Producing a Video to Communicate Radon Health Risks in Williamsburg

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Intro to Geologic Research
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Introduction

Radon gas is a common hazard in residential basements, where radon seeping out the ground can enter into houses and eventually cause lung cancer. The William & Mary Geology Department has been investigating the presence of radon in the Williamsburg area for years. Since the 80s, Rick Berquist has been conducting and encouraging research projects that build this knowledge. These efforts have culminated in the development and validation of a radon risk map of the Williamsburg area (Miller, 2021; Mondshine, 2021). Online videos are an increasingly common medium for information and entertainment consumption, and have potential for effective science communication (Finkler and Leon, 2019). One of the ways to make science communication engaging is to tell a story. Storytelling allows people to connect to a concept, and informs their decisions (Joubert et al., 2019). There is a general lack of understanding in the United States of radon and the health risks it poses (Vogeltanz-Holm and Schwartz, 2018). For this project, I will produce a video that tells the story of radon to the Williamsburg community. It will communicate what radon is, previous research at William & Mary, and how people can learn more about it. This project will include the development of storytelling methods and accessibility standards that the video will follow.

Research Goal

The purpose of this video will be to communicate how radon is a potential health hazard to the Williamsburg public. To do so, it will establish what radon is and how it is naturally formed, as well as how it is a health risk. The video will then summarize previous research on Radon in the Williamsburg area, including student research projects at William & Mary. The video will conclude with encouragement for viewers to learn more about radon, and to get their homes tested. To do all of this effectively, a thorough review will be conducted of the previous research done concerning radon in the Williamsburg area, and how it fits

into the broader landscape of radon literature. This review will include radioactive decay processes, the stratigraphy of Williamsburg, and the methods of previous researchers. I will also research best practices in video communication of science, as well as what accessibility guidelines should be followed. This will inform the scriptwriting process, and create objectives to be met by the final video. The video will be an approachable introduction to why radon is an important topic for everyone in Williamsburg to be aware of.

Geologic Background

Radon is a chemical element with the atomic number 86. It occurs naturally as a short intermediate step in uranium decay chains (Figure 1). It has three isotopes: ^{219}Rn, ^{220}Rn, and ^{222}Rn (Weigel, 1978). ^{222}Rn is the most impactful on humans, and the isotope of radon I'll be referring to for the remainder of this project. ^{222}Rn has a half-life of 3.82 days, meaning that after that amount of time half of a given quantity of ^{222}Rn will have decayed into the next decay product. The products directly following ^{222}Rn are solids, and also short-lived. Two of them, ^{218}Po and ^{214}Po, emit alpha particles when they decay. When ^{222}Rn is inhaled into the lungs, this process can take place within the lungs. Alpha particles can damage the cells lining airways within the lungs, eventually leading to cancer. This is how exposure to radon increases one's risk of lung cancer (National Research Council (US) Committee on the Biological Effects of Ionizing Radiations, 1988). Radon exposure is the second-highest cause of lung cancer in the United States, behind smoking tobacco.

Concentrations of radon are commonly measured in becquerels per kilogram (Bq/Kg), or picocuries per liter (pCi/L). Becquerels and curies are both measurements of radioactivity, i.e. they represent the frequency of radioactive decays.

The Environmental Protection Agency's published radon risk map shows Virginia's coastal plain as the lowest-risk region in the state, labeled as "Low Potential (less than 2pCi/L)" ("Virginia - Radon Zones"). The Virginia Department of Health has published the same map on their website ("Indoor Radon Program – Radiological Health"). Someone living in the Williamsburg area who reads this map would likely conclude that their home is at negligible risk of radon exposure. While this might be true for much of the coastal plain, research has shown there are areas of higher risk that would be colored in red on the aforementioned map.

In 1978, Khandelwal and Singh published a short article in Health Physics sharing that they had discovered radioactivity in whale bone vertebra in the Chesapeake Bay area, including in the Yorktown Formation. Research on radon at William & Mary started around 1989 when Jennifer M. Cooper wrote a report about

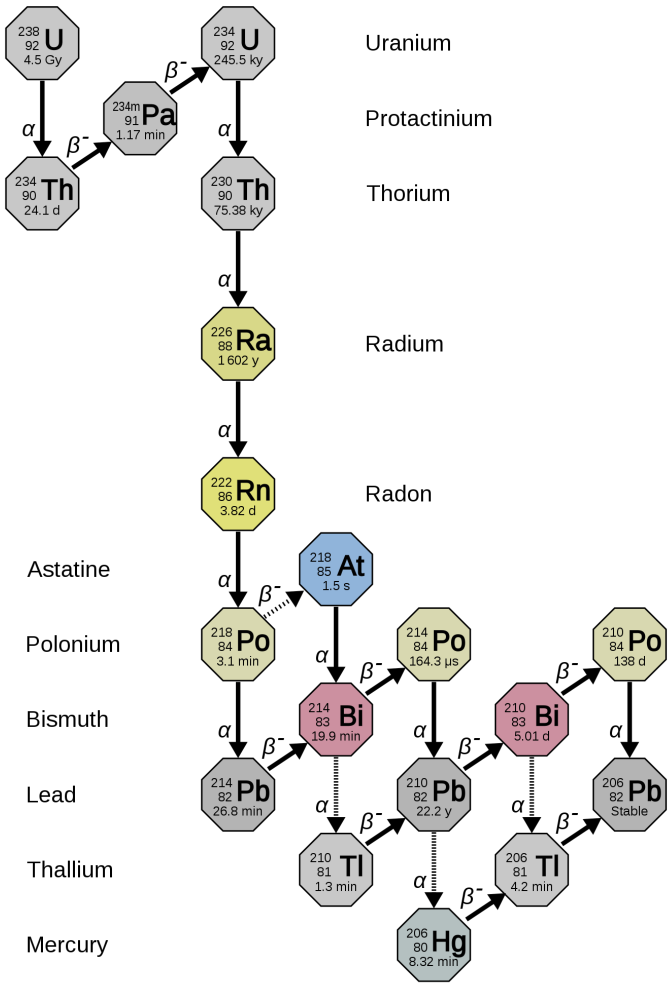

Figure 1: Decay chain of uranium (User:Tosaka, 2014)

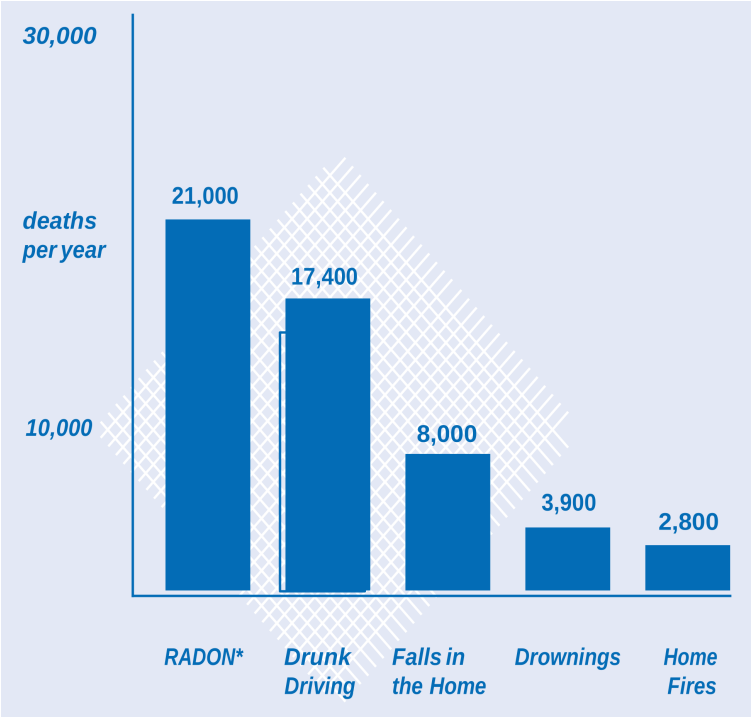

Figure 2: Yearly radon-related deaths compared to other common causes in the US (US EPA, 2014)

the Yorktown Formation as a potential source of radon in the Williamsburg area (Cooper, 1989). She tested a number of different locations in York River State Park, correlating the Yorktown formation with radon emission using her own data.

The second student at William & Mary to investigate radon was Tracy Whitesell. Her project involved testing different locations for radon, and she compared different formations by makeup and average radon concentration. Her results clearly show that the Yorktown has higher radon concentrations than nearby formations. Whitesell was one of the first to so thoroughly illustrate the radon landscape in the Williamsburg area, and her work was remarkable in confirming the suspicions of previous researchers. In the final sentence of her thesis, she recommended that "houses built within or on the Yorktown should be tested for radon" (Whitesell, 1990).

In 2020, Dorian Miller created a "risk map" of radon near William & Mary's campus. This map was created by mapping elevation data at certain thresholds, because the Yorktown Formation is a horizontal layer that becomes closer to the surface as the elevation decreases (Miller, 2021).

In 2021, Zoey Mondshine validated the risk map, by testing individual homes and comparing their relative test results to the regions on the risk map. Among other observations, she identified a home in the "Low Radon Risk" region with radon levels above the EPA's recommended limit of 4pCi/L (Mondshine, 2021).

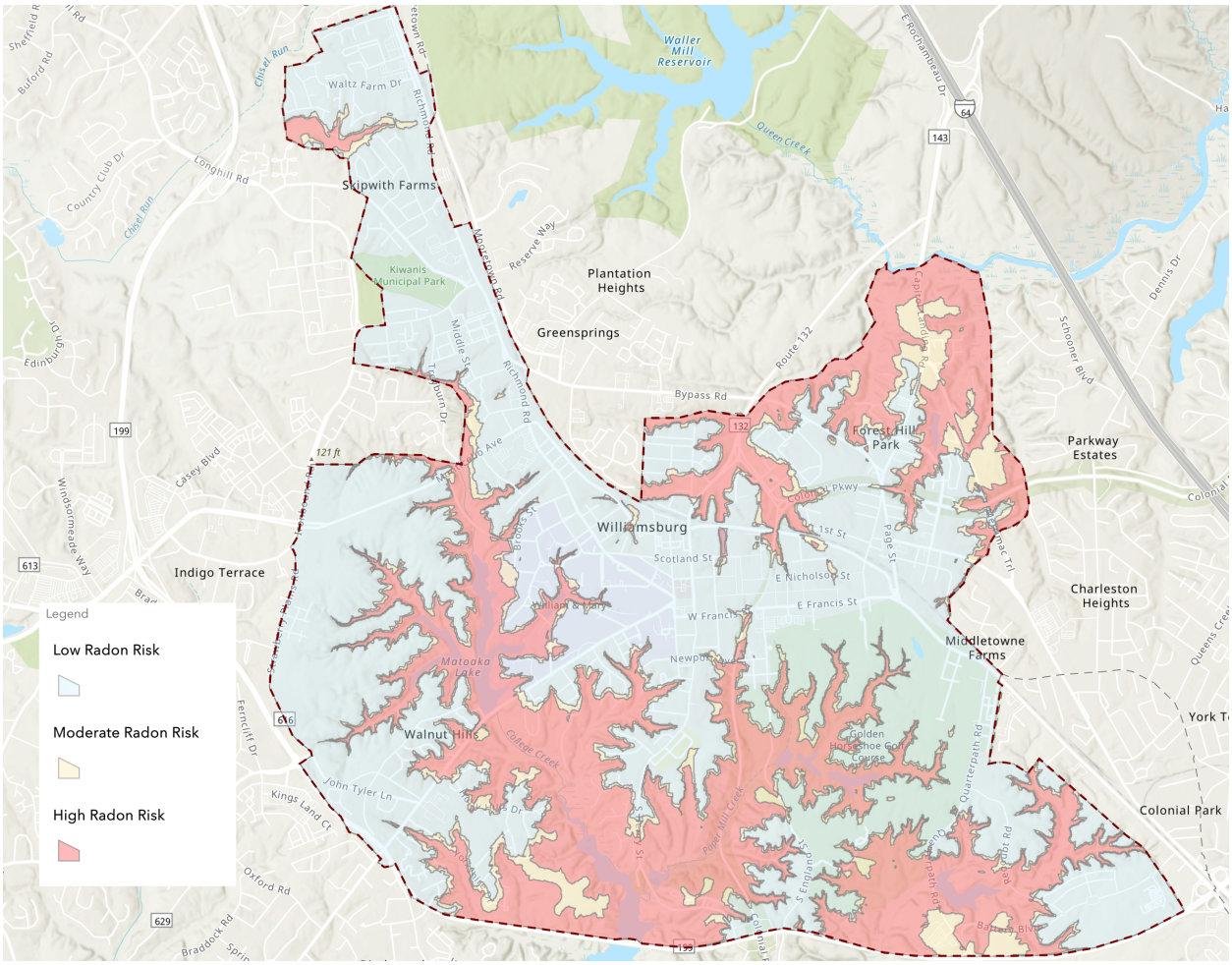

Figure 3: Radon risk assessment map of Williamsburg (Miller et al., 2020)

Materials and Methods

This video will be produced in three major stages. The first will be a literature review investigating what makes videos for science communication effective, and how to make them as accessible as possible using captions and colors friendly to the color blind. I will also continue to read about and communicate with the people who have conducted research on radon in this area.

The second stage of this project will be script development. I will write a script based on the research goals described above and the guidelines established in my literature review. This stage will include meetings with stakeholders including W&M faculty and students, and community members who have previously volunteered to participate in radon-related research. These meetings will help me hone the accuracy of the message and power of the story that I will communicate.

The third stage of this project will be the development of the video. This will include filming any interviews or other footage that I might need, and editing them together to realize the script. I will review the video with the same stakeholders before finalizing it. This will help ensure it represents their work as well as possible, communicates the topic in a way they find effective, and gives them an opportunity to review footage of themselves before the video is released.

References

Cooper, J., 1989, A Study of the Relationships Between Radon Gas and the Geology of the Coastal Plain of Virginia: William & Mary unpublished Research Experience for Undergraduates Project Report, Department of Geology.

Finkler, W., and Leon, B., 2019, The power of storytelling and video: a visual rhetoric for science communication: Journal of Science Communication, v. 18, p. A02, doi:10.22323/2.18050202.

Indoor Radon Program – Radiological Health Virginia Department of Health, https://www.vdh.virginia.gov/radiological-health/indoor-radon-program/ (accessed May 2021).

Joubert, M., Davis, L., and Metcalfe, J., 2019, Storytelling: the soul of science communication: Journal of Science Communication, v. 18, p. E, doi:10.22323/2.18050501.

Khandelwal, G.S., and Singh, J.J., 1978, Radioactivity of whale vertebra fossils in the Chesapeake Bay area: Health Physics, v. 35, p. 411–413.

Miller, D., 2021, MAKING A DERIVATIVE RADON-RISK MAP OF WILLIAMSBURG, VIRGINIA, *in*

GSA, https://gsa.confex.com/gsa/2021SE/webprogram/Paper362191.html (accessed May 2021).

Miller, D., Berquist, R., and Kaste, J., 2020, Radon in Williamsburg Area Homes (DRAFT): https://storymaps.arcgis.com/stories/10f6d3d7c0014a1087fe3ef14f306520 (accessed April 2021).

Mondshine, Z., 2021, VALIDATION OF THE DERIVATIVE RADON-RISK MAP OF WILLIAMSBURG, VIRGINIA, *in* GSA, https://gsa.confex.com/gsa/2021SE/webprogram/Paper361957.html (accessed May 2021).

National Research Council (US) Committee on the Biological Effects of Ionizing Radiations, 1988, Health Risks of Radon and Other Internally Deposited Alpha-Emitters: Beir IV: Washington (DC), National Academies Press (US), http://www.ncbi.nlm.nih.gov/books/NBK218125/ (accessed May 2021).

US EPA, O., 2014, EPA Assessment of Risks from Radon in Homes: Reports and Assessments, 88 p., https://www.epa.gov/radon/epa-assessment-risks-radon-homes (accessed May 2021).

User:Tosaka, 2014, Uranium-238 decay chain diagram: https://commons.wikimedia.org/wiki/File:Decay_chain(4n%2B2,_Uranium_series).svg (accessed May 2021).

Virginia - Radon Zones Environmental Protection Agency, https://www.epa.gov/sites/production/files/2015-02/documents/r3-va-riskmap-largefont.pdf.

Vogeltanz-Holm, N., and Schwartz, G.G., 2018, Radon and lung cancer: What does the public really know? Journal of Environmental Radioactivity, v. 192, p. 26–31, doi:10.1016/j.jenvrad.2018.05.017.

Weigel, F., 1978, Radon: Chem. Ztg, v. 102, p. 287–299, http://inis.iaea.org/Search/search.aspx?orig_q=RN:10454521 (accessed May 2021).

Whitesell, T.E., 1990, The Correlation Between Geologic Formations and Radon Emission in Surry and Williamsburg, Virginia [Senior Thesis, Department of Geology]: William & Mary, 63 p.

Budget

I do not anticipate any costs for this project. If I do need to meet with anyone outside of Williamsburg, it would probably be more appropriate to do so virtually anyways because of the ongoing COVID-19 pandemic.

Timeline

Summer 2021

By the start of the 2021-2022 school year, I will have completed the literature review, drafted the script for the video, and reviewed the script with various stakeholders for their feedback. These three elements will be broken into three month-long chunks, in that order, from June through August. Throughout this time I will be meeting with my advisors to review my progress and get feedback.

Fall 2021

By 2022, I will have filmed all interviews, produced a draft video, and reviewed it with various stakeholders. These interviews will be scheduled as the semester starts, and any other footage will be collected as needed according to the script.

Spring 2022

By the W&M Geology Department's Senior Research Saturday, I will have adjusted the video based on feedback I received in the fall, and added any remaining captions.