

2027-04-09 · 80 minutes

Mitigation notes

Your goal: Turn an April 8 colony count into CFU per mL and explain what a drinking-water coliform test adds, then propose evidence-based strategies to reduce a community's exposure to a chosen pollutant.

One product: Mitigation notes with a plate-count record (colonies on your 30 to 300 plate or the C2 practice data, CFU per mL with the calculation shown, and one sentence on why LB growth is not a coliform test), two strategies (source-side and receptor-side), dose-reduction predictions, feasibility tradeoffs, and a justified recommendation.

Question: Your community faces one pollutant with an at-risk population, so should you spend limited resources stopping it at the smokestack or protecting the people downwind, and which gives the most risk reduction per dollar?

Start the work

A culture counts only the living bacteria that grow on that medium in that time, so a count needs a countable plate, a clean negative control and a night of incubation.

1. Start with the April 8 plates, which incubated overnight: check control N, count the 30 to 300 plate through the closed lid and calculate CFU per mL with C1, or use C2. Write one W1 sentence on what LB growth cannot show, then hand the closed plates back for bleach decontamination.
2. Answer the two starting prompts, then read E1-E3 and D1. Identify the pollutant, exposure route and priority population.
3. Sort the source-side and receptor-side strategies into the two columns. Use M1 as a different comparison.
4. Complete both conditional dose predictions. Explain how each strategy could reduce exposure without inventing a percentage.
5. Compare costs, timing, coverage and feasibility. Record a partner critique or your own critique and one revision.
6. Write the recommendation paragraph using both strategies and two evidence cards. Apply Q1 to the separate factory scenario.
7. Write the funding exit and check the same mitigation notes before saving or submitting.

Save the same record locally if the exact assignment or route is unavailable. Keep actual Problem 4, prior data, official water work and weekly validation evidence pending as needed.

Words you will use

mitigation

An action intended to reduce a harmful exposure or its consequences.

pollutant

A substance or mixture in the environment that can cause harm under relevant conditions.

PM2.5

Fine airborne particles generally 2.5 micrometers or smaller in diameter.

micrometer

One millionth of a meter.

emissions

Pollutants released from a source.

source-side

Acting on the generation or release of a pollutant.

receptor

A person or other organism that may encounter a pollutant.

receptor-side

Acting where people encounter pollution rather than stopping its source release.

exposure pathway

The chain from a source through a medium to contact with a person.

inhalation

Taking air and substances in it into the respiratory tract by breathing.

exposure

Contact between a person and a pollutant.

dose

An amount received, with the dose type and time period specified.

potential inhaled dose

The amount entering the nose or mouth; it is not all necessarily absorbed.

internal dose

The amount that crosses an absorption boundary into the body, such as into blood.

risk

The chance of a harmful outcome under specified exposure conditions.

hazard

The potential of an agent to cause harm.

vulnerability

A feature or circumstance that can increase susceptibility to harm.

at-risk population

People identified as a concern using evidence about exposure or susceptibility.

concentration

Amount of a substance in a stated volume or mass of a medium.

CADR

Clean air delivery rate, a particle-cleaning capacity rating used with room size.

filtration

Removal of material from a stream, such as particles captured from air.

ozone

A reactive gas that can irritate the lungs.

feasibility

Whether a plan can be implemented under its practical constraints.

tradeoff

A gain in one consideration accompanied by a cost or limitation in another.

coverage

Which people, places and times an intervention reaches.

maintenance

Continuing work and supplies needed for a system to function.

phasing

Introducing an intervention in stages over time.

cost-effectiveness

Benefit relative to cost, requiring a defined benefit measure and comparable time period.

conditional prediction

An expected direction or outcome that depends on stated assumptions.

claim

The recommendation or conclusion being defended.

evidence

Information used to support or question a claim.

reasoning

The explanation connecting evidence with the claim.

CER

Claim, evidence and reasoning presented as a connected argument.

toxin

A poisonous substance produced by a living organism.

bioaccumulation

Buildup of a substance within an organism over time.

biomagnification

Increasing concentration across levels of a food chain.

colony-forming unit (CFU)

A cell or clump that grows into one colony on agar.

CFU per mL

Colony-forming units in each milliliter of the original sample.

countable range

Plates with 30 to 300 colonies, the range microbiologists typically count.

LB agar

A general nutrient gel that many kinds of bacteria grow on; it does not identify them.

total coliforms

A group of related bacteria, mostly harmless, used to check water treatment and pipe systems.

E. coli

Escherichia coli, a coliform whose presence in drinking water points to possible fecal contamination.

membrane filtration

Passing a measured water volume through a filter that is then placed on a growth medium.

enzyme substrate test

A coliform test whose medium changes color or glows when coliform or E. coli enzymes act on it.

negative control

A plate that should grow nothing; growth on it means contamination.

C1: read the April 8 plates

Your April 8 plates have incubated at 37°C since yesterday. Plates kept at room temperature have had only about 24 hours, so their colonies may be too small to count; use C2 for those. Keep them taped shut and upside down, and count through the closed plate; never open it. Wear gloves, and wash your hands when you finish.

Check control N first. No colonies on N supports that your technique kept other bacteria out. Colonies on N mean the counts from that set cannot be trusted; record that instead of a CFU value.

Find the plate with 30 to 300 colonies. Put a small marker dot on the bottom of the plate over each colony as you count it, so no colony is counted twice. Record a count for every plate, writing more than 300 for a crowded plate.

CFU per mL = colonies ÷ (volume plated in mL × dilution). The volume plated was 0.1 mL. Write the dilution as a fraction, so the 1/100 plate is 0.01. Label the answer CFU per mL.

When you finish, hand the closed plates to your teacher for bleach decontamination. No plate is opened in class.

C2: practice plate data if your plates cannot be counted

Use these invented practice data only if your plates did not grow, were kept at room temperature, control N grew colonies, or no plates were made. Label your work practice. No bacteria were grown for this table.

Practice sample P, with 0.1 mL spread on each plate: the 1/10 plate had more than 300 colonies; the 1/100 plate had 187 colonies; the 1/1,000 plate had 21 colonies; control N had 0 colonies.

Choose the plate in the countable range and calculate CFU per mL with C1. Then say why the other two plates are not used.

W1: a plate count is not a coliform test

EPA's Revised Total Coliform Rule uses total coliforms and *E. coli* to judge drinking water. Total coliforms are a group of related bacteria that, with few exceptions, are not harmful; EPA uses them to check whether water treatment and the pipe system are working.

E. coli points to possible fecal contamination, and EPA sets its health goal, the maximum contaminant level goal, at zero. A total coliform positive leads to repeat samples, and too many positives require the water system to look for the cause.

Federal rules test a 100 mL sample and ask only whether total coliforms and *E. coli* are present or absent; a count is not required. Approved methods include membrane filtration and enzyme substrate tests, which use media that coliforms and *E. coli* change in ways most other bacteria do not.

Your LB plate grows many kinds of bacteria and shows none of those identities. Growth on LB shows bacteria are present in the mock sample; only a coliform test could say whether they are coliforms or *E. coli*. You know this sample holds *E. coli* K-12 only because your teacher added it, not because the plate showed it.

Volume matters too. Your plate held 0.1 mL of sample, one thousandth of the 100 mL a water test examines. Bacteria present at a few per 100 mL would almost never land on your plate, which is one reason membrane filtration passes the whole 100 mL through a filter.

E1: follow the pollutant and the people

Particulate matter, or PM, is a mixture of airborne solid particles and liquid droplets. PM_{2.5} means fine particles generally 2.5 micrometers or smaller in diameter. Some particles are released directly. Others form in air from gases.

The practice pathway is diesel-truck particle emissions to outdoor air, then nearby homes and breathing. Inhalation brings particles into the respiratory tract. EPA explains that small particles can affect the lungs and heart.

EPA identifies children and people with heart or lung disease among groups that may be more affected by particle exposure. That does not diagnose anyone. D1 assigns a priority group using its stated exposure setting and vulnerability.

A pollutant is not necessarily a toxin produced by an organism. Do not describe all traffic particles as biological toxins. No health record or personal address is needed for this task.

E2: compare points of intervention

Source-side mitigation acts on the release of pollution. Receptor-side mitigation acts where people encounter it. Reducing release can help beyond one room, but its reach depends on transport and other sources.

EPA describes indoor filtration as a supplement to source control and ventilation with clean outdoor air. Portable air cleaners serve a room or area. They cannot remove every pollutant or protect someone outdoors.

Particle filtration is not a guarantee of gas removal. Match a particle cleaner's clean air delivery rate, or CADR, to room size. Actual performance also depends on operation and filter replacement.

EPA advises avoiding devices that intentionally produce ozone, a lung irritant. No product is selected or installed in this lesson. D1 assumes a suitable particle-filter device solely for planning.

Source measures are not always slower or more costly. Receptor measures are not always cheap or immediate. Use the given proposal details, rather than assigning those traits to the whole category.

E3: emissions, exposure, dose and risk differ

An emissions percentage describes a release at its source. It does not directly give the change in outdoor concentration, personal exposure, inhaled dose or illness risk.

EPA distinguishes potential inhaled dose from internal dose. Not everything entering the nose or mouth is absorbed into blood. Concentration, breathing rate and time can support an inhaled-amount estimate when all are specified.

For this task, predict dose direction conditionally: if concentration in the air actually breathed falls, with breathing and time otherwise unchanged, the inhaled amount should fall. D1 supplies no concentration changes, so do not invent a percentage.

A risk assessment also needs information about the hazard, exposure, response and uncertainty. Some inhalation assessments use air concentration directly with matching reference values. Converting every concentration into body-weight dose is not a universal rule.

D1 cannot tell us illnesses avoided or risk reduced per dollar. Make a reasoned comparison of likely reach, timing and feasibility. Acknowledge this quantitative limit in the recommendation.

D1: complete original traffic-planning case

Everything in this card is invented for practice. No community survey, air sample, intervention or health outcome occurred. The fictional Birch Court has 20 homes beside a delivery depot.

The case assigns repeated truck idling beside these homes. Ten homes include children or residents with an existing lung condition. Use these exposure and vulnerability details to name the priority subgroup. No individual details are supplied.

The case council has an assumed \$100,000 total planning budget for the next two years. It can approve either proposal or both. These are classroom cost assumptions, not vendor quotes, actual funding or permission to act.

Source proposal S: replace the depot's diesel delivery trucks with electric trucks on the same route. The assigned cost is \$60,000, including implementation and maintenance through year 2. Assume charging capacity and fleet availability are included. Replacement is completed at the end of year 2; no earlier replacement is assumed.

S would remove those trucks' tailpipe emissions once operating. EPA notes that electric vehicles still generate brake and tire particles. Road dust, other vehicles and other sources remain. Electricity production is outside this local tailpipe comparison. Outdoor and infiltrating traffic particles could fall, but the size of that change is unknown.

Receptor proposal R: provide one suitably sized particle-filter air cleaner for one main room in each of the 20 homes this year. The assigned first-year total is \$20,000, including installation, electricity, replacement filters and instruction.

R needs a further \$4,000 total for electricity and replacement filters in year 2. Assume the council can arrange this support. Actual use, noise tolerance and room coverage still need checking. Owning a device is not proof of protection.

R may reduce particles in treated rooms while running. It does not reduce depot emissions or protect residents outdoors, at work, or in untreated rooms. Neither proposal supplies a measured dose reduction or an illness reduction.

Compare the same two-year cost period: add the year 1 and year 2 costs for each proposal, then add S and R for the combined cost. There is no supplied cost beyond year 2. Check whether both fit this fictional budget; fit alone does not prove effectiveness or fairness.

R1: make the whole comparison recoverable

Use two columns headed source S and receptor R. In each, record the intervention point, population and place reached, conditional dose prediction, timing, two-year cost and one feasibility limit.

Then write a claim-evidence-reasoning paragraph. Choose what to fund first, cite at least two card IDs, explain the pathway and tradeoff, and name missing performance evidence. Include both strategies in the same notes.

A partner can question who is reached or when the plan begins. Working alone, compare your first choice with the other column and write the strongest objection. Record one actual revision or a reasoned agreement; do not invent a partner response.

Recovery route: first sort cleaner trucks as source-side and home particle filters as receptor-side. Use D1 for the costs. Write which you would fund first and why, then complete both columns and the full recommendation.

Optional extension: argue for R during years 1 and 2 while S is installed. Use your combined two-year total and identify continuing maintenance after year 2 as unresolved. Do not add percentage reductions or assume independent effects.

Q1: self-check with deliberately missing information

Strategy A removes 95 percent of a factory's emissions but costs 40 million dollars and takes 8 years. Strategy B gives every affected home an air purifier for 2 million dollars this year. Which is the better recommendation, and what makes that a judgment call rather than obvious?

The 95 percent refers to factory emissions, not personal dose or illness. The eight-year description gives no construction phasing. Do not assert that A protects nobody before year 8 unless that extra assumption is stated.

Check what the \$2 million for B does and does not tell you about how well, where and for how long the purifiers would work. Delivery this year does not by itself establish protection this year.

Give a conditional A, B or combined recommendation and explain the judgment. Identify one missing performance fact and one timing or maintenance fact that could change it. An immediate information-gathering step can accompany a provisional choice.

Choosing A is not automatically wrong. Larger source reductions, obligations and outdoor coverage may matter. Choosing B is not automatically right because its initial price is lower. Do not rank cost-effectiveness numerically without comparable benefits and costs.

P1: keep actual coursework and practice distinct

Today's class continues Activity 4.1.2 Analysis of Water Contamination with Claim Evidence Reasoning, part of the Problem 4 activity and its evidence portfolio. Confirm the assigned portion and upload route.

The 4.1.2 introduction concerns water bacteria, DNA isolation, PCR and gel interpretation. The 4.1.3 Testing the Waters procedure includes eleven reagent tests on two waters, health-effects notes, research and peer comparison.

That official work uses its Student Resource Sheet, actual results, teacher directions and further contamination/remediation research with 4.1.2 findings. This traffic case does not complete those water investigations or their remediation conclusions.

April 8's culture plates test a teacher-prepared mock sample, not real drinking water, and a plate count is not a coliform test. Keep any actual water test, assigned photographs, pathway diagram and data analysis pending until completed.

The deeper unit asks for an actual EPA or CDC dataset, high and low values, a higher-exposure group with a reason, and a pathway/risk analysis. This case does not replace those actual-data requirements.

No homework is due before this class. April 8's Exposure pathway preparation was 25 minutes in Lab Notebooks. Retain it if unfinished. The complete solo route is R1.

This week's work requires prototype validation notes, while today's focus is environmental mitigation. Preserve the teacher-assigned weekly packet and unfinished validation work; confirm the applicable deadline.

The April 9 weekly reflection asks what your validation plan measures and why defining success after seeing results would be cheating. Use your actual plan, or record that it is missing. An honestly labeled later revision differs from pretending a post-result criterion was set in advance.

The next dated class, April 12, is exposure-map submission. Keep your actual pathway, data with threshold citations and mitigation notes together for that task.

The April 12 lesson also includes preparation for a twofold endpoint bench activity. Confirm its actual protocol and date with your teacher; this practice does not authorize a bench procedure. Submit only work actually completed.

M1: different worked household-smoke comparison

This separate fictional model concerns wood smoke entering one home from its own old heater. No real household or experiment is described. The model assigns a \$7,000 two-year budget.

Source option: replace the wood-burning heater with electric heat for an assumed \$6,000 total through year 2, available next year. Receptor option: a suitable room particle filter for \$500 in year 1 and \$100 in year 2.

The source option stops smoke from that heater once replaced. Other outdoor and indoor sources remain. The filter may lower particles in its treated room while used, but leaves the heater release unchanged.

If the air actually breathed contains fewer particles and breathing/time stay equal, the potential inhaled amount should decline. No measured concentration or dose reduction is supplied, so I do not claim a percentage or health outcome.

I would conditionally fund the \$600 two-year room-filter option first and reserve \$6,000 for heater replacement, totaling \$6,600. My reason is earlier possible indoor exposure reduction while addressing the source later.

This choice depends on a suitable filter, actual use and the assigned replacement schedule. I would verify room performance and continuing operating costs. Another choice could prioritize source replacement if that timing or the filter evidence changed.

Try the decision

D1 gives cost assumptions but no measured dose or illness reductions. What can the recommendation responsibly claim?

- Choose a conditional sequence using coverage, timing and cost, and state the missing performance evidence.
- Treat the largest emissions cut as the same percentage reduction in illness.
- Declare the cheaper filter plan superior before checking use, room coverage or upkeep.

Explain your choice using the reading. Discuss it or say it to yourself. This practice does not add another submission.

Your 80-minute flow

0–10 minutes	Check control N, count the April 8 plate in the 30 to 300 range through the closed lid, calculate CFU per mL with C1 or C2, and write the W1 sentence.
10–15 minutes	Answer the Cleveland possibility and both starting prompts.
15–28 minutes	Read E1-E3 and D1, then identify the priority group and sort S/R. Use M1 to see a complete different comparison.
28–43 minutes	Complete both columns and their conditional dose predictions; use R1 recovery as needed.
43–55 minutes	Compare costs, timing and coverage; record partner or solo critique.
55–70 minutes	Write the recommendation paragraph; apply Q1 to the factory scenario.
70–80 minutes	Write the funding exit; check product and P1 status; save or submit the notes with the plate-count record.

Your response record

Use these labels on paper or in your document. The space below also works when this page is printed.

Read the April 8 plates

Check control N, count the plate in the 30 to 300 range through the closed lid, and calculate CFU per mL with C1. Write one sentence using W1 on what LB growth can and cannot show about drinking water.

No countable plate, or colonies on N? Use C2's practice data and label it practice. Never open a plate.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

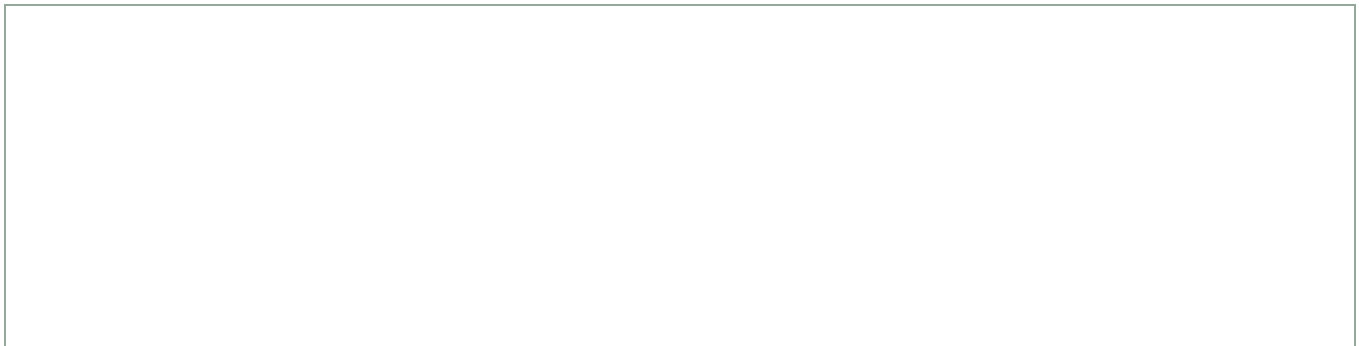


Commit your starting ideas

Name one thing Cleveland could do to reduce air pollution. Give one source-side example and one receptor-side example. Explain why the cheaper option may not be better.

Propose a possibility, not an unverified claim about an existing city program. Use no personal address or health information.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



Build both mitigation columns

Use D1 and E1-E3 to identify the pollutant, pathway and priority group. Complete both R1 columns with a conditional dose prediction and at least one cost or feasibility tradeoff each.

S and R use the same two-year cost window. If lost, sort the strategies first, then use every D1 field; a one-sentence recovery start does not finish the product.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.

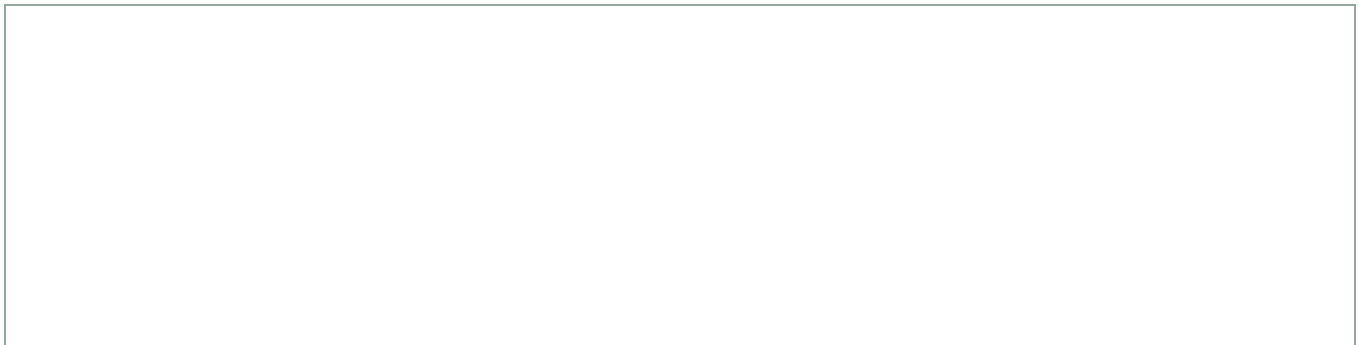


Check the competing choice

Compare both columns with a partner, or use the solo objection in R1. Record the strongest objection to your first choice and one actual revision or reasoned agreement.

Check treated-room coverage, outdoor exposure, timing and continued maintenance. Do not invent measured benefits.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



Write the justified recommendation

Write one CER paragraph naming what you would fund first. Include both strategies, cite at least two evidence cards and justify the risk-to-cost balance with its uncertainty.

A, B or a combined sequence may be defensible when the case facts and missing performance evidence are explicit. Here S and R name the traffic options; Q1 has separate A and B options.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



Transfer to the factory self-check

Answer Q1 with a conditional recommendation and identify the missing performance and timing or maintenance facts that could change it.

Keep emissions, dose and health risk distinct. Do not supply an unstated eight-year no-benefit assumption.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



Finish and keep the right status

State which traffic strategy you would fund first and why. Record actual/solo checking and the P1 holds. Keep unfinished official, pathway, data and weekly work separate.

If ready, complete the R1 combined-sequence extension. Answer the separate weekly reflection only from your actual validation plan; otherwise mark that input pending.

Use this space or the same labeled section in your existing document. Add paper when your table, graph or drawing needs more room.



Check your product

- You proposed two distinct mitigation strategies.
- You justified a recommendation using risk and feasibility.
- I completed both intervention columns, conditional predictions, critique, CER and funding exit.
- I kept emissions, exposure, dose and risk distinct and named missing performance evidence.
- I counted a 30 to 300 plate or the C2 practice data, calculated CFU per mL with units, and explained why LB growth is not a coliform test.

Keep the limit: Original case assumptions support a planning argument, not a measured emissions, exposure, dose or health-risk reduction. They cannot enact policy, fund a purchase or complete actual PLTW investigations.

Turn in your work

Use the teacher-confirmed April 9 Claim Evidence Reasoning assignment for your BI course and section. Put the plate-count record at the top of the same mitigation notes and save them as one PDF if that route is assigned. Label the case original practice; attach only work actually completed and check the submission confirmation.

Save the same record locally if the exact assignment or route is unavailable. Keep actual Problem 4, prior data, official water work and weekly validation evidence pending as needed.

[Open this assignment in Schoology.](#)

Carry forward

Compare where mitigation acts, whom it reaches, when it works and what it costs; a release percentage alone cannot establish the best health protection.

Carry actual pathway, data, citations and mitigation notes into the assigned exposure map; keep missing authentic inputs pending. How will your map connect the pollutant source, exposure route and proposed mitigation?

Sources and resources

[Open today's page](#)

EPA-EV · Modeling Emissions from Electric Vehicles

U.S. Environmental Protection Agency

<https://www.epa.gov/moves/can-i-model-emissions-electric-fuel-cell-and-hybrid-vehicles-and-equipment-moves>

EPA-PM · Particulate Matter (PM) Basics

U.S. Environmental Protection Agency

<https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>

EPA-HEALTH · Health and Environmental Effects of Particulate Matter

U.S. Environmental Protection Agency

<https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>

EPA-FILTER · Guide to Air Cleaners in the Home

U.S. Environmental Protection Agency

<https://www.epa.gov/indoor-air-quality-iaq/guide-air-cleaners-home>

EPA-DOSE · Exposure Assessment Tools by Routes: Inhalation

U.S. Environmental Protection Agency

<https://www.epa.gov/expobox/exposure-assessment-tools-routes-inhalation>

EPA-RISK · Conducting a Human Health Risk Assessment

U.S. Environmental Protection Agency

<https://www.epa.gov/risk/conducting-human-health-risk-assessment>

OPENSTAX-MICRO · Microbiology, 9.1 How Microbes Grow

OpenStax, Rice University

<https://openstax.org/books/microbiology/pages/9-1-how-microbes-grow>

EPA-RTC · Revised Total Coliform Rule And Total Coliform Rule

U.S. Environmental Protection Agency

<https://www.epa.gov/dwreginfo/revised-total-coliform-rule-and-total-coliform-rule>

CFR-141-852 · 40 CFR 141.852 Analytical methods and laboratory certification

Electronic Code of Federal Regulations

<https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-141/subpart-Y/section-141.852>