

# Tracking Air Quality in Colorado

A middle school curriculum integrating real-world research with real-life learning.

CIRES Education Outreach University of Colorado - Boulder





## Know Your AQ: Tracking Air Quality in Colorado

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#### **Acknowledgements & Funding**



Recognition and thanks goes to the Volkamer Research Group (CIRES/CU Boulder) for its funding to make this project possible (NSF CAREER Grant AGS 0847793). Thank you to Jennifer Stroh (CIRES) for editorial support and to Amanda Morton (CIRES) for administrative support. Project conception, development, and management by Jennifer Taylor (CIRES) and Susan Sullivan (CIRES).

Appreciation and gratitude are extended to the following individuals and organizations for their generous assistance and contributions of scientific expertise in support of this curriculum:

#### 1.1 Air Quality: More than Meets the Eye

Collaborators & Credits:
 Gordon Pierce, Colorado Department of Public Health & Environment
 Chris Dann, Colorado Department of Public Health & Environment
 Roya Bahreini, University of California-Riverside
 OzoneAware.org kindly provided the "Air Pollution 101" activity (adapted)

## 1.2 Oh No, O<sub>3</sub>zone: "Good Up High, Bad Nearby!"

 Collaborators & Credits: Audra McClure, NOAA Boulder Atmospheric Observatory and Niwot Ridge Research Station

#### 1.3 Sherlock NOx: The Mystery of Unnatural Pollution in Natural Places

Collaborators & Credits:

Jim Cheatham, National Park Service
Tamara Blett, National Park Service
Lisa Devore, Colorado Department of Public Health and Environment

#### 1.4 Carbon Gases CSI: Mobile Lab, Methane & More

Collaborators & Credits:

Recognition and thanks goes to the Petron Research Group (CIRES/CU Boulder) for its funding to make their contribution to this project possible (NOAA and NSF SRN AirWaterGas CBET - 1240584).

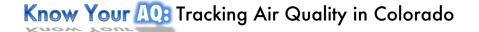
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#### **Curriculum Introduction**

Every summer along Colorado's Front Range, ozone pollution periodically spikes to unhealthy levels, despite federal and state efforts to control the lung-damaging chemical. Cars are running cleaner, and power plants are emitting fewer pollutants, so why does ozone still regularly soar above health-based limits?

When ozone levels spike, Environmental Protection Agency (EPA) experts recommend that people, especially those in sensitive groups—children, the elderly, and anyone with pre-existing respiratory conditions, plus healthy individuals participating in strenuous outside activities —limit time outdoors. Seven years ago, Colorado's Front Range fell out of compliance with federal regulations designed to protect people's health.

During July and August 2014, nearly 200 scientists from agencies and universities across the country focused sophisticated instruments on the Front Range atmosphere, seeking to better understand the sources of emissions and the chemistry that contributes to the region's air quality challenges. Ultimately, the goal is to share discoveries with decision makers seeking to clear the air.

The National Center for Atmospheric Research (NCAR) and NASA led the summer's joint FRAPPÉ and DISCOVER-AQ air quality campaign. An array of aircraft made detailed atmospheric measurements, supported by other instruments on the ground. CIRES and NOAA scientists contributed primarily with ground-, tower-, vehicle-, and balloon-based instruments.

Adapted from: http://cires.colorado.edu/news/press/2014/airquality.html

#### Driving questions:

- What are the causes and effects of air quality issues in Colorado's Front Range?
- How are human health and the environment affected by air quality issues?
- How do scientists monitor ever-changing air quality?
- Where can people find reliable information about air quality current conditions & forecasts?
- What solutions exist to improve and maintain healthy air quality?

#### Curriculum context:

- Essential Question: What are the causes and effects of air quality issues and how do they affect human health and the environment?
- Middle School, grades 6-8 with potential to adapt to other grade levels
- STEM content aligned with NGSS & Colorado science standards and 5E Instructional Model
- 4 modules, 2 periods/1 block per module
- Modules can be completed independently, sequentially, and extended into a larger unit of study







### **Curriculum Matrix**

Know Your AQ Module	Module Scope	Module Sequence (Time min.)	Science Standards
1.1 Air Quality: More than Meets the Eye  Time: 100 min. (2 class periods / 1 block)	Clear skies are clean skies, or are they? Engage in a visual demonstration on the causes & effects of air pollutants on air quality and kinesthetic activities on particulate matter & visibility!	Engage: Now You See It (5) Explore: Air Pollution 101 #1 (30) Explain: Air Pollution 101 #2 (15) Elaborate: Visibility & AQ (35) Evaluate: AQ 3-2-1 Exit Ticket (15)	NGSS: MS-PS1-4, MS-ESS3-4 CO 6 <sup>th</sup> gr. Physical Science 1.2, 1.3
1.2 Oh No, O₃zone: "Good Up High, Bad Nearby!" Time: 100 min. (2 class periods / 1 block)	Not all ozone is created equal. Learn about ozone's role in the atmosphere and explore actual research data to compare and contrast conditions that affect ground-level ozone values.	Engage: Ozone Video & Image (15) Explore: Ozone Formation (35) Explain: O <sub>3</sub> nce Upon (25) Elaborate: Ozone Alerts & AQI (15) Evaluate: Ozone Quick Quiz (5)	NGSS: MS-PS1-2, MS-LS2-5 CO 6 <sup>th</sup> gr. Physical Science 1.2 CO 6 <sup>th</sup> gr. Life Science 2.1
1.3 Sherlock NOx: Unnatural Pollution in Natural Places  Time: 100 min. (2 class periods / 1 block)	Wilderness areas have clean air, right? Take virtual video field trips to explore air quality research sites and investigate the causes, effects, and solutions to nitrogen deposition in Rocky Mountain National Park.	Engage: On the Air Video (10) Explore: RMNP AQ Video (15) Explain: N-Dep. Evidence (25) Elaborate: Connecting the N-Dep. Dots (30) Evaluate: N-Dep. Past, Present & Future Reflection (20)	NGSS: MS-LS2-4, MS-LS2-5, MS-ESS3-3 CO 6 <sup>th</sup> gr. Life Science 2.1, 2.2 CO 8 <sup>th</sup> gr. Life Science 2.1
1.4 Carbon Gases CSI: Mobile Lab, Methane & More  Time: 100 min. (2 class periods / 1 block)	Find the "fingerprints" of carbon gases in thin air. Take a virtual mobile lab drive with scientists to investigate and learn about atmospheric carbon gases, their sources, and impacts on air quality.	Engage: Scientist Interview & Mobil Lab Introduction (15) Explore: Researching Carbon Gases (35) Explain: Carbon Gas Predictions (15) Elaborate: Carbon Gas Data Analysis (20) Evaluate: Carbon Gases & Me Think- Pair-Share (15)	NGSS: MS-LS2-3, MS-PS1-1, MS-ESS3-5 CO 6 <sup>th</sup> grade Physical Science 1.2 CO 6 <sup>th</sup> gr. Life Science 2.2 CO 6 <sup>th</sup> gr. Earth Science 3.3



