, wind patterns, and precipitation over a long period of time. Scientists apply observations combined with computer models to investigate and predict climate change, not only in the present but also in the past and future <sup>2</sup>. The accumulated climate data records can provide evidence of climate change, including, but not limited to, global temperature increases, rising sea levels, heat waves, hurricanes, wildfires, droughts, floods and precipitation, and so on. Climate change, such as a small increase in temperature, can affect environmental sustainability and directly affect human and animal mortality both in the short term and long term <sup>3</sup>.

If people on earth continue current behaviors that are harmful to the environment and only think for their own benefit, greenhouse gasses will further increase, and climate change will become increasingly severe and

unpredictable, which will harm not just the places reported in the current news which may still be far from you, but to the places near or right where you are living. Climate change is not a distant concept, and combatting the impact of it is the most urgent task of the century. Everyone, especially youth, should stand up and contribute their best effort. But what exactly are the youth doing and what are their reactions? An environmental impact survey conducted in 2022 in the United States by The Harris Poll on behalf of 4-H to youth aged 13 and above disclosed some facts about youth reactions to climate change <sup>5</sup>. It revealed that 63% of youth are concerned that their family will be affected by climate change in the near future, and 84% believe that if we don't address climate change today, it will be too late for future generations. About 60% of youth think they have started taking action to minimize energy use and waste. However, all these actions are still limited; there are many more environmental actions that youth can take. More environmental youth organizations should be formed as there are larger groups of the population still ignoring climate change and continuing to contribute their carbon footprint. Environmental education is needed more than before for different populations, including kids, teens, and adults. Youth are at the forefront of environmental concerns and should become the main educators besides the school system and become advocates to make their impact against climate change.

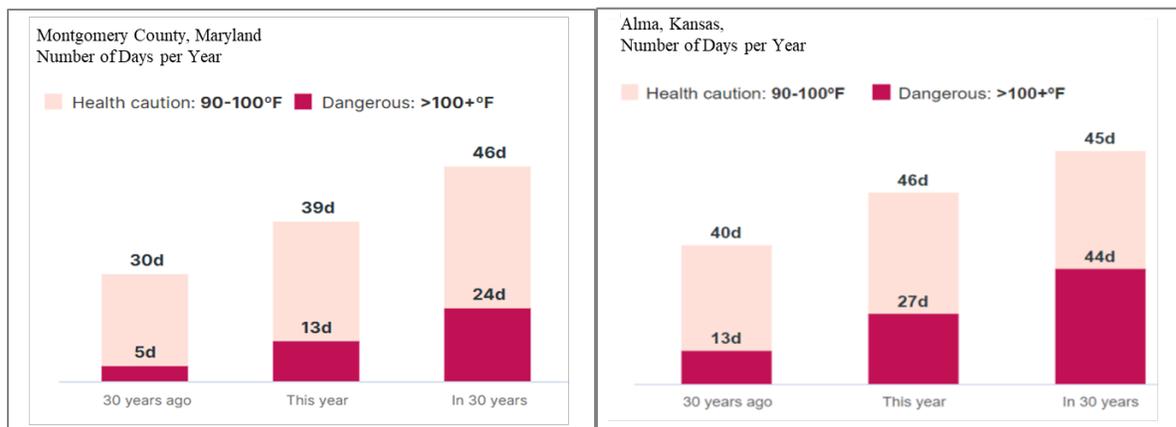
## The Current Status of Climate Change

Both global land and sea temperatures have been increasing since 1850, with the average earth temperature increasing by 0.11°C per decade up till 2023; however, the rate has increased to 0.2°C per decade since 1982 <sup>6</sup>. Historically, oceans have absorbed over 90% of excess heat resulting from greenhouse gas emissions because of the huge amount of water-covered area on earth and the higher heat capacity of water than land. Without bodies of water, the land temperature that we are experiencing would be a lot hotter than it is today <sup>7</sup>. In addition, the excess heat is not equally distributed on earth. Hence, the increase in global temperature will have disproportionately destructive impacts on the environment. It has been predicted that areas of human habitation will have a temperature increase 1.5 times more than the global average due to human activity and living conditions <sup>8</sup>, and the Arctic Ocean winter temperature will warm three times faster than the global average because the temperature change at high latitudes will be amplified, due to snow and ice albedo feedbacks <sup>9</sup>. Though water can absorb more heat and the temperature may appear to increase slowly, the global warming impact on aquatic ecosystems is more significant because aquatic ecosystems, especially aquatic animals, have limited ability to adapt to climate change, and therefore, the abundance of species, migration, growth and distribution of aquatic animals all will be impacted greatly <sup>10</sup>. One example that proves the migration is that the Maryland Department of Natural Resources reported that a man fished the largest Florida pompano from the Chesapeake Bay of Maryland because Maryland has been warmer than normal due to climate change <sup>11</sup>. The same report also mentioned that warmer water, with a 1-2° F temperature increase in the Chesapeake Bay, holds less oxygen, making it harder to survive for local fish like the striped bass <sup>11</sup>.

Climate change also causes rising sea levels, which is not only because of water thermal expansion due to temperature increases but also because of the melted water from glaciers. The average sea level rose almost 9 inches from 1880 to 2020, and the average sea level rise of 4 inches in 2022 alone was recorded as the highest increasing record <sup>12</sup>. The rise in sea level will be the most costly effect of climate change because a huge number of people will be forced to migrate <sup>13</sup>. Many communities will experience frequent damage due to flooding and storms, and further degradation of coastal wetlands will be caused by sea-level rise; besides, rice production in many areas, especially in Asia, will also be significantly reduced <sup>14</sup>. A report has projected that in Maryland, the sea level will rise 1-1.6 feet by 2050 and 4.9 feet by 2100. With only a 3-foot rise, several areas along the Maryland coast would be submerged, particularly areas by the Chesapeake Bay; Annapolis and Baltimore will be the two cities most severely affected in Maryland <sup>15</sup>.

Heat waves are another aspect caused by climate change, which describes extreme heat and is a period of abnormally hot weather. Due to climate change, the number of yearly heatwave days is increasing each year in areas of heatwave history. The historical extreme heat data of two random places in the United States, Montgomery County, Maryland (left) and Alma, Kansas (right), as examples, are presented in Figure 1 <sup>16</sup>. The data, aligned with the

prediction by WHO, show that with increasing average temperatures, dangerously hot days and heatwaves will occur more frequently<sup>17</sup>. Temperatures that are above 90°F can be physically dangerous for vulnerable individuals; temperatures that are above 100°F can be hazardous for everyone<sup>18</sup>. It has been well known that increased exposure to heat has detrimental effects on human health, not only limited to morbidity but also mortality<sup>19</sup>. Extreme heat can worsen health risks from chronic conditions, including respiratory, mental, and cardiovascular conditions, and cause acute kidney injury. In August 2024, Maryland reported that heat-related ER visits were the highest within six years since the Maryland Department of Health began publishing that data in 2019<sup>20</sup>. In addition, the News reported by Stanford University also mentioned that extreme heat threatens the health of children and the elderly first as they are vulnerable populations, not only physically: extreme heat also impacts mental wellness, and it is believed that higher rates of violence and suicide are associated with the extreme heat<sup>21</sup>.

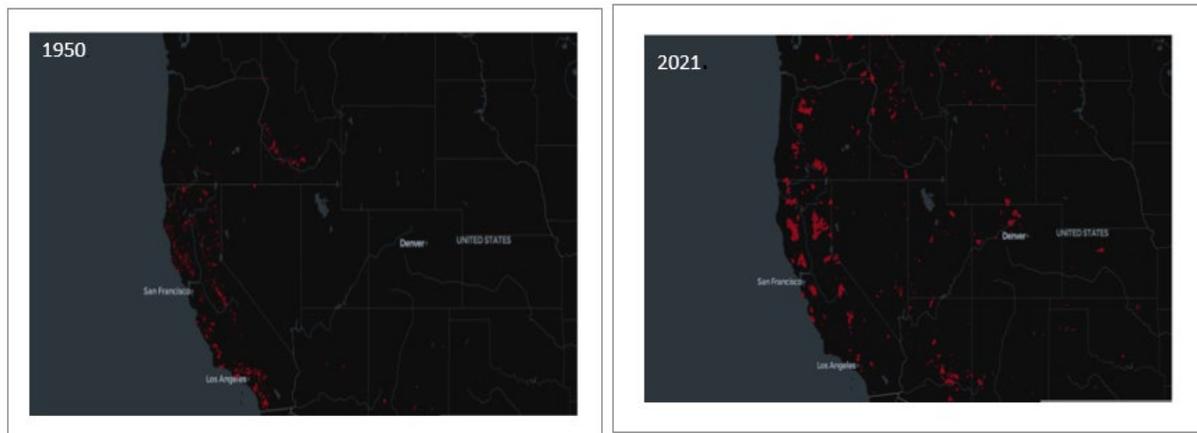


**Figure 1.** Changing Heat Patterns in Montgomery County, MD (left) and Alma, KS (right)

A hurricane is a strong storm that can be life-threatening. The intensity and frequency of hurricanes are considered related to climate change and should increase with climate change developments based on the theoretical model<sup>22</sup>. Interestingly, the total number of hurricanes is not changing. However, tropical climate regions, where hurricanes form, are expanding, and hurricane-prone regions are moving in the direction of the North and South poles due to climate change, which is proved by scientific data. The impact of this shift is significant as cities that have never previously been affected by hurricanes are now being affected, endangering millions of residents who are not prepared for flood and wind damage. This shift puts populated coastal areas in the path of severe storms and puts the north and south of the tropics in the Northern and Southern Hemisphere, respectively, in danger as well. The decrease in temperature difference due to global warming is considered the factor that contributes to the shifting of hurricane patterns<sup>23, 24</sup>. The recent Hurricane Helene in 2024 left highly destructive damage from the Gulf Coast of Florida, passing Georgia and Tennessee to North Carolina, about 500 miles, is proof of climate change. The deaths caused by Hurricane Helene are about three times the cumulative deaths over the 28 years in the covered area due to extreme weather. The unpredictable hurricanes due to climate change make no place safe.

A wildfire is an unwanted and unplanned fire in a natural area such as a forest or grassland. Drawing a direct relationship between wildfires and climate change is not an easy task, as the cause of wildfires can be natural or anthropogenic. However, it remains true that many dry conditions, including less snowpack, longer periods of droughts, and frequent lightning strikes due to climate change, can dramatically contribute to wildfires<sup>25</sup>. Historical trends indicate wildfires are getting worse across the world. The land area burnt by wildfires in 2000 was double that in 1990<sup>26</sup>. Even worse, wildfires are not only happening on the West Coast but have expanded to mid-America. An analysis showed that the wildfire risk for Montgomery County, Maryland, will change from no risk now to moderate risk in 30 years due to climate change, with up to 104,108 properties being potentially affected, representing 37% of

all properties in Montgomery County<sup>27</sup>. The wildfire data in the U.S. of 1950 (left) and 2021 (right), Figure 2, are represented below to illustrate the expansion of wildfires due to climate change<sup>26</sup>. This shift is attributed to drier fire fuel that is greatly influenced by climate change. Wildfires not only burn forests and land and bring danger to wild animals, but they also directly contribute to climate change by emitting large amounts of greenhouse gas carbon dioxide. The greenhouse gas emissions record from California's wildfires in 2020 has demonstrated that wildfires were second to transportation in emitting greenhouse gasses. In addition, wildfire smoke spreads toxins, such as benzene, sulfur dioxide, and many more, across a wide area due to incomplete combustion, which brings vital danger to humans, animals, and the environment<sup>25</sup>. In July 2023, Canadian wildfires led to hazy, smoky skies in Montgomery County, to which the Maryland Department of Environment issued an air quality alert indicating the concentration of the fine particulate has become harmful to human health. We share the same air on earth, and this is a good example of climate change being a global issue.



**Figure 2.** Wildfire (in red) perimeters in the U.S., 1950 (left) and 2021 (right)

A drought is a period of drier-than-normal conditions, which can last for days or even years<sup>28</sup>. The current climate change conditions have made South America experience the driest July in history in 2024<sup>29</sup>. It has been predicted that the area of droughts in East Africa may increase by up to 54% by the end of the 21st century<sup>30</sup>. Excessive heat is the cause of the droughts. Compared to other disasters, such as floods and wildfires, droughts are called silent disasters that have severe impacts on agriculture yield and food security<sup>29</sup>. In July 2024, Montgomery County experienced the most excessive heat within 15 years, which caused a drought and caused lawns and gardens to turn yellow<sup>31</sup>. Residents and businesses were asked to conserve water and help reduce demand on the region's water supply systems. Drought impacts are not limited to farmers but every resident.

Floods and precipitation are also significantly related to climate change. Climate change, especially global warming, can alter river flood size and frequency and make it less predictable in each area. The current data not only shows that large flood areas have been moved across the Pacific Northwest, northern Great Plains, and Northeast but also shows that extreme single-day precipitation occurred more frequently in the recent 30 years in the contiguous 48 U.S. states<sup>3</sup>. Large floods can harm crops and damage homes and roads, which impose high costs on society and the economy. Floods and precipitation can also impact something that we may never think of. Montgomery County disclosed a few of the potential impacts that floods and precipitation can make. For example, floods and precipitation cause more erosion and sedimentation, which will fill up habitats, causing many aquatic critters living in between rocks and logs to have no place to live; even worse, sediment also impacts drinking water for places like Montgomery County, where local rivers and reservoirs are water sources. Cloudy, sediment-laden water requires extra filtration and treatment steps, which add up the cost for residents<sup>32</sup>. With climate change getting worse and more frequent floods

and precipitation happening, it is not hard to imagine that climate change will increase the cost of living, which impacts everyone.

## What Can Youth Do to Address Our Changing Climate?

In combating climate change, there is already the Paris Agreement, a legally binding international treaty about climate change adopted by 196 parties. The main goal is to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels” and pursue efforts “to limit the temperature increase to 1.5°C above pre-industrial levels.” Each country has been making national and local policies to guide its economic development towards this goal, for example, transitioning to clean energy generation and zero-emission vehicles. The direction is right, but the development speed is less than expected and different in each country.

More action must be taken. It is important to understand that solving climate change is not just the responsibility of countries and governments, industries, and organizations; it is the responsibility of every person, as our demands and our needs are what drive climate change. To combat climate change, we need to reshape the way we think and the way we do things. The decisions that we make every day may seem simple, but they add to our carbon footprint on this earth. As youth, we are the future of the planet. We are the ones who will be most impacted by our changing climate, so we must take action to fight for our own future. It may seem overwhelming at times because there are over 8 billion people on the planet and we have bypassed the 350 ppm (safe level of carbon dioxide in the atmosphere), but we can do much more than we imagine. Every small change we make now can bring future generations a better living environment, food security, and health. Youth can contribute to a greener future and help to solve the global crisis of climate change. To find the solutions to climate change, we should analyze each of the causes of climate change and then provide our own youth’s solutions.

### Youth Solution I - Self-Action to Reduce Carbon Footprint

- Youth solution - Transportation cause: transportation itself is responsible for 28% of greenhouse gas emissions <sup>4</sup>. Using petroleum-related fuel in engines can release considerable amounts of carbon dioxide into the environment, where passenger cars are the biggest contributors, accounting for 41% of those emissions, followed by trucks, which account for 23% of those emissions <sup>2</sup>. Youth can lead by example and encourage their families to transition to zero-emission vehicles, like all-electric vehicles. Instead of driving, we can walk, ride E-bikes or bicycles, scooters, or take public transportation and carpool. All of these are effective ways to reduce greenhouse gas emissions from transportation.
- Youth solution - Electricity cause: about 60% of electricity in the United States is generated from the burning of fossil fuels, which accounts for about 25% of greenhouse gas emissions <sup>4</sup>, including carbon dioxide, nitrous oxide, and methane <sup>33</sup>. In 2021, renewable energy, including hydropower, solar, and wind, accounted for only around 5% of electricity generation <sup>33</sup>. Youth can lead by example and encourage their families to install solar panels to help accelerate the transition to clean energy, reducing the use of fossil fuels.
- Youth solution - Industry cause: manufacturing industries that produce our goods are significant sources of greenhouse gasses, contributing 23% <sup>4</sup>, mainly from manufacturing carbon-intensive products, such as basic chemicals, iron/steel, concrete, paper, aluminum, and glass <sup>34</sup>. Youth can lead by example and teach their family to correctly recycle items such as paper, plastics, aluminum, and glass, which are frequently consumed in our daily lives. We should use reusable bags for shopping, choose to purchase products with environmentally friendly packaging, and purchase less to reduce waste. We can donate our clothes and household goods

to reduce new consumption. All of these ways to reduce, reuse, and recycle can help the manufacturing industry reduce greenhouse gas emissions by not producing so much in the first place.

- Youth solution - Agriculture cause: Agriculture, including the global food system, accounts for 10% of U.S. greenhouse gas emissions<sup>4</sup>. It was found that agricultural activities majorly emit nitrous oxide (chemical fertilizer and food system), methane (industrialized livestock), and very little amounts of carbon dioxide<sup>35</sup>. Deforestation that opens new land for agricultural activity majorly emits carbon dioxide as it removes the vegetation and soil that store carbon by keeping it at ground level or underground<sup>36</sup>. In addition, livestock also contributes a great deal to the emission of methane, so food originating from plant or animal sources poses varying degrees of adverse effects on global warming<sup>37</sup>. Youth can reduce food waste, make sustainable meals, pack our diet with more plant-based foods, and train families to make compost. At home, instead of cutting down trees, we can plant trees, as trees remove carbon dioxide from the air. With all of these, we help agriculture reduce greenhouse gas emissions.
- Youth solution - Buildings cause: Buildings (both commercial and residential) also emit a lot of greenhouse gasses, accounting for 10%<sup>4</sup>. All the activities within buildings, including lighting, cooking, heating, hot water supply, ventilation and cooling, and running appliances, contribute to these emissions<sup>34</sup>. Even worse, about 30% of the energy used in U.S. buildings goes to waste due to building inefficiencies<sup>38</sup>. At home, we should save as much energy as we can by using LED lights, turning off lights when not in use, reducing air conditioning use, reducing the water heater temperature, adjusting our thermostat seasonally to save energy, and encouraging our family to change to high-energy efficient appliances. Another important way to save energy at home is to turn off all digital devices when they are not being used and try to reduce the use of these digital devices, including cell phones, computers, iPads, and electronic notebooks.

## Youth Solution II - Education to Make More People Environmentally Conscious

One of the most impactful actions that youth can take is environmental education. Current environmental strategies are not creating change fast enough because environmentalism is not coded into our society's culture. Only through education can we completely change people's social behavior and make environmentalism a habit. The impact of a sustainable social behavior change will be long-term. A large portion of our population, including many adults, still do not have much concept of environmental protection. There are a few possible thinking paths in people's minds that ultimately lead to people's wrong behaviors toward the environment:

1. Overestimating nature's capacity - they think no matter what people do to nature, nature will recover by itself.
2. Underestimating their individual impacts on the environment - they think small things they do, good or bad, will not have an impact on the environment and will not save the environment.
3. Disbelief in scientific data that proves climate change.
4. Thinking that climate change will not be coming soon, so they will not be affected in their life.
5. Thinking climate change causes no personal harm to humans.

No matter what belief an individual holds, it is apparent that environmental education is very much in need, and only environmental education can change people's mindset. Environmental education should occur in different forms as different people will accept some forms of education more readily than others. Youth can lead such multi-faceted forms of education by founding their own clubs or organizations to provide environmental education to the whole population, including other youth, younger kids, and even adults, using their creative thinking skills. This will fill the gap of lack of environmental education in the K-12 education system. Youth can promote environmental education in schools, communities, parks, libraries, and town centers. There are already some youth environmental organizations leading the change, such as Eco MoCo<sup>39</sup> and Peer Outreach With Energy Resources (POWER)<sup>40</sup>. Eco

MoCo hosts various forms of environmental education and advocacy projects, including library and school presentations, posters, trash pickups, letter-writing campaigns, a published environmental recipes cookbook, environmental contests, recycled art events, social media campaigns, policy papers, workshops, tabling events, testimonies, clothing and household items drives, and more. POWER, a joint program of Nature Forward and Montgomery County Department of Environmental Protection, trains high school students to host energy education presentations across Montgomery County, Maryland, in libraries and community recreational centers, as well as various energy literacy events. However, this is not enough. The whole country and the whole world need a lot more of these youth-led environmental initiatives to educate and inspire changes for a more environmentally focused societal culture. Solving climate change from its roots means changing people's social behavior through environmental education, and youth can lead the role.

### Youth Solution III - Advocacy for Resilience and Adaptation to Climate Change

Climate change is real and is happening now. The impacts will continue to be felt by us today and tomorrow. While we are trying to reduce our carbon footprint in many ways to slow it down, the impacts have been catastrophic as we have seen. To reduce the damage caused by climate change, we need to admit that climate change is real and realize that the weather might be unpredictable. A place that never has had a hurricane may have a hurricane happening. A place that never has flooded may have a flood next summer. All people on the planet must adapt and be resilient to climate change. Adaptation refers to adjusting to the actual and expected change in climate and its effects. Resilience means being able to anticipate, prepare, and respond to hazardous events caused by climate change. There are still many populations that are not aware of climate change and even don't recognize its prevalence. As a result, when hazardous events due to climate change suddenly happen, those people are not prepared at all, and more damage will happen to them. Youth should take their role as advocates for resilience and adaptation to climate change. Youth can make flyers, give presentations, and use social media to advocate how to cope with hazardous events like hurricanes or floods. Youth can use current news as examples to share how the weather is unpredictable and what people should do to prepare for these weather events. Youth can teach younger kids all these hazardous events due to climate change and use games to teach young kids how to escape from these. Youth can also interfere with adults' decision-making through letter-writing campaigns to ensure adults make the right policy decisions for resident buildings, roads, and water reservoirs that are resilient and adaptable to climate change.

### Conclusion

Climate change harms every person on earth, physically and mentally, both directly and indirectly. It also affects economies, biodiversity, and food security. With only a 1°C increase in global temperature so far, we are already experiencing severe impacts such as rising sea levels and extreme weather. It is hard to imagine what will happen to the world if global temperatures increase by 4°C. The cause is primarily anthropogenic, as greenhouse gasses are released from human activities. Continuing such harm will only facilitate a greater increase in global temperature, and many areas of the world will experience more unexpected damages. Low-income countries and the most vulnerable communities that contribute to climate change the least are being affected the most, while when fighting climate change, they have the weakest ability to fight due to economic and technological limitations. The transition to a more sustainable world can only take place successfully through collaboration between players locally and internationally with effective policy frameworks, facilitating green infrastructure and technology developments and adaptation. A global fund and a shared technology network will be needed for low-income countries to combat climate change. At the same time, more environmental education must take place to fundamentally reverse the social behaviors and mindsets that oftentimes unconsciously accelerate climate change. Youth should start to change not only their own actions but, more importantly, take the lead on a multi-faceted environmental education to make people's social behavior more environmentally friendly and ultimately solve environmental issues, such as climate change. Besides, youth

should advocate for resilience and adaptation to climate change to reduce the harm to humans during hazardous events caused by climate change.

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