

This product is a part of the Radiological Education Monitoring and Outreach Project (REMOP) conducted by the University of Georgia Savannah River Ecology Laboratory in Burke County, Georgia with assistance from Georgia Women's Actions for New Directions. This project is supported by grants from the Department of Energy Savannah River Site.



**Savannah River
Ecology Laboratory**
UNIVERSITY OF GEORGIA

1. Introduction to REMOP and the Scientific Method

Concepts

- The creation of REMOP from SRS CAB and community recommendations.
- Who SREL and Georgia WAND are, and their roles in REMOP.
- How questions become drivers to scientific inquiry and scientific monitoring programs.
- REMOP's goals to provide data and education on environmental monitoring programs.

Skills: observation, decision-making, critical thinking

Materials

- PowerPoint slides
- Handout

Time Consideration: Preparation 10-15 minutes, one 40-minute period

Objectives

- Participants will describe the history of the Shell Bluff, GA area and goals for the Radiological Education, Monitoring, and Outreach Project (REMOP).
- Participants will understand who the Savannah River Ecology Lab (SREL) and Georgia Women's Actions for New Directions (WAND) are and their roles in REMOP
- Participants will be able to explain the scientific process and how they have used it in the past
- Participants will understand the process of creating a scientific experiment

Key terms: scientific method, experiment, assessment, observation

Background

This is the first Community Talk for the Radiological Education, Monitoring, and Outreach Project (REMOP) in Burke County, Georgia. REMOP is created by UGA SREL with support from Georgia WAND to help inform citizens in the Shell Bluff community and Burke County, Georgia, about their environment and the impacts of public and private industries on their environment with specific focus on heavy metal and radionuclide contaminants. UGA SREL is a research institution of the University of Georgia located in Aiken, SC on the Savannah River Site (SRS). Since 2002, communities and organizations in Georgia have been asking for reinstatement of monitoring programs in Georgia, particularly in Burke County. The creation of REMOP directly stemmed from the SRS Citizen's Advisory Board (CAB) Recommendation 317 (1), requesting that independent environmental surveillance program is re-established in Georgia funded by the Department of Energy-Savannah River (DOE-SR). This resulted in DOE-SR asking SREL to perform a review the efficiency of current monitoring programs and provide recommendations to DOE-SR of potential options to address concerns of the SRS CAB and citizens of Georgia (2). SREL's final recommendations included developing a strategy to incorporate limited monitoring data as a basis for providing outreach and education to help local

residents draw their own conclusions concerning health risks. At the same time, the U. S. Environmental Protection Agency (EPA) was working with a contractor on a Technical Assistance Needs Assessment (TANA) for Shell Bluff and Burke County residents. The results of this assessment also indicated topics REMOP should cover and how to provide content to the public.

SREL will be providing monthly Community Talks that provide information on a wide-variety of topics that will provide foundational knowledge to understanding current and future monitoring programs in the region. Our first talk is about the Scientific Method, and next month we will discuss Contaminants in Our Lives. REMOP's goals include increasing community knowledge about monitoring programs in the area and provide educational opportunities to community members focused on local contaminants. A Community Advisory Council (CAC) made up of leaders from Shell Bluff and Burke County will act as the first review for REMOP content. There will also be an External Advisory Council that is made up of experts from multiple disciplines, including environmental toxicology, nuclear engineering, environmental justice and local stakeholders. SREL is also planning to conduct data collection from water (both well water and surface waters), soil, garden vegetables, and domestic animals in 2018 for educational purposes to provide insight to past and current monitoring data. Data collected as part of REMOP are intended to be used for educational and outreach purposes only and are not for environmental monitoring or any regulatory purposes. Data collected under REMOP will not meet the requirements of a legally authorized monitoring program. For example, data collected under REMOP will not be gathered in compliance with the geographic, statistical, or site selection procedures required by a legally authorized monitoring program conducted by or on behalf of any regulatory agencies. We will collect these samples in partnership with community members and present the results during the second year of REMOP.

The contaminant history in Shell Bluff and Burke County focuses on two well-known sources, the Department of Energy Savannah River Site and Georgia Power's Plant Vogtle. There are multiple groups that perform monitoring of radionuclides and heavy metals in the area – including SRS and Plant Vogtle. Governmental agencies data is publicly available but sometimes hard to find or understand. The Georgia Environmental Protection Division monitored radionuclides from the early 1970s until 2002. Since the end of the monitoring program, Georgia WAND has been working with community members to reinstate a monitoring program in Georgia. There is limited monitoring of water in the region for heavy metals like mercury (9, 10, 11) by governmental organizations. Private companies must provide data to show they are meeting compliance laws regulated by the US EPA, but they do not have to release this data to the public (7). Scientific studies have seen negative health effects from areas where heavy metals and radiation exposure exceeds regulatory limits (12, 13, 14). Due to human health concerns raised by Shell Bluff community members about the impacts of radionuclides and heavy metals in the area (see Georgia WAND's History of Shell Bluff brochure), it is important to understand how monitoring programs in the area are set up, are regulated, and what the data mean to citizens in Burke County.

Before we can get too detailed about the mechanisms behind environmental monitoring programs, the energy industry, and other topics in REMOP, it is important to understand the basis of scientific studies – the Scientific Method. The Scientific Method is the most basic component of scientific research. The Scientific Method is where scientists start to build research questions and experiments to answer those questions (8). The Scientific Method has five parts: 1. Make an observation, 2. Make a prediction, 3. Test the hypothesis with an experiment, 4. Analyze the results, 5. Make a conclusion. It's important for this process to remain unbiased, or neutral. Scientists created series of checks and balances throughout the scientific method so that potential biases and assumptions can be addressed. It's also very important to realize that the scientific method is not limited to science experiments – many people unknowingly use this method in everyday life (4) and even participate in it,

through opportunities like Christmas Bird counts and stream monitoring programs. If a person decides to test the fastest route to work or which fertilizer grows larger vegetables, this is participating in the process of the scientific method. REMOP was created because Shell Bluff and Burke County community members observed things in their environment and then proceeded to ask questions. REMOP's goals include engaging the community, answering questions, and helping community members understand the opportunities and resources available for drawing their own conclusions in the future.

Preparation

- Prepare mechanism for viewing PowerPoint slides if choosing to use slides during the presentation.
- If not using slides, prepare worksheet and handout for participants.
- Prepare bleach and food coloring experiment (see activity appendix).

Lesson

1. Ask participants if they have ever noticed something in their community or asked a question about their surroundings. If using Powerpoint to show the figures, pull up Figure 1. If using the handout, point out on the handout where Figure 1 is located.
 - a. If these observations align with REMOP's history (people getting sick, environmental observations, etc.), then point out that this is the first step in the scientific method (make an observation).
 - b. If observations suggested do not fall along those lines or the room is silent, begin suggesting observations you make in your life to tie back into environmental quality (it's hotter this spring than last spring, the wetlands are drying up faster than usual, etc). Help guide the participants to observations that lead to REMOP's creation, and then point out that this is the first step in the scientific method (make an observation).
2. Using the observations participants suggested, ask if anyone has ever formed a question about those observations. If the observation is about fish dying in the water, for example, then ask if anyone has a hypothesis about why this happens. When a question is suggested, state that this is the second step in the scientific method, make a prediction.
3. Ask participants if they have ever tested whether or not their prediction is true. Have they tried testing two different routes to work or church to see if one is faster than the other? Or have participants tested how one fertilizer grows better vegetables than another one? Explain that this is where scientists perform experiments, where data is gathered to begin answering the original question (the prediction) and open up the possibility to asking additional questions.
4. State that when someone tests their prediction, they are collecting data. When they time how long it takes to drive from one point to another, the time is data. Comparing vegetable sizes after the application of two types of fertilizers, measuring the vegetable size is data collection and data comparison. We use data to draw conclusions about what we've previously observed and formed a question about.
5. Determine what participants did with this information (the data). Did it change their habits? Did they ask more questions? Did they test their original question again or continue to test follow-up questions?
6. Explain that this is the very basic foundation of scientific inquiry. If using Powerpoint, pull up Figure 2. If participants are using handouts, refer to Figure 1 again on the handout. Explain that Figure 2 represents a small bit of how scientists practice the scientific method. That the scientific method becomes more complicated during data collection (due to experiment failures, method creation, etc.) and is peer-reviewed to ensure that the science is accurate and not-exaggerated. It is also important that the results are reproducible; so for example, if your neighbor drove the same 2 routes to work and reached the same conclusion as you. That there are series of checks and balances created to make sure that science is moving forward, but that checks and balances need to be re-evaluated on a regular basis to

make sure it's working well. Science isn't perfect, but that accountability is created through the continuous cycle of asking questions and challenging assumptions.

7. Revisit how REMOP was created – through community observation and question-asking. Point out that these are the first two steps in the scientific method. Pull up Figure 3 on the Powerpoint and/or point it out on the handout. Show that science is connected with the communities it works within. That participant who is currently attending the program are helping move the scientific process forward – continuing to ask questions, gather information, and, in the future, collect data so that we can draw conclusions about the environment we live in.
8. Time Assessment: Is there enough time for the activity? If not, continue to ending remarks. If so, move on to the activity demonstration.

Activity

Bleach and Food Coloring – this activity demonstrates the power of bleach to remove color. Bleach is a common household cleaning product that is commonly used to remove stains and sanitize surfaces. We expect the bleach to cause a color change, but how will the color in the water change?

Supplies: 2 clear cups or jars, 2 colors of food coloring, bleach, PPE (gloves, eye protection, paper towels)

1. Fill a clear cup or jar with water. Add 2-3 drops of food coloring.
2. Add drops of bleach until the color in the water begins to change. How many drops does it take until all the color is gone? Have participants record this information on their handout.
3. Add a few drops of a second food coloring dye. What happens? How is it different than when food coloring is added to pure water?
4. Explain that these observations lead us to the conclusion that bleach can remove color. How much color is determined by how many drops of food coloring we added and how much bleach we added.
5. Ask the participants if they have ever done an experiment like this in their own home. Did they record or remember the data they gathered? Are they gathering any observations currently they are hoping to test out in the future?
6. Reiterate that everyone is practicing the scientific method throughout their days and their lives, whether they've recognized it before or not.

Figures

Figure 1. The Scientific Method in its most basic form; with 5 steps, leading from one to the next.

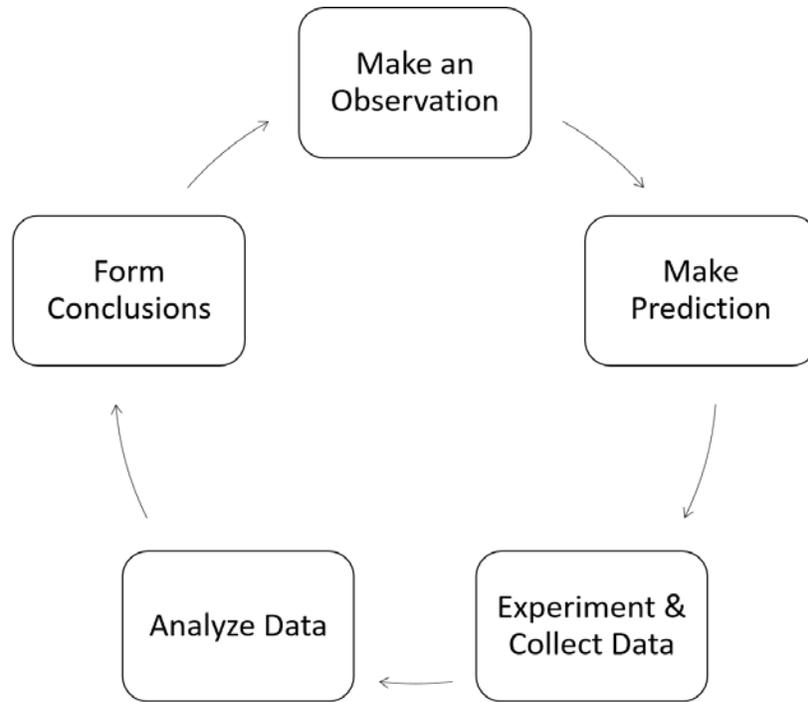


Figure 2. The Scientific Method with added steps and procedures to illustrate how scientists use the scientific method on a daily basis and as a foundation for their experiments.

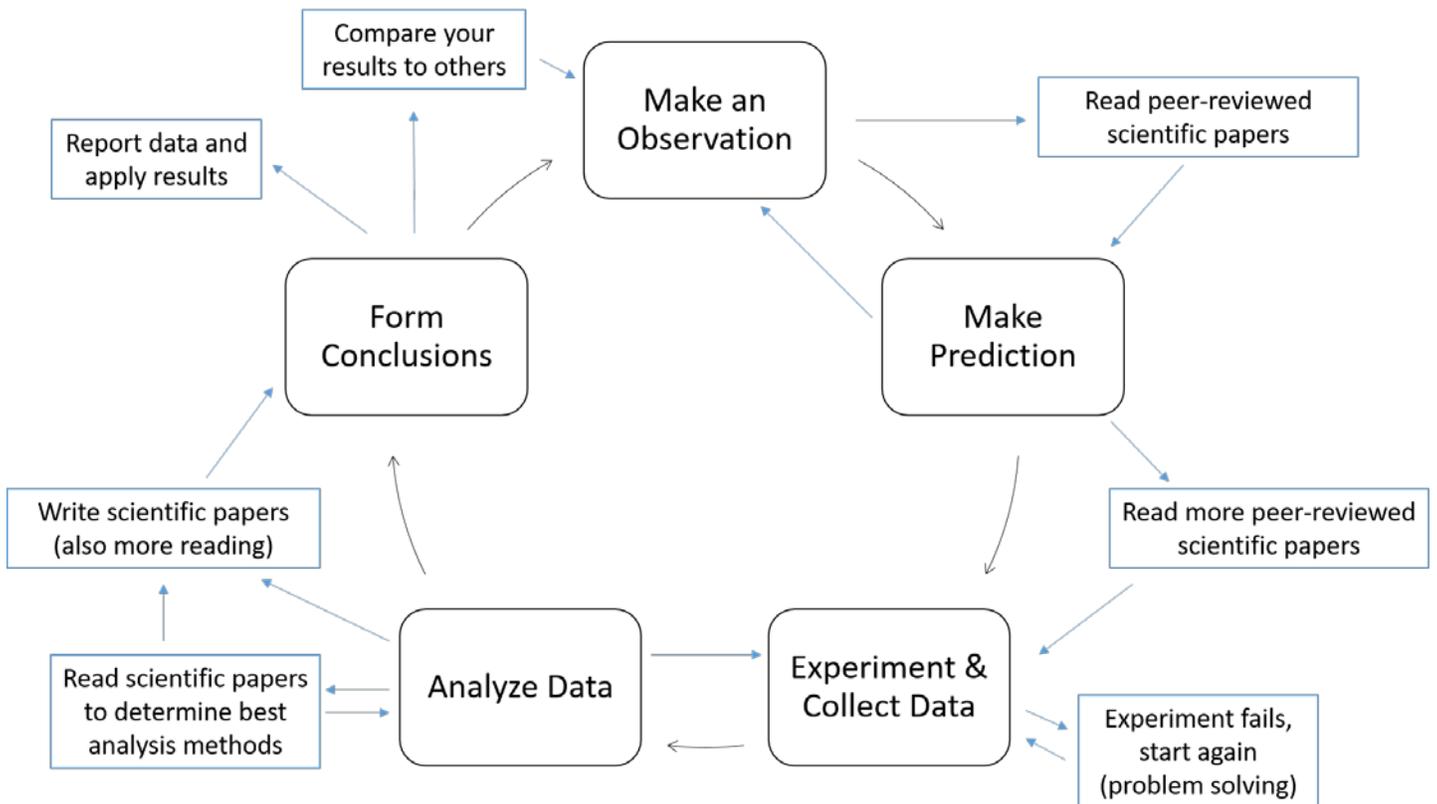
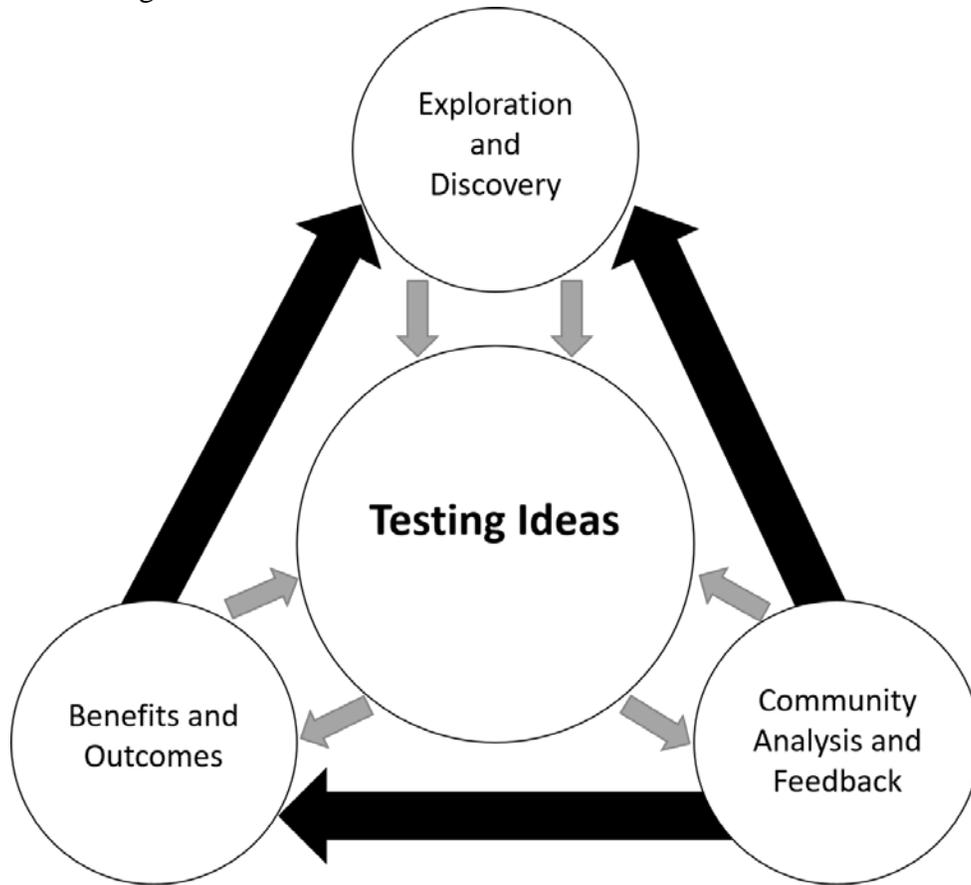


Figure 3. Simplification of how the scientific method (Testing Ideas) is involved with society in a larger picture. Scientific inquiry participates in exploration and discovery, community improvement and feedback, and the benefits and outcomes through other sources.



Resources

1. <http://www.srs.gov/general/outreach/srs-cab/library/meetings/2015/fb/CABChairBoardUpdateSeptember222015.pdf>; slides 7-13
2. http://archive-srel.uga.edu/docs/SREL_CAB_317.pdf
3. McPherson, G. R. 2001. *Teaching and Learning the Scientific Method*. The American Biology Teacher 63 (4): 242-245.
<http://www.bioone.org/doi/full/10.1662/00027685%282001%29063%5B0242%3ATLTSM%5D2.0.CO%3B2>
4. McCleery, J. A. and G. A. Tindal. 1999. *Teaching the Scientific Method to At-Risk Students and Students with Learning Disabilities Through Concept Anchoring and Explicit Instruction*. Remedial and Special Education 20 (1):7-18.
5. <https://www.youtube.com/watch?v=OMWNFOD3zPs>
6. Enforcement and Compliance History Online, U. S. Environmental Protection Agency.
<https://echo.epa.gov/>
7. Resource Conservation and Recovery Act 42 U.S.C. §6901 et seq., 1976. RCRA Online
<https://yosemite.epa.gov/osw/rcra.nsf/how+to+use?OpenForm>
8. Hanauer, D. I., D. Jacobs-Sera, M. L. Pedulla, S. G. Cresawn, R. W. Hendrix, and G. F. Hatfull. *Teaching Scientific Inquiry*. 2006. Science 314:1880-1881.
9. Gonthier, G. J. 2013. Hydrogeology and water quality of the Dublin and Midville aquifer systems at Waynesboro, Burke County, Georgia, 2011. U. S. Geological Survey Scientific Investigations Report 2013-5026, 39p
10. Water Quality in Georgia 2002-2003
https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Water_Quality_In_Georgia_305b303d_Y2004.pdf
11. Cherry, G.S., and Clarke, J.S., 2007, Simulation and particle-tracking analysis of selected ground-water pumping scenarios at Vogtle Electric Generation Plant, Burke County, Georgia: U.S. Geological Survey Open-File Report 2007-1363, 51 p., Web-only publication at
<http://pubs.usgs.gov/usgspubs/of/2007/1363>
12. Rowe, B. L., P. L. Toccalino, M. J. Moran, J. S. Zogorski, and C. V. Price. 2007. Occurrence and Potential Human-Health relevance of volatile organic compounds in drinking water from domestic wells in the United States. Environmental Health Perspectives 115 (11): 1539-1546.
13. Mozaffarian, D., and E. B. Rimm. 2006. Fish intake, contaminants, and human health evaluating the risks and benefits. JAMA 296 (15): 1885-1899.
14. Jarup. L. 2003. Hazards of heavy metal contamination. British Medical Bulletin 68: 167-182.

Disclaimer

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If you have any questions, please call 803-725-2649 or email remop@srel.uga.edu.

Handout

01: REMOP & the Scientific Method

The Radiological Education, Monitoring, and Outreach Project
University of Georgia Savannah River Ecology Laboratory

This handout is to follow along with the presentation, REMOP and the Scientific Method. If you have questions while participating, please let us know.

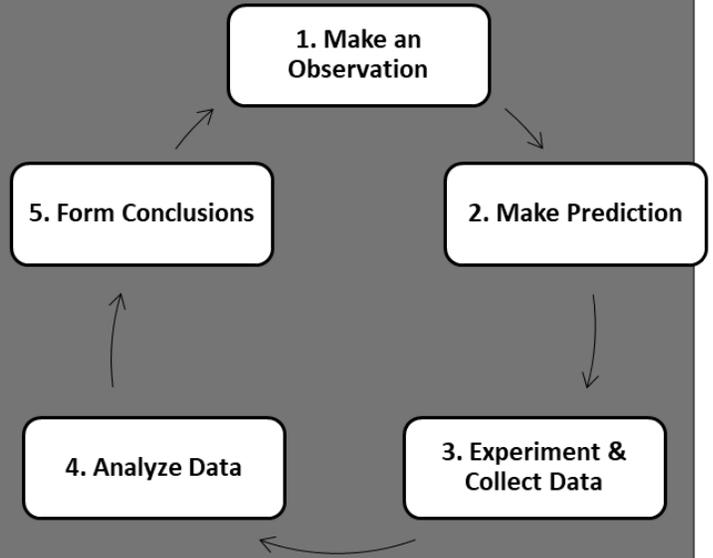
What is the Scientific Method?

The Scientific Method is the foundation for building scientific experiments that scientists can answer questions with.

But while scientists follow this basic foundation, the actual process can be a lot more complicated. Scientists regularly undergo review of their methods and practices to make sure that they're correct. Many times, scientists will ask more questions based on the conclusions from one experiment.

What observations do you make in your daily life?

It could be about the weather patterns over time or how many vegetables your gardens grows when using a particular type of fertilizer. If that observation changed over time or you change your habit, you were participating in the scientific method!

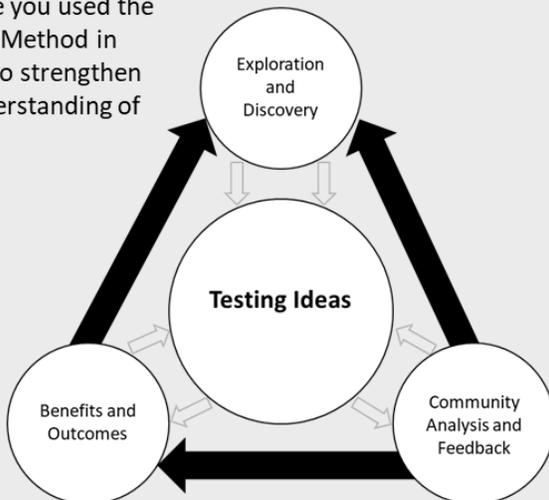


REMOP in the Scientific Method

REMOP was created through the process of community member observations and stakeholder review. When you ask questions to learn more, you're participating in the Scientific Method.

We can use the Scientific Method to create better communities. When you participate, it makes the whole process stronger.

How have you used the Scientific Method in your life to strengthen your understanding of a topic?



Your Notes

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