Developing and Curating Environmental Science Lesson Plans at All Grade Levels to Create, Encourage, and Nurture Student Confidence in Their Scientific Ability

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Purpose and Rationale

Only 40% of U.S. Environmental Science teachers do one hour of experimentation each week, compared to 65% of Biology, Chemistry, and Physics teachers.

- To be fully effective, science education requires at least an hour a day devoted to inquiry and experimentation.
  - Elementary teachers devote 15 minutes or less a day to inquiry, and middle school and high school teachers about 45 minutes per day.[1]

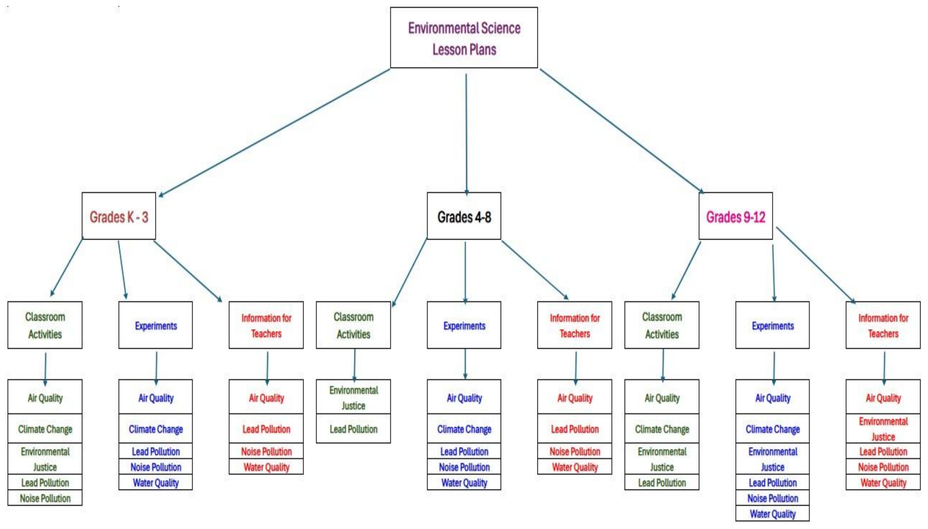
What people value guides how they think and feel about specific situations and motivate how they respond to those situations throughout their lives.

- Students value what they learn in the classroom. When students perform experiments in class, it becomes a valuable skill, and it increases their confidence in their ability to "do science".[2,3]
  - Without regular exposure to lessons utilizing inquiry and experimentation, only 23% of high school students believe they have the academic ability to "be a scientist", compared to 43% of students who are comfortable with experimentation and data analysis.[2]

The purpose of this project is to create an online repository of easy to implement and age-appropriate classroom activities that will incorporate experimentation and data analysis and raise students' awareness of topics in environmental science. The lessons are designed to be relevant to the lives of K-12 students and are intended to foster a lifelong love of science and encourage students to become "science people" and consider science-related careers.

Teachers can access the experiments and activities directly through the LSUHSC-New Orleans School of Public Health by following this link: Adrienne Katner, DEnv, MS - Public Health or by scanning the QR Code.

Lessons on these topics are available at all grade levels :

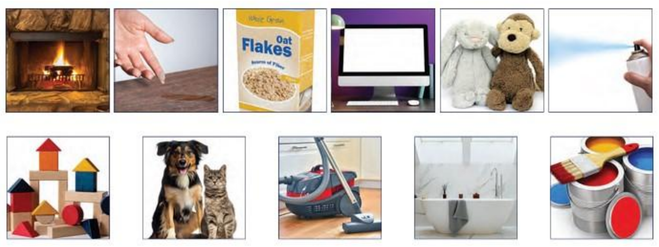


Air Quality is One of Six Lessons With Experiments Designed to Grow Along With Students

Grades K-3: The Lesson Utilizes Students' Natural Curiosity[2]

The lessons encourage younger learners to think about a topic they may not have considered before, and "put it on their radar" as something that is important.

Part 1: What are the sources of pollution? This involves a gallery walk that encourages students to think about and identify where air pollution in their home comes from and identify those places using Post-it notes.



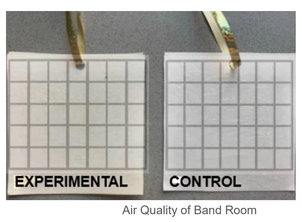
Part 2: Build "Pollution Catchers" that will allow them to see the small particles they breathe in on a regular basis.

Grades 4-6: The Lesson Makes the Topic Relevant to Students[2]

In the middle grades, the concept of air quality moves from the home to the school campus. The lesson incorporates data analysis that allows students to measure the quality of the air they breathe every day at school.

Levels of Health Concern for AQAD	AQI Value	Ozone (ppb)	$PM_{2.5}$ (µg/m³)
High Moderate	90-100	67 – 70	30.6 – 35.4
Unhealthy for Sensitive Groups	101-150	71 – 85	35.5 – 55.4
Unhealthy	151-200	86 – 105	55.5 – 150.4
Very Unhealthy	201-300	106 – 200	150.5 – 250.4
Hazardous	301-500	> 200	250.5 – 500.4

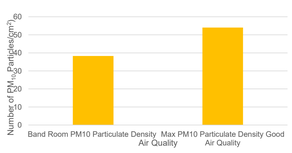
Students trap particulates in air on a card with a grid. They use a microscope to count the number of particles on the card to quantitatively measure the quality of the air inside their school, and to devise solutions to improve it, if necessary.

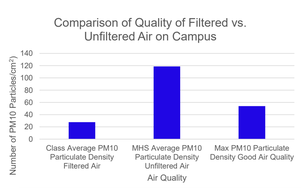


Air Quality of Band Room

Data Collection

Data Analysis





Grades 9-12: The Lesson Builds Students' Confidence in Their Science Ability[2]

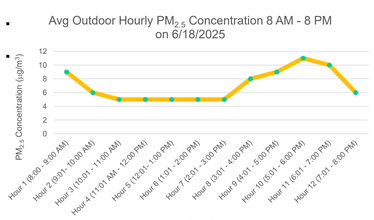
In high school, students use air sensors to measure the concentration of criteria pollutants in the air inside the school building as well as outdoor locations they frequent. They formulate and test hypotheses and present their data and conclusions .

An **AirBeam Air Sensor** allows students to collect and share the data they collect nationwide. It collects data every minute and organizes it into a spreadsheet.

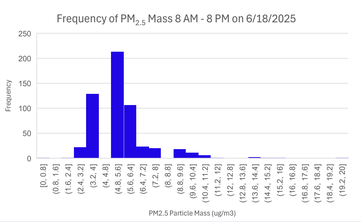
Elapsed Time	Avg Hourly PM2.5 (ug/m3)
Hour 1 (8:00 - 9:00 AM)	9
Hour 2 (9:01- 10:00 AM)	6
Hour 3 (10:01 - 11:00 AM)	5
Hour 4 (11:01 AM - 12:00 PM)	5
Hour 5 (12:01- 1:00 PM)	5
Hour 6 (1:01 - 2:00 PM)	5
Hour 7 (2:01 - 3:00 PM)	5
Hour 8 (3:01 - 4:00 PM)	8
Hour 9 (4:01 - 5:00 PM)	9
Hour 10 (5:01 - 6:00 PM)	11
Hour 11 (6:01 - 7:00 PM)	10
Hour 12 (7:01 - 8:00 PM)	6

Students can analyze the data to reveal trends in air quality (Graph A) or they can create a histogram that shows the most common amounts of particulates in the air during their study (Graph B).

Graph A



Graph B



References

[1]National Academies of Sciences, Engineering, and Medicine. "The Current Status of Science Instruction." 2015

[2] Lei, R. F., Green, E. R., Leslie, S. J., & Rhodes, M. (2019). Children lose confidence in their potential to "be scientists," but not in their capacity to "do science". *Developmental science*, *22*(6), e12837.

[3] Schwartz S. H. (1992). Universals in the content and structure of values: Theoretical tests in 20 countries. *Advances in Experimental Social Psychology*, 25, 1–65.

Acknowledgements

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