Know Your AQ:

Tracking Air Quality in Colorado

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

CIRES Education Outreach
University of Colorado - Boulder

CIRES
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Contents

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1.1 Air Quality: More than Meets the Eye

- Collaborators & Credits:
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1.2 Oh No, O_3zone: "Good Up High, Bad Nearby!"

- Collaborators & Credits:
  Audra McClure, NOAA
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1.3 Sherlock NOx: The Mystery of Unnatural Pollution in Natural Places

- Collaborators & Credits:
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1.4 Carbon Gases CSI: Mobile Lab, Methane & More

- Collaborators & Credits:
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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 6th gr. Physical Science 1.2, 1.3
1.2 Oh No, O_3zone: "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_3nce Upon (25) Elaborate: Ozone Alerts & AQI (15) Evaluate: Ozone Quick Quiz (5)	NGSS: MS-PS1-2, MS-LS2-5 CO 6th gr. Physical Science 1.2 CO 6th 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 6th gr. Life Science 2.1, 2.2 CO 8th 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 6th grade Physical Science 1.2 CO 6th gr. Life Science 2.2 CO 6th gr. Earth Science 3.3