UCONN

INDOOR AIR QUALITY INITIATIVE

Cleaner Classroom Air

Mini Lesson Series
Grade Level: High School

Overview: This lesson series is meant to compliment the implementation of a Do-It-Yourself air purifier. The lessons introduce indoor air quality and focus on the Science and Engineering Practices (SEPs) such as asking questions, analyzing data, and communicating information. The lessons can stand on their own or be adapted to supplement curricular units.

Revised: 01/07/2026

Background Information

Indoor air quality matters, because we spend about 90% of our time indoors. Things in the air such as particulate matter (PM) and airborne viruses such as COVID-19 can have negative impacts on human health, especially for younger people whose respiratory systems are still developing and older people who often spend even more time indoors. Many factors influence indoor air quality, including temperature and relative humidity. Indoor air quality includes pollution from outside such as wildfire smoke, emissions from vehicles, and ozone.

More information can be found at EPA Indoor Air Quality in Schools

While commercial air purifiers exist, a DIY air purifier can be built using inexpensive materials, including a box fan, four MERV filters, cardboard, and duct tape. The fan pulls air through four standard HVAC filters that catch airborne pollutants. The DIY air purifiers reduce the amount of particulate matter and airborne viral particles. Design criteria for an air purifier include effectively filtering airborne viral particles, dust, allergens, and particulate matter. Constraints include cost, size, noise, and time. Classrooms are a unique challenge, because there are more people than in a home or a typical office, and students need to be able to hear their teacher and classmates. Schools do not have unlimited budgets, and commercial air purifiers are expensive. This makes the DIY option a more accessible option.

More information can be found at the Corsi-Rosenthal Foundation website

Lesson Series Overview

The four mini lessons below are sequential, but they do not need to be done four days in a row. Having students collect and analyze air quality data can be a longer-term project, depending on time and school curriculum. The lessons offer a brief introduction to indoor air quality and how air purifiers work, as well as practicing multiple SEPs.

Lesson Series Outline

1. Introduction to Air Quality
    a. Students will complete stations with different factors that impact air quality (temperature, particulate matter, etc.). This will help them understand the data collected by the air quality monitor.
    b. SEPs: asking questions and defining problems; analyzing and interpreting data; constructing explanations and designing solutions
2. Building the air purifier
    a. Students will build an air purifier. Students conduct a tissue test, figuring out how to increase efficiency. Students plan investigations relating to air quality or the air purifier.
    b. SEPs: asking questions; planning and conducting investigations
3. Analyzing Data
    a. Students analyze and interpret data from the air quality monitor. Students graph and interpret data from the investigation planned during lesson 2.
    b. SEPs: analyzing and interpreting data; using mathematical and computational thinking
4. Sharing the Results
    a. Students will communicate their findings to the community.
    b. SEP: constructing explanations and designing solutions; obtaining, evaluating, and communicating information

Lesson 1: Air Quality

Driving Question

What is indoor air quality and why does it matter?

Student Learning Objectives

- Students will be able to define an engineering design problem, identify criteria and constraints, and analyze relevant data.
- Students will ask questions that can be investigated through experimentation.

NGSS Performance Expectations

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

NGSS Science and Engineering Practices

- Asking questions and defining problems
- Planning and carrying out investigations
- Analyzing and interpreting data
- Constructing explanations and designing solutions

Materials

HS Slides.pptx

Intro IAQ Stations HS.pptx

HS Student Worksheets.docx

Lesson Sequence

1. Think-Pair-Share
    a. Do you think about the air you breathe? Have you ever?
    b. Consider dust, pollen, viruses, smog, asthma, etc
2. Display the air quality monitor
    a. Either generic photo that is in the slides OR add a photo from one of the school monitors, so students can see real data
    b. What is this device? What does it tell us? Why do we have it?
        i. The air quality monitor measures multiple factors that influence air quality. It provides some of those measures (temperature, relative humidity, etc), as well as the air quality index, a number calculated from multiple factors. The school has multiple air monitors to determine the indoor air quality.
3. Exploration: Stations or Jigsaw This can be set up as stations so that all students practice all skills, or it can be a jigsaw where students focus on one "station" and share out what they learned with others.
    a. Analyzing and interpreting data: Temperature
        i. Students will interpret graphs about the effect of temperature on student learning.
    b. Defining problems (engineering)
        i. Infographic about indoor air quality in schools
        ii. Students will define the problem, brainstorm criteria and constraints of a solution
    c. Air Quality and Human Health
        i. Watch the American Lung Association video.
        ii. Write three sentences how air quality can affect health
    d. Asking questions (science)
        i. Read about AQI and PM
        ii. Write testable questions and hypotheses relating to AQI and/or PM
    e. Analyzing and interpreting data: PM
        i. Students will interpret graphs about the effect of particulate matter on student learning.
4. Collecting baseline data
    a. Students can collect initial data from the air quality monitor in a variety of ways:

i. On paper, by hand (Student Data Table.docx)
ii. Data collection form (data is compiled in spreadsheet)
iii. IQ Air's Air Visual Dashboard (each school has a login)

5. Closure (discuss or have students write as exit ticket)
    a. Show the air quality monitor from the beginning class. Has the air quality changed during class?
    b. What does the air monitor tell us? What can we learn from it over time?

Possible Connections

Life Science: How does air quality affect our health?

HS-LS1-2 and HS-LS1-3

Some air pollution is small enough to travel into the bloodstream. Students can argue with evidence about the importance of the DIY air purifier for preventing negative health impacts at the cellular and organ system levels. Students can create models to explain why air pollutants cause coughing, eye irritation, and other symptoms.

Physical and Earth and Space Sciences: Is ozone good or bad?

HS-ESS3-1, HS-ESS3-4, and HS-PS1-2

Ground level ozone is a harmful pollutant, but stratospheric ozone is a necessity. This can lead to a discussion of whether "chemicals" can be classified as good or bad. Students can evaluate the use of ozone generators as air purifiers (Ozone Generators Sold as Air Cleaners (EPA)). Ozone chemistry is complicated, so focus should be on the importance of outer electrons for chemical reactions.

Lesson 2: Building an Air Purifier

Driving Question

How can we improve our classroom's air quality?

Student Learning Objectives

- Students will be able to explain how the air purifier cleans air.
- Students will be able to ask testable questions and plan an investigation

NGSS Science and Engineering Practices

- Asking questions and defining problems
- Planning and carrying out investigations

Materials

HS Slides.pptx

HS Student Worksheets.docx

3-10 kits for building the DIY air purifiers

Tissue/toilet paper

Scissors

Lesson Sequence

1. Engage: Show pictures of DIY air purifiers
    a. What do you think these devices do?
    b. What were some of the criteria and constraints that we brainstormed during the last air quality lesson?
2. Building
    a. Today we are going to build an air purifier!

b. Assign roles to students (depending on class size and number of groups)
    i. Adhesive engineer - cuts strips of tape, helps tape edges, and cleans scissors after
    ii. Sustainability Coordinator - cuts cardboard square, ensures waste is disposed of correctly
    iii. Quality Control Engineer - checks filter direction, looks for gaps in tape
    iv. Project manager - keeps track of time and materials, can also help assemble as needed
    v. Additional roles as needed
        1. Photojournalist – take photos and write captions
        2. Art director – gathers materials for and plans decoration
c. Play video and pause after the box fan is taped to the box, then play video from the beginning, pausing to let students follow each step
    i. Gather materials. Take the fan out of the box and make sure it works.
    ii. Cut a 50.8 cm x 50.8 cm square from the cardboard box (approximately the large side of the box).
    iii. Assemble the air filters (arrows face in, must be square). Tape edges.
    iv. Tape cardboard square to top of filters. Flip it over (the cardboard is the bottom of the box)
    v. Tape fan to the filters. Be sure the fan will blow air up!

3. Investigation: Is *all* the air being filtered?
    a. Conduct tissue test: *Use tissue, toilet paper, or steamers. While the fan is off, lay the tissue on the fan. The tissue will float when it is above the fan blades. At the corners, the tissue will get "pulled in," because the fan is pulling air in without the filter being in the way. The tissue will fall in the middle where the plastic is holding the fan blades, but the fan isn't "pulling" the tissue into it.*
        i. Where is the clean air leaving the fan?
        ii. Where do we want the dirty air entering the fan?
        iii. Can air sneak in without going through a filter?
    b. Use tape to close off areas where air can sneak in

4. Planning investigations
    a. Students can plan an investigation using the air monitors or observing the filters. They can choose variables, outline a procedure, and determine what data to collect.
    b. Possible variables include location in the classroom, fan speed, number of students in the classroom, etc.
5. Exit Ticket
    a. What is the purpose of the DIY air purifier?
        i. Cleaning the air. The fan pulls dirty air through the filters and pushes clean air out into the classroom.
    b. What is the purpose of the shroud?
        i. Shroud blocks dirty air from getting into the fan without going through the filters.

Possible Connections

Developing and using models

Students can create a model showing the movement of particles with and without the DIY air purifier or with and without the shroud. Students can show how the air is being pulled through the filters or through the corners around the fan blades.

Evaluating an Engineering Design

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. Students can evaluate the design and consider the trade-offs for different designs.

Experimental Design: Planning an investigation in the real world

There are many challenges to testing the air purifier in schools and classrooms. For example, a control group that does not use the air purifier could result in students getting sick. Different classrooms have different

numbers of students and different amounts of dust. Students can brainstorm these challenges and ethical concerns.

Lesson 3: Analyzing Data

Driving Question

Is the air getting cleaner?

Student Learning Objectives

- Students will be able to transform raw data into a visual representation.
- Students will be able to explain the trend in air quality over time.

NGSS Science and Engineering Practices

- Analyzing and interpreting data
- Using mathematical and computational thinking
- Constructing explanations and designing solutions

Materials

HS Slides.pptx

HS Student Worksheets.docx

Lesson Sequence

1. Look at the data ahead of time and consider unexpected results (hopefully, the air quality improves over time)
    a. Air quality stayed the same: It's possible that the location of the air monitor has proper ventilation or that the school has an efficient HVAC system. This is particularly true if the initial readings were quite low (AQI < 15) because the monitors are only sensitive down to a certain point.
    b. Air quality worsened: There could be other factors impacting levels in the classroom. The outdoor air quality might be worse,

or the classroom is much more active on the day the air purifier was running.

2. Think-Pair-Share
    a. What is the purpose of the DIY air purifier?
    b. What data can we collect to determine if the DIY air purifier is working?
3. Collect and transform raw data
    a. Raw data from one or more air monitors
    b. Graph by hand or spreadsheet
4. Claim, evidence, reasoning
    a. What does the data tell us? Write a claim.
    b. What evidence do we have to support the claim?
    c. What is the reason behind the claim? *Why* are the data like this?
5. Exit Ticket
    a. Who would want to know about these results?
    b. How might we present the results to that audience?

Possible Connections

Life Sciences/Health: How has the air purifier affected students?

Students can develop a hypothesis relating to the impact of DIY air purifiers on health or student learning and brainstorm how they might test that hypothesis.

Physical Science: How loud is the air purifier?

HS-PS4

Students can measure the decibel level of the DIY air purifier with different fan speeds using any device with a microphone and internet at the site Sound Decibel Meter. They can then compare it to measurements taken during common class activities (e.g. teacher talking at the front the room, group work, quiet working time).

Lesson 4: Sharing the Results

Driving Question

Who cares about the air?

Student Learning Objectives

- Students will be able to communicate scientific information to a specific audience.
- Students will be able to argue with evidence in writing.

NGSS Science and Engineering Practices

- Constructing explanations and designing solutions
- Obtain, evaluate, and communicate information

Materials

HS Slides.pptx

HS Student Worksheets.docx

Lesson Sequence

1. What is science communication and why does it matter?
    a. Scientists and engineers work on real-world problems and need to communicate their findings to a wide range of audiences, not just other scientists.
    b. How do scientists communicate complicated information?
2. Introduce the RAFT activity. Students can choose their audience and format, but they should justify their choice.
    a. Role: student
    b. Audience
        i. PTO
        ii. School Board

        iii. Politicians?
    c. Format
        i. Social media post(s) or campaign
        ii. Letter
        iii. Presentation (slides)
        iv. Infographic
        v. Report
    d. Topic
        i. Indoor air quality
3. Gallery Walk
    a. Have students share their RAFT products with each other!
4. Exit Ticket: How has your thinking about air quality changed?
    a. I used to think _____. Now I think _____.
5. *The final products from the RAFT should be shared with their intended audience if possible!*

Possible Connections

Persuasive Writing

CCSS.ELA-LITERACY.W9-10.1

Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.