



N.C. Air Awareness Annual Report July 2020 – June 2021

North Carolina
Department of Environmental Quality
Division of Air Quality
Planning Section

<https://deq.nc.gov/ncairawareness>



COVID IMPACTS

This annual report outlines the N.C. Division of Air Quality's (N.C. DAQ) overall work to inform North Carolina citizens about air pollution and how to reduce their impact on air quality which can benefit the entire community. The reporting period is in line with the state fiscal year (SFY) 2020-2021 and covers July 1, 2020, through June 30, 2021.

Just as many state agencies and businesses were adversely affected by the COVID 19 pandemic, N.C. DAQ's education and outreach was also impacted. For the majority of 2020-2021, N.C. DAQ operated in a remote or telework mode. This is an important change in the way in which the N.C. Air Awareness program operates. Many of the in-person events we attend and promote were cancelled and have not resumed. Regardless, N.C. DAQ continues to outreach goals as staff work remotely even though face-to-face meetings are most effective for our programs. However, despite the reduced amount of in-person activity, the program continued to deliver air quality messages, engage with the public, and share ways to reduce harmful air pollution through voluntary actions.

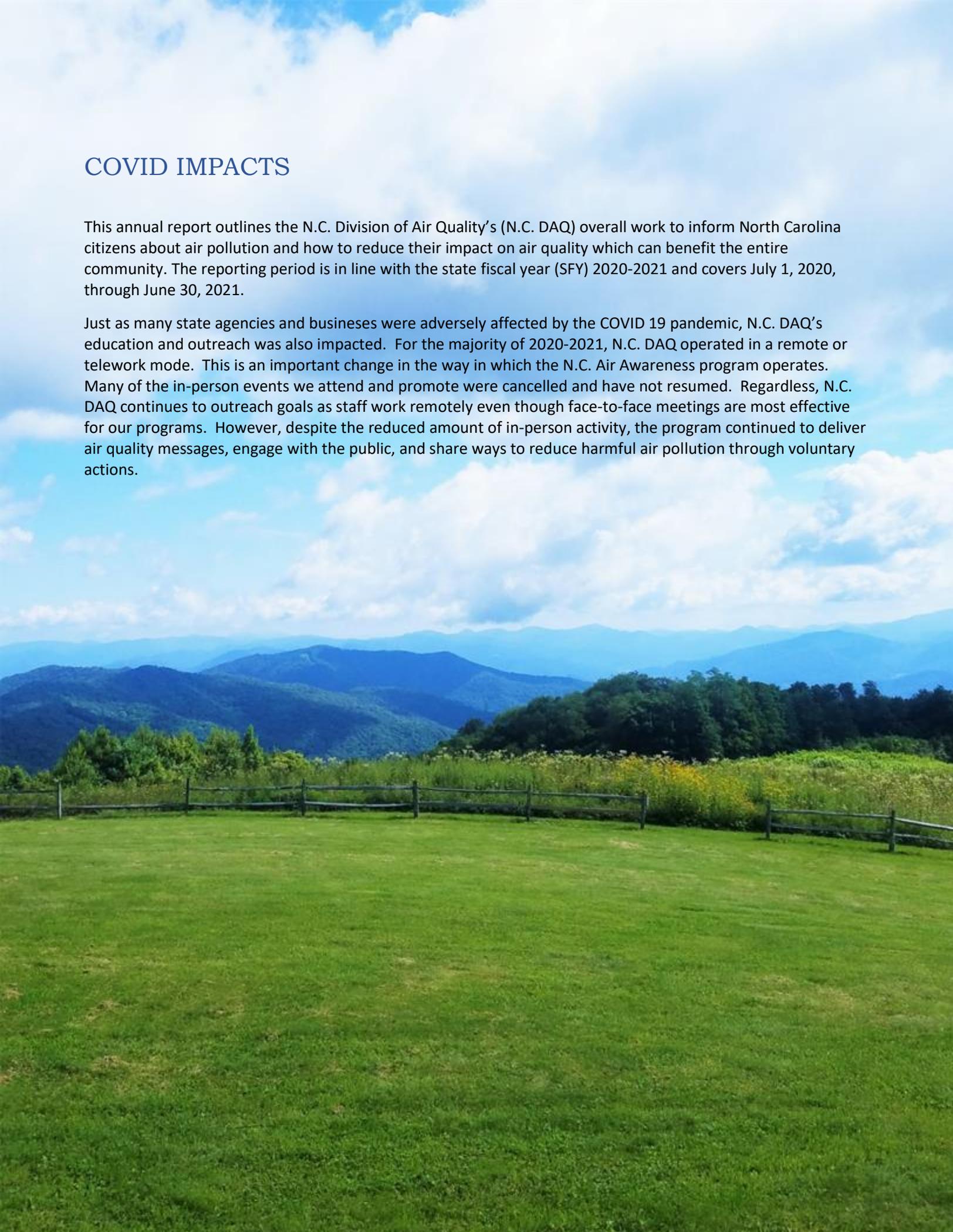


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HIGHLIGHTS



EDUCATION

- Held 19 virtual education events
- Reached over 800 students
- Worked with 15 different schools from across the state



TRAININGS/WORKSHOPS

- Provided professional development to over 200 educators
- Helped to create a new professional development initiative: N.C. Climate Education Network
- Increased training and provided resources for regional office staff and their outreach programs



COMMUNITY ENGAGEMENT

- Mecklenburg County's Air Quality Learning Station has been built in First Ward Park, Charlotte. It is now up and running for school groups and passersby to explore
- Through virtual platforms reached over 2800 people
- Celebrated EPA's Air Awareness week and Earth Day through Facebook and blog posts sharing tips on how to improve air quality



PARTNERSHIPS

- 5 new partnerships in continuing education that spread across the state
- STEM (Science, Technology, Engineering, Mathematics) education initiative
- Further enrichment in climate change education with the N.C. Forest Service and Department of Public Instruction Driver's Education program



RESOURCES DEVELOPED

- 42 new virtual resources developed for air quality education
- Videos, Ed Puzzles, quizzes, study guides, and training documents
- Designed to be easy, "grab and go" for educators across the state

INTRODUCTION

We are pleased to present the N.C. Air Awareness Annual Report for state fiscal year (SFY) 2020-2021 and covers July 1, 2020, through June 30, 2021. The N.C. Air Awareness annual report provides highlights of key air quality education and outreach efforts for the North Carolina Division of Air Quality (N.C. DAQ) and the stretch of our education efforts despite challenges, like the coronavirus pandemic.

Our network of local air awareness coordinators, environmental educators, partners and N.C. DAQ staff have compiled data regarding the educational and outreach services occurring across the state. This data is utilized to provide a snapshot of the types of engagement occurring as the result of N.C. Air Awareness program and the scale of its outreach efforts across the state. The report is segmented into three main categories including:

Education efforts – kindergarten through 12th grade school presentations, activities and training and workshops for educators to increase students’ knowledge about air quality matters.

Community engagement efforts – participation in fairs, festivals, Earth Day celebrations and other local events to reach the public and increase knowledge about voluntary actions that can be taken to protect the air quality.

Partnership efforts – partnering with organizations to help their employees learn about air quality and ways in which to protect their health.

N.C. DAQ works with the state's citizens to protect and improve outdoor, or ambient, air quality in North Carolina for the health, benefit, and economic well-being of all. To carry out this mission, the N.C. DAQ operates a statewide air quality monitoring network to measure the level of pollutants in the outdoor air, develops and implements plans to meet future air quality initiatives, assures compliance with air quality rules, and educates, informs and assists the public with regard to air quality issues. This report focuses on non-regulatory, or voluntary, efforts to further reduce air pollution and improve air quality.

N.C. Air Awareness has been successful in implementing air quality outreach and education initiatives for more than two decades to many different audiences including schools, private businesses, communities, municipalities, and other organizations. Much of the work is done through partnerships with like-minded organizations, groups and businesses that are willing to spread our air awareness messages to help their communities or organizations. The program reaches thousands of citizens annually. The N.C. Awareness is grounded in cutting-edge air quality science and education techniques. For instance, educating about low-cost alternatives to help reduce air pollution and improve air quality.

To achieve the N.C. DAQ air quality goals, the N.C. Air Awareness program advocates voluntary actions such as relieving traffic congestion, reducing harmful tailpipe emissions, achieving and maintaining the national air quality standards, and reducing unnecessary vehicle idling. The N.C. Air Awareness program uses monitoring information, as well, to inform the public about air quality across the state. The cumulative impact of these and other actions, North Carolina air quality has improved over the past two decades. At the core of the program is the forecasting system, <https://airquality.climate.ncsu.edu/air/>, which produces daily air quality forecasts based on the Air Quality Index values for ground-level ozone and particle matter.

Significant progress has been made to improve air quality in North Carolina. However, important and challenging work remains today to maintain the current air quality standards and to insure clean air. As areas in North

Carolina continue to attain the National Ambient Air Quality Standards¹, the N.C. Air Awareness programs increases opportunities to maintain the improvements while engaging communities using science-based information.



ENVIRONMENTAL EDUCATION

N.C. Air Awareness conducts many direct environmental education programs and projects which has N.C. DAQ staff, local coordinators, or partners working hand in hand with community groups. Under normal conditions the local Air Awareness coordinators and N.C. DAQ staff venture to educate and inform the public through classroom presentations, afterschool programs, summer camps, science fairs, and other community events. By utilizing these and other education channels, N.C. Air Awareness has directly worked with and reached thousands of kindergartens through 12th grades (K-12) and university students, teachers, parents and community leaders.

Many of the projects and lessons offered are adopted from proven environmental education curriculums, like the one developed by the Environmental Protection Agency (EPA) or developed by N.C. DAQ. All of N.C. Air Awareness education lessons and activities align to the N.C. Essential Standards so teachers can easily bring them into their classrooms. Some topics include:

- Driving Choices: Cars and Air Quality
- Electricity Efficiency and Air Quality
- Renewable Energy Technology and Air Quality
- Air Quality and Health
- Air and the States of Matter
- The Chemistry of Combustion
- Environmental Careers

In the Classroom

During the 2020-2021 fiscal year the education team reached over 1200 students, all through online events. Education efforts occurred through a myriad of digital events and the education was thankful for the teacher relationships built in years past, these relationships created the opportunity for us to be invited into classrooms across the state digitally allowing for messaging about transportation and its impacts on air quality to continue to reach far and wide! From schools in Wake County to Buncombe County, the team worked alongside teachers to create content and remotely

¹ Federal air quality regulations mandated by the Environmental Protection Agency

teach classes of students on air quality, energy technology and environmental careers primarily for high school and middle school educators.

In an effort to adapt and pivot, the Air Awareness team also attended virtual career fairs, summits and environmental education competitions. We are thankful to have meteorologists that also help as they worked with Keith Bamberger to give a presentation virtually at Shining Rock Academy.

Team members from across the state, including Mecklenburg County, Asheville Regional Office and the Raleigh's Green Square office, conducted five interviews with students from Burke County's Freedom High School. The students were working in groups and created interview questions that surrounded air quality in North Carolina. These interviews worked through air quality issues across the regions of our state, efforts and behavior that could be taken to help improve air quality, health impacts of pollutants like ozone as well as the air quality index.

Annie Lee met virtually with students from Asheville High School to discuss careers in environmental fields. Sarah Duffer, an educator we have worked with for the past three years, invited Annie in to work with high school students. This presentation was not only geared toward air quality, but also to environmental careers and their related fields. Special attention was provided to the renewable energy's need for tradespeople, welders and electricians to help assemble and maintain new energy infrastructure.



The Mecklenburg County Air Quality program as well as the Fayetteville Regional Office were particularly active in outreach. For instance, Denise Bruce, an Environmental Specialist from the Fayetteville Regional Office, has been influential in her outreach efforts. While following COVID-19 distancing guidelines, she ventured to a Sampson County middle school, where she spoke with over 90 students on air quality. Denise said the students were excited to have a guest, to learn about air quality and how daily habits impact it. The teacher and Denise both hope she can return to the school in the coming year to inspire more students and foster more relationships.



TRAININGS/WORKSHOPS

North Carolina is home to a network of diverse educators and landscapes. N.C. Air Awareness works to train future, influential environmental educators and classroom teachers on how to incorporate air quality topics into activities at their schools, education centers and museums. N.C. DAQ provides and supports unique outdoor and environmental education workshops for teachers looking to excel in environmental science and air quality instruction.

This quality education continued through digital platforms, easily accessible to educators with teaching resources. Having the Introduction to Air Quality course available online allowed for a wider audience overall as well as to those in or near CMAQ eligible-areas in western North Carolina, the greater Mecklenburg region, the Triad and Triangle regions. The online course moves through the history of air quality and air quality legislation in North Carolina, transportation as a primary source of pollution, the different curriculum opportunities provided, and a live chat with an air quality specialist. The workshop, designed for formal classroom and environmental educators, provides a variety of activities that enhance their own understanding. Educators also benefit from activities that can translate directly into their classes. During the course of this fiscal year another 45 educators advanced their journey in completing this workshop on their own time.

Career and Technical Education Conference

In November, Keith and Annie had the pleasure to present as part of a North Carolina's statewide Career and Technical Education virtual conference. This conference had a STEM (Science Technology Engineering and Mathematics) focus. For this particular event our workshop title, and focus, was "Making the Invisible Visible: Air Quality Tools and Technology for Educators". This event, with STEM in mind, encouraged awareness of air quality issues, ownership of behaviors that contribute to air quality and help to explore new vehicle technologies that aid in improving air quality.

N.C. Climate Education Network

Creating content is one area that the Air Awareness team thrives in, and this year the team was able to facilitate in the growth of the N.C. Climate Education Network. In November Annie Lee, of the Air Awareness Team, was invited to be part of the leadership team alongside Rebecca Ward of the State Climate Office and Lauren Daniel with the Division of

Water Resources. The network is designed to build a bridge of conversation between state climatologists and scientists to science educators across the state.



To date, the N.C. Climate Education Network has reached over 120 attendees. Core information delivered is about best practices in communication, the science behind human behavior, burning of fossil fuels for transportation and industry impacting air quality and atmosphere composition. Partnerships have been forged with the following to deliver content on climate sciences limited to, entities NASA, Sea Grant, N.C. State, NC State University's North Carolina Institute for Climate Studies in Asheville, Coastal Studies Institute, and UNC Asheville.

Building relationships within other branches of the scientific community have been essential to the success of this network. Content covered by the network include increased rates of evaporation and precipitation dumps and explaining the process of how climate reports are made and the resulting changes in society they can create.

Regional Office Staff

During the year the core Air Awareness Team was diligent in meeting with regional office staff from across the state to help support them in their education efforts. Over the course of these quarterly meetings new virtual content was shared, best educational practices for distance learning shared as well as support for upcoming opportunities. From these sessions regional office staff felt more comfortable sharing new resources with local school groups and classrooms particularly members of the Fayetteville Regional Office and Mecklenburg County Air Quality. After trainings these two offices were influential in picking up a wider scope of education outreach opportunities within virtual classrooms across the state.



COMMUNITY ENGAGEMENT

Through community events, the N.C. Air Awareness program provides a gateway for the public to learn about the science of air quality impacts on health, air quality forecasts and the steps people can take to maintain air quality. Our goal is to continue participating in events covering a wider audience, such as fairs, festivals, Earth Day celebrations and Senior Games events. Ingenuity and creativity need to be celebrated the Air Awareness team pivoted to utilizing social media and other digital platforms means to engage the community during the pandemic.

Mountain Science Festivals – Online!

Even educational festivals were even held online! Keith Bamberger was able to attend multiple Mountain Science Festivals in the western portion of North Carolina and teach on air science and pollution.

Air Quality Learning Station in Charlotte. N.C.

Situated in Mecklenburg County, and overseen by Mecklenburg County Air Quality, this station is at First Ward Park. This educational air sensor station and solar flower have been getting a lot of attention this year. The goal of this flower and sensor module is to engage and educate and collect data visible to the curious passerby, as well as school groups, researchers on various forms of air pollutants. The design shares on the importance of air quality as well as renewable energy technology.



The Air Quality Learning Station 1.0 in Charlotte, NC, has a free-standing sensor / instrument panel with display screen that has a public facing and outreach component as well as a future research component in collaboration with local universities and groups. It can become a hub for research, education projects and provide another data point for DEQ meteorologist.

Electricity for the system is offset by using a Smartflower solar system (a smaller, less expensive solar install could replace the flower and greatly reduce costs): a flower-shaped series of solar panels that track the sun's position in the sky through the day. This provides an emissions-free power source while also being an attractive way to grab the public's attention. Electricity generated by this Smartflower is connected to the First Ward Park's electrical system and thus helps to supplement the electrical demands of the parks' facilities and lights.

Another Air Quality Learning Station 2.0 is being developed for installation in Robeson County and will be packaged into a small cabinet sensor suite known as an Airpointer. This suite monitors for Particulate Matter 2.5 (PM2.5) –and Ozone (O3) using scientific-quality sensors. The Airpointer system is modular, so there is room for the addition of a third sensor in the future for other pollutants. To ensure the highest-quality data, AQLS 2.0 will include FEM and near-FEM quality air pollution sensors. It may also be accompanied and powered by a solar array or flower.



Social Media Campaigns

Earth Day 2021 – #EarthDay2021

Participating in April's Earth Day has become an annual event for the N.C. Air Awareness Team, due to the pandemic the Division of Air Quality once again took to social media to engage the general public across the state. These posts were sent across Facebook, Twitter and the N.C. DEQ blog reached almost 2,000 individuals through the Twitter posts alone. Posts included a Brief History of Earth Day, educational resources for teachers on air quality, the impacts of new medium and heavy-duty vehicle technology, and exciting new electric pickup trucks that have hit the market.

#AQAW 2021: National Air Awareness Week hosted by AirNow²

Celebrate Air Quality Awareness!

"On behalf of our AirNow partners – National Oceanic and Atmospheric Administration (NOAA) National Weather Service, Centers for Disease Control and Prevention (CDC), U.S. Forest Service (USFS), National Aeronautics and Space Administration (NASA), and U.S. Department of State – EPA is pleased to announce Air Quality Awareness Week 2021 will be celebrated May 3 – 7."

AirNow.Gov

In May Mecklenburg County Air Quality joined the N.C. Air Awareness Team in writing posts for Air Quality Awareness week. In total, this campaign reached over 3,000 citizens! Raising awareness and educating on a myriad of topics impacting air quality and health.

5/3: Monday - Wildfires & Smoke

5/4: Tuesday - Asthma & Your Health

5/5: Wednesday – Citizen Science & Sensors

- Air sensor post
- Lichens video post
- Careers In Science

5/6: Thursday – Environmental Justice Communities & Air Quality

5/7: Friday – Air Quality Around the World

Additional posts included Where to find current air quality data and how to download the AirNow app, a photo montage video of pollution reduction tips that Mecklenburg County Air Quality staff use at home and an invitation to visit the new Air Quality Learning Station in Ward Park in Charlotte, N.C.

² (AirNow.Gov)



PARTNERSHIPS

NC Air Awareness staff, working in partnership with area businesses, agencies and organizations, expanded the discussion of air quality issues to be able to reach a wider audience. The program also encourages businesses and organizations to learn and act regarding commuting alternatives, teleworking, idle reduction, utilizing the air quality forecasts, cleaner transportation, emissions reductions opportunities, and individual and corporate responsibility for air quality.

Vehicle Emissions Reduction Activities (VERA)



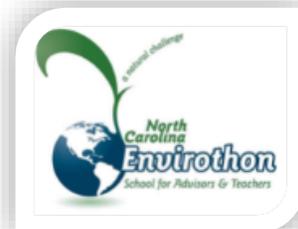
Working with individual classrooms, the VERA program has taught on air quality responsibility by meeting in person with driver’s education classrooms. The program has now advanced, and the N.C. Air Awareness team partnered with the North Carolina Department of Public Instruction (NCDPI) to create content for the Driver’s Education state-wide curriculum. The presentations created during this fiscal year are being rolled into the state mandated curriculum and includes details on vehicle choice based on emissions from idling one’s vehicle, to car maintenance, efficient driving habits as well as the carbon footprints of these choices.



We are also excited to encourage a deeper understanding electrical grid system and the nuts and bolts of electrical transportation versus traditional oil fuels. This fiscal year saw the hard labor behind lesson and presentation development. We look forward to the utilization of these new materials into the NC Driver’s Education coursework in the 2021-2022 fiscal year.

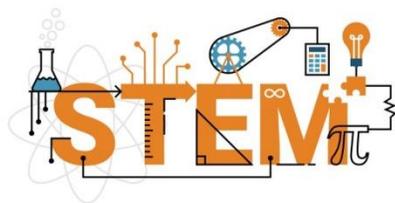
Envirothon

Partnering looked different this year, a lot of times it meant creating content to be shared virtually. For example, the Division of Air Quality provided the [Current Environmental Issues](#)



[Ed-Puzzle study guide](#)³ and quiz for regional 2021 Envirothon Competitions⁴ reaching about 1,200 students and the Envirothon coaches.

The Asheville Regional Office has been responsible for the Current Environmental Issues portion of the Mountain Region (Area 1) of annual Envirothon competition for several years. This includes researching and making a test based on the Current Environmental Issues, and teaching at the Envirothon event. Most years we used the Wheel of Air. In 2021, the event was virtual. For this new virtual event we created an Ed-Puzzle for the students to review the materials and a quiz. The Ed-Puzzle used the It's Our Air 3-1 Scientific Literacy Video and the About Science Introduction Video. The Quiz was based on the study resources for the 2021 Envirothon.



Science Technology Engineering Mathematics Education

There was an increase in the amount of collaboration with the educators of the Department of Environmental Quality. We had the fortune of working together to participate in the Wake County Public School System STEM (Science Technology Engineering & Mathematics) virtual summer workshop. This event allowed us to present a variety of air quality issues to light and educational strategies to the teachers of Wake County. We worked alongside the Division of Water Resources, Lauren Daniel, and Rebecca Coppa of the Division of Energy Mineral and Land Resources. This collaborative effort enabled the Air Awareness to have a larger audience to educators and teach about how environmental systems interact in addition to the ways air quality improves from teleworking, carpooling, and a variety of vehicle choices.

YES! Resilience Academy and NC Forest Service

Keith Bamberger worked with a group of Teen Climate Ambassadors called Youth Engaging in the Science of Resilience (YES Resilience) Academy. The YES Resilience Academy is a free, year-long STEM enrichment program for high school students who both learn about climate change and resilience and develop projects to study and reduce the effects of climate change. The YES Resilience Academy is led by the UNC Institute for Government and the Museum of Natural Science. Keith's role in partnering

Youth Engaging in the Science of Resilience



A free, year-long youth STEM enrichment program for high school students

³ [Current Environmental Issues Ed Puzzle Study Guide](#)

⁴ [North Carolina Envirothon](#)

with them to lead a virtual workshop in March that focused on the effect of climate change on forests and wildfires. As forest fires contribute to air quality health, and continue to intensify, this workshop was beneficial to understand this vulnerability.

For this workshop the Air Awareness team partnered with the NC Forest Service and Extension Forestry. Prior to the workshop the students participated in an Ed-Puzzle of It's Our Air Video 1-2 Combustion, then took part in a virtual escape room which included air and combustion puzzles, a Know the Code Scavenger Hunt, and smoke matching activities. The students were successful in setting the Air Avenger free, and he appeared live to thank the students.

The Division of Air Quality creations included new combustion activities, a new bank of air quality resources, as well as mix and match activities in and presentation about smoke from fire. We worked with air sensor monitoring on the site of the controlled burn at Prairie Ridge.



RESOURCES DEVELOPED

Online Resources

NC Air Awareness shifted from direct in person programming during the pandemic and focused on producing content and reaching people virtually. In fact, 42 new resources were created online for education and outreach.

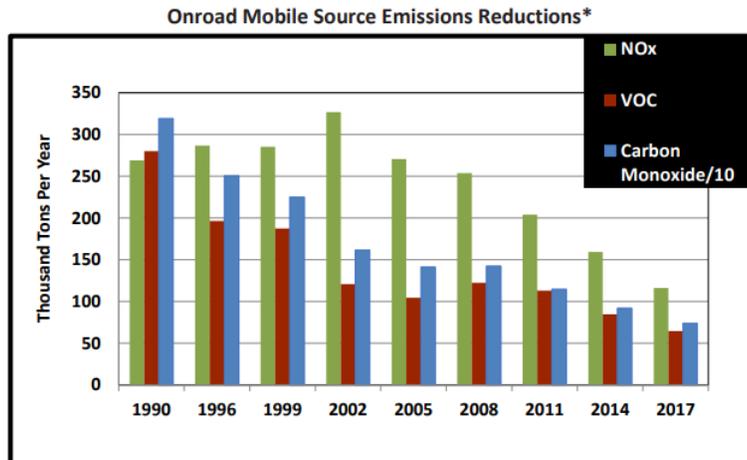


The content was designed for teachers to use with students and has been developed to extend beyond the pandemic. As staff we needed to learn new tools to create the content which included: videos, EdPuzzle along with content sharing tools that were easily accessible by educators, as well as other presentation and education tools. The content developed by the Air Awareness team went through a multi-step review process amongst the Air Awareness team, colleagues within the Division of Air Quality environmental educators, classroom teachers and members of the Office of Environmental Education.



CURRENT TRENDS

North Carolinians are breathing the cleanest air in decades. State leaders, regulatory agencies, electric utilities, industry, and the public have significantly addressed air quality concerns in recent years. Their collective efforts are achieving impressive results to reduce tropospheric ozone and particulate matter (PM) pollution.



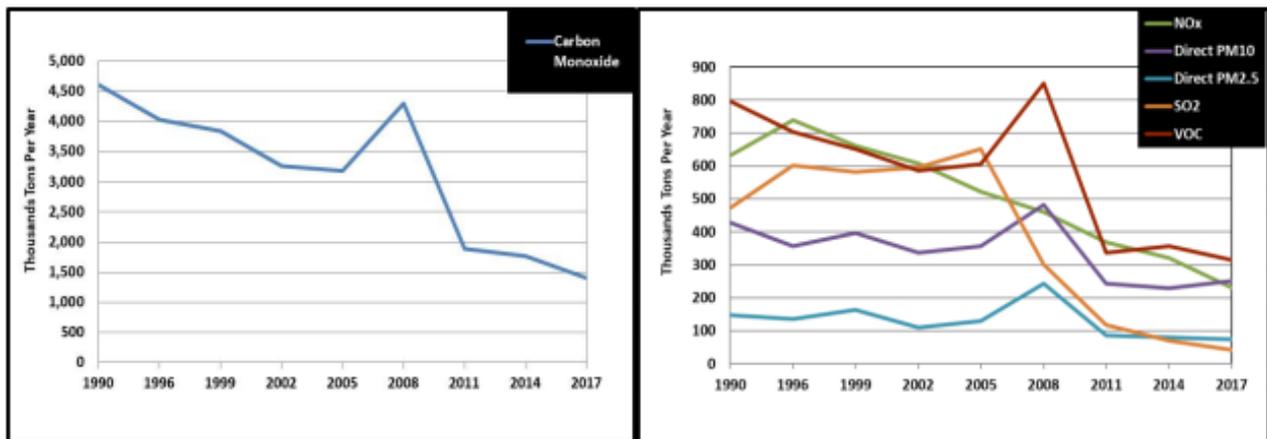
* The NOx emissions spike in 2002 is attributed to EPA adjusting the onroad emissions model.
 ** CO emissions represented in this chart were divided by a factor of 10 for comparability purposes.

From 1990 through 2017, statewide emissions of sulfur dioxide (SO₂) declined 91%, carbon monoxide (CO) by 69%, oxides of nitrogen (NO_x) by 63%, PM_{2.5} by 49%, and volatile organic compounds (VOC) by 60%.

Transportation emissions associated with everyday operation of passenger vehicles and trucks have also declined significantly (see the following “Onroad Mobile Source Emissions Reductions” chart). From 1990 through 2017, CO, NO_x, and VOC emissions have declined by 77%, 57%, and 77%, respectively. The decline in

onroad emissions is associated with several on-the-books national rules that have been phased in over time, starting with the federal Tier 1 emissions standards from 1994-1999, national low emissions vehicle standards from 1999-2003, Tier 2 emissions standards from 2004-2010, and heavy-duty vehicle standards from 2007-2010. Further reductions are expected to occur in the future under the Tier 3 vehicle emissions and fuel standards from 2017-2025. As a result of these standards, North Carolina’s vehicle fleet has become cleaner as newer low-emitting vehicles replace older higher-emitting vehicles, and the emissions controls on the vehicles are more technologically advanced - thus lasting longer and less prone to malfunctions or failures.

Annual Statewide Criteria Air Pollutant Emissions*



*A significant wildfire event occurred in 2008 that substantially increased CO, PM, and VOC emissions. Direct PM_{2.5} and direct PM₁₀ represent small particles of particulate matter with an aerodynamic diameter less than or equal to 2.5 and 10 micrometers, respectively.