

Bringing Real World Research into the Classroom

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Donaher Lab at UTK

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The Problem(s)

- Many K-12 students in the US are using textbooks which are 7 – 10 years old and contain outdated information (FCC, 2012)
- Lack of access to STEM role models and misunderstanding of what it means to be a scientist/engineer may prevent K-12 students from seeing STEM careers as realistic options (LPS, 2024)
- Scientists and engineers are often bad communicators due to use of jargon, assuming audience knowledge, and a lack of training in public engagement

The Solution

- Connect K-12 educators with researchers to bring real-world research into the classroom
- Benefits include:
 - Humanizing STEM professionals in K-12 students eyes makes STEM careers seem more attainable
 - Provides training for young scientists and engineers to become better communicators
 - Gives students a “snapshot” of cutting-edge trends in STEM

Scientific Research and Education Network

- Non-profit started by graduate students at the University of North Carolina at Chapel Hill in 2012
 - Has since expanded to include 6 chapters (NC Coast, NC Triangle, Georgia, George Mason, Alabama, and San Diego)
- Goal is “to foster the translation and dissemination of current scientific work to educators and to help enhance the science literacy of today’s youth”



Image credit: SciREN

Scientific Research and Education Network

- Annual events
 - Lesson Plan Workshop
 - Networking Event

SciREN

is as easy as

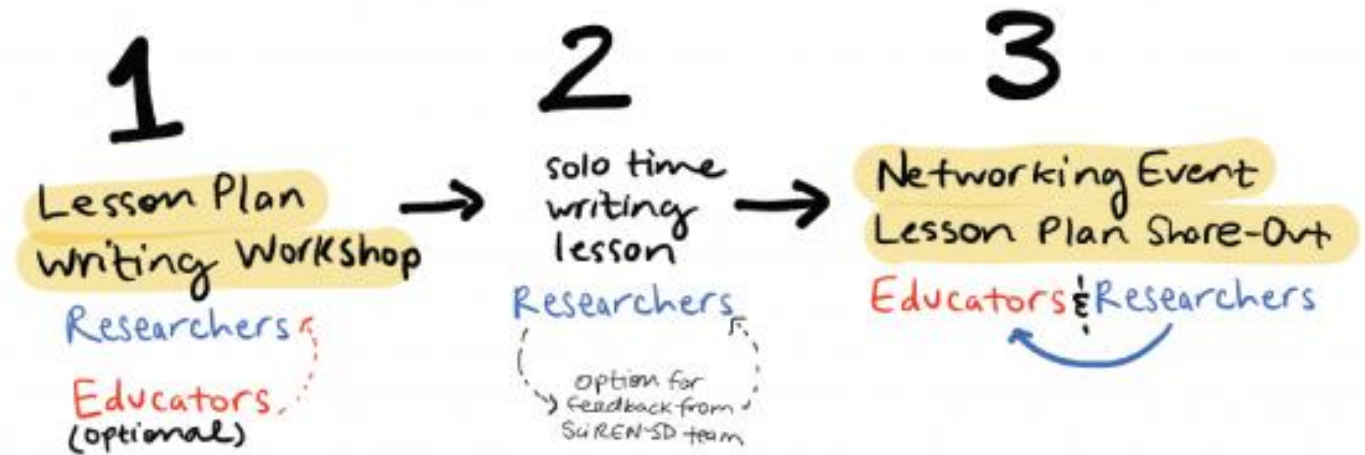


Image credit: SciREN

Scientific Research and Education Network – Lesson Plan Workshop

- Educator-led
- Structure:
 - Introduce the concept of lesson plan preparation to researchers
 - Particular emphasis on connecting to state-specific and national standards
 - Educator panel shares advice on lesson plan development
 - Small group discussion between researchers and educators
 - Develop lesson plan ideas
 - Determine how specific research fits into classroom curricula at different grade levels
 - Ensure lesson plan activities are classroom-ready exercises that meet state and national standards

Scientific Research and Education Network – Networking Event

- Hosted at local informal science education institutions (museums or aquariums)
- Table event – researchers present lesson plans
 - Face-to-face interaction
 - Exchange of ideas and materials
- Active at the NC Coast, NC Triangle, and Georgia chapters



After the Events

- Teachers bring lesson plans back to the classroom
- Researchers take lesson plans to outreach events
- Maintain the network and encourage collaboration among members



After the Events



Scientific Research and Education Network

- SciREN Lesson Plan Portal
(<https://scirenplans.com/doku.php?id=start>)
 - Example: [Introduction to Environmental Engineering](#) by Julia Kendall

Introduction to Environmental Engineering: A Water Filtration Experiment Lesson Outline

General Lesson Information
Title: Introduction to Environmental Engineering: A Water Filtration Experiment
Overview/Annotation- <i>A short summary or description of the lesson including activities and science concepts.</i> This lesson plan introduces students to the concept of environmental engineering, it's importance in protecting our air, land, and water, what techniques are used to clean our water, and provides a hands-on activity where students will be able to build and test their very own water filters.
Setting or format (outdoors, in groups, lab, etc.): In groups in standard classroom or lab
Intended group size (if groups are used): Groups of 3-4 students
Intended grade level(s): Science - 5 th , 6 th , 7 th
Approximate Time of Lesson (<i>Ideally break down into 20-50 minute periods</i>): Four 50 minute periods

Credit: Julia Kendall

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Content Standards- *List Alabama Course of Study Standards that connect to lesson*
5th: SC15.5.16 - Collect and organize scientific ideas that individuals and communities can use to protect Earth's natural resources and its environment (e.g., terracing land to prevent soil erosion, utilizing no-till farming to improve soil fertility, regulating emissions from factories and automobiles to reduce air pollution, recycling to reduce overuse of landfill areas).

SC15.5.17 - Design solutions, test, and revise a process for cleaning a polluted environment (e.g., simulating an oil spill in the ocean or a flood in a city and creating a solution for containment and/or cleanup).*

6th: SC15.6.16 - Implement scientific principles to design processes for monitoring and minimizing human impact on the environment (e.g., water usage, including withdrawal of water from streams and aquifers or construction of dams and levees; land usage, including urban development, agriculture, or removal of wetlands; pollution of air, water, and land).*

SC15.5.15 - Analyze evidence (e.g., databases on human populations, rates of consumption of food and other natural resources) to explain how changes in human population, per capita consumption of natural resources, and other human activities (e.g., land use, resource development, water and air pollution, urbanization) affect Earth's systems.

7th: SC15.7.9 - Engage in argument to defend the effectiveness of a design solution that maintains biodiversity and ecosystem services (e.g., using scientific, economic, and social considerations regarding purifying water, recycling nutrients, preventing soil erosion).

Scientific Research and Education Network

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Day 1: Introduction to Water Filtration

Objective:

- Understand why water filtration is important.
- Learn about different types of contaminants in water.
- Discuss how natural and man-made filtration systems work.

Materials:

- 5-gallon bucket of dirty water (prepared with dirt, white vinegar, and dish soap).
- Dixie cups.
- Paper towels.
- Portable turbidimeter (to measure water clarity).
- Whiteboard and markers.

Day 4: Improving and Finalizing Filters

Objective:

- Analyze filter effectiveness.
- Modify designs for better results.
- Discuss real-world applications.

Materials:

- Existing water filters from Day 3.
- Additional materials for adjustments.
- Measuring cups, graduated cylinders, turbidimeter.
- Paper towels for cleanup.

Scientific Research and Education Network

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- Example: [Introduction to Environmental Engineering](#) by Julia Kendall

Team members _____

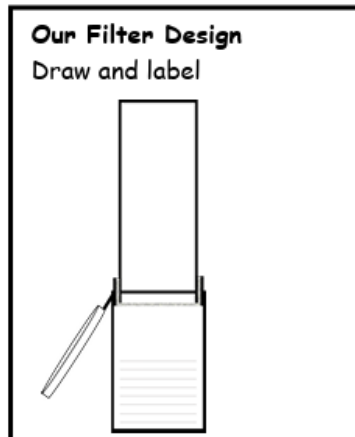
Water Purification

The **purpose** of the experiment is to design a filter to purify water.

You will **evaluate** your design based on (1) the cost of the filter, (2) the time it takes to filter 3 ounces (1 dixie cup) of dirty water, and (3) the purity of the filtered water.

Here are the **materials** available to build your filter and their costs. In the table, write how much of each you will use and calculate the cost for each material and the total cost to build your filter. Maximum 75¢

Material	Price	How much we will use	Cost
1 cotton ball	2¢	x	= ¢
1 tablespoon of rice	3¢	x	= ¢
1 tablespoon of sand	5¢	x	= ¢
1 teaspoon of carbon	10¢	x (2 max)	= ¢
1 coffee filter	25¢	x (1 max)	= ¢
TOTAL COST TO BUILD OUR FILTER (maximum is 75¢) →			= ¢



Our Data

Cost to build our filter
_____ ¢

Time to filter 3 ounces of the dirty water
_____ minutes

Turbidity of filtered water
_____ (scale of 1-5)

Challenge

You are working for Stone Clean Water Engineering Company and have been asked to design a new water filtration system for a community with a polluted water supply.

The community gives you a list of three requirements:

- (1) The system should be CHEAP
- (2) The system should work FAST
- (3) The water should be POTABLE

You have 5 materials to put in your filtration system: cotton balls, rice, sand, carbon, coffee filter. You can use them in any order and different amounts, but you can spend a maximum of 75¢ for your filter system.

Designing your filtration system

- (1) **Write** down how much of each material you will use in the table.
- (2) **Use your math skills to calculate** the cost to build your filter with these materials, and **write** down the cost in the data box.
- (3) **Draw** your filter design and label the materials in your drawing.
- (4) **WHEN ASKED**, **send** one partner to obtain your materials and polluted swamp water.
- (5) **Build** your filtration system using the materials in your design.
- (6) **WHEN INSTRUCTED**, **filter** the water, and **record** the time in minutes needed to collect 3 ounces (oz) of purified water.
- (7) **Record** the turbidity of your filtered water in the data box.
- (8) **Calculate** your score and **record** it on the back of the sheet.

TURN OVER THE SHEET TO DETERMINE YOUR FILTRATION SCORE!

Credit: Julia Kendall

Next Steps

- Reach out to local SciREN chapters or other graduate student organizations to see if any events are being hosted near you
- Coordinate with students attending WM Symposium to gauge interest in initiating a nuclear-themed event
 - Lesson plan workshops could be hosted during the Symposium to take back for local networking events across the country
- Identify similar opportunities to bring cutting edge research into the community via collaboration with local universities and other research-based institutions

During the event, each scientist received contact information from **an average of 22 educators** interested in classroom visits

More than 95% of educators who attend the networking events indicate that they would be using these lesson plans in the classroom

More than 95% of participants reported making strong connections during the event and were interested in future events