

Crystal Clear: An Interdisciplinary, Immersive-Learning Short Documentary about Water

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Link to Video

<https://www.youtube.com/watch?v=c9qmuTQfiY4&feature=youtu.be>

ABSTRACT

Arsenic is a known toxin—and it is in our water. But should it be a cause for concern? *Crystal Clear? Arsenic in Indiana's Drinking Water* explores this question, and the answer may be surprising. This short documentary explains the origins of arsenic in our drinking water supply and consults experts to identify its impact. Students enrolled in the class *Water Quality Indiana* at Ball State University began producing the documentary in January 2019. All the students involved had backgrounds in science, but none had prior media-production experience. Expert interviews included in the documentary included Mark Elliot, from the Hoosier Microbiological Lab; Jessi Haeft, Ph.D., an assistant professor at Ball State University's Department of Environment, Geology, and Natural Resources; and Bradley Hayes, M.D., a doctor affiliated with Indiana University Health's Ball Memorial Hospital. Key takeaways from the students' aggregate reflections include: (1) their general underestimation of the time and effort that goes into documentary production; (2) their acknowledgment of arsenic as a naturally occurring toxin, but one that is not currently of paramount concern in regards to Indiana's drinking water supply; and (3) the noticeable increase in their own media literacy as a result of this experience, which may have longer-term implications for these aspiring science professionals.

ARSENIC IN INDIANA'S DRINKING WATER

Arsenic naturally occurs throughout the United States, including Indiana, in its rocks, soil, plants, and water (IDEM, 2011). The mineral composition of geologic media is one control on the concentration of arsenic in water. The other important factor is the redox potential (Eh) and pH of the water (Huang, 2016). The presence of arsenic in potable water supplies is common (Welch, and others, 2005). Once dissolved in water, and even at high concentrations, arsenic has no color, smell, or taste (IDEM, 2011). The U.S. Environmental Protection Agency (EPA) sets the maximum level of arsenic permitted in our water supply, and, as of 2002, the maximum threshold is 10 parts per billion (ppb), which, according to the Indiana Department of Environmental Management (IDEM), equates to a few drops of ink in an Olympic-sized swimming pool (IDEM, 2011).

Exposure to high concentrations of arsenic has been linked to cancer, cardiovascular issues, and diabetes (Navas-Acien and others, 2008); however, consequences from lower levels of arsenic in drinking water are not as established (Ferdosi and others, 2016). Nevertheless, in terms of public perception, Indiana residents tend to express concern whenever contaminants such as arsenic are present in the water they drink (IndyStar, 2017).

Since 2013, IDEM has collected 1,162 water samples from unique sample sites within 20 hydrogeologic settings across Indiana, based on a stratified sampling procedure (Spindler and Denney, 2018). These samples were analyzed for 200 parameters, including arsenic concentration; from this aggregate population, IDEM detected dissolved arsenic in 44 percent of the samples, or about 512 samples (Spindler and Denney, 2018). Moreover, of this total number of samples, 11 percent exceeded the EPA maximum standard (10 ppb), which means that, while 127 water samples from across Indiana did exceed the limit, the remaining 1,035 samples did not (Spindler and Denney 2018). Researchers determined that 119 of those 127 samples having arsenic concentrations more than 10 ppb were from Indiana's glaciated area north of the Wisconsin Glacial Boundary (Spindler and Denney, 2018). According to the data, hydrogeologic settings rich in glacial till contained higher levels of arsenic concentration (Spindler and Denney, 2018). Therefore, the presence of arsenic in drinking water may not necessarily result from negligence or malicious intent. However, current instances of negligence exist, such as those by the former USS Lead facility, which resulted in toxins being released to the air and in the water supply (Lyons, 2017).

The Office of Water Quality at IDEM regulates public water supplies to ensure they meet EPA compliance standards. Private wells, such as those in more rural areas, are not regulated by IDEM; in these instances, the onus is on the individual homeowner to ensure their water supply remains safe and potable (IDEM, 2011). Homeowners with private wells should have them tested every 5 years to monitor arsenic concentration (IDEM, 2011).

Using the current research as a foundation, we produced a short documentary to communicate the importance of this issue. However, this paper does not highlight the particular science involved in the research; rather, we attempted to contextualize the production of the video through the perspectives of the students and to generally assess their thoughts on the value of this particular immersive learning experience.

IMMERSIVE LEARNING AT BALL STATE

Immersive learning, typically drawing upon tenets of project-based learning, experiential learning, service learning, and community-engaged scholarship, is a pedagogical practice unique to Ball State University, located in Muncie, Indiana. Immersive learning “brings together interdisciplinary, student-driven teams guided by faculty mentors to create high-impact learning experiences, [where] students earn credit for working collaboratively with businesses, nonprofits, and government agencies to address community challenges” (BSU, 2017). Immersive learning does count toward a faculty member's promotion and tenure at Ball State, and in its recently unveiled Strategic Plan (BSU, 2019), the university identified the importance and value of this pedagogical practice, identifying an immersive-learning project as a high-impact practice alongside undergraduate research and study abroad (BSU, 2019).

WATER QUALITY INDIANA—NEXUS OF SCIENCE AND JOURNALISM

Water Quality Indiana (and Costa Rica)—the course that led to this short documentary—was an interdisciplinary opportunity to explore local and global concerns in relation to water, specifically in Indiana (with assistance from the Indiana Geological and Water Survey) and in Costa Rica (with assistance from Liga Comunal del Agua, an area nonprofit that “offers technical, legal, administrative, and financial assistance for building and maintaining potable water systems in rural areas”) (ASADAS, 2019). This Honors College course includes an overview of history, demonstrating the earliest known relationships between water and

ancient civilizations. It rapidly progressed in terms of chronology, noting technological advances such as the development of sewage treatment systems and the reverse osmosis process, and the majority of the semester was spent examining current issues that affect our drinking water. In the end, students chose to focus on arsenic in drinking water as the topic of the documentary.

The students studied and analyzed storytelling techniques used in documentaries, which were new concepts to them. They also learned about their respective production roles, and from real-time problems and challenges that occurred during the process, had to exercise judgment and critical thinking to make informed decisions about the final deliverable. In sum, they researched past studies and available data about arsenic in Indiana's drinking water supply, identified key personnel and conducted pre-interviews with them to learn more, developed a story angle suitable for the documentary's duration and target audience, gained familiarity and confidence with media-production equipment necessary to record interviews and related visual sequences, coordinated schedules and kept communication lines open for consultation, edited all content into a cohesive, engaging narrative, and sought diverse tactics for the documentary's distribution, including this paper.

In a continuation of the class in Summer 2019, most of the same students explored current water challenges that face communities in and around Hojancha, Guanacaste Province, Costa Rica. This international experience served as an optional extension of what was accomplished on a local scale via the short documentary about Indiana's drinking water. While on the ground in this developing nation, they identified potential causes of water-related problems, how these challenges affect local water, and what the community partner—Liga Comunal del Agua—does to address the issues and effect change. Emphasis was placed on the people affected by these water issues. In the end, this immersive-learning experience provided students the opportunity to deepen their understanding of water in relation to people—locally and globally.

This concept stems from the original Water Quality Indiana program (Water Quality Indiana, 2019). Conceived in 2011 and implemented in 2013, this program has brought together science and journalism undergraduates to explore local and regional water-quality issues with mentorship from area nonprofit organizations (Water Quality Indiana, 2019). Since Fall 2013, this program has enrolled 44 students through four iterations, primarily undergraduates but also a few graduate students, who represent eight departments in

four university colleges. My co-director and I acquired just under \$110,000 in internal and external grants to sustain curricular initiatives, including allowing 16 of those 44 students to present scientific and multimedia deliverables at 12 conferences across the country (Borgmann and others, 2014; Sprague and others, 2014; Purtha and others, 2015; and Sroufe and others, 2015). Those curricular initiatives have led to five publications, two of which are peer-reviewed or juried (Kuban and others, 2015); this has also resulted in a Ball State University Immersive-Learning Award and a Green Initiative Award from the Council on the Environment. Most recently and before the Spring 2019 class, a different team of students produced an award-winning 25-minute documentary: "Downstream: Connecting Indiana to the Gulf of Mexico" (Downstream, 2016).

CLASS/PRODUCTION SETTING AND SYNTHESIS

In the university course that led to the featured short documentary (Honors 390: Water Quality Indiana and Costa Rica), students read *Water 4.0: The Past, Present, and Future of the World's Most Vital Resource* (Sedlak, 2015). The intended course outcomes were to:

1. Identify key terms, vocabulary, and concepts associated with water resources;
2. Critically analyze (drinking) water challenges from the past—causes, consequences, solutions—and in the present, likely causes, possible consequences, and potential solutions;
3. Synthesize information from multiple sources, including scholarly texts, documentaries, and online resources;
4. Articulate thoughts both through individual assignments and the collaborative documentary project; and
5. Connect the subject matter with their own choices and behaviors.

The students involved in the production of the short documentary provided structured reflections below. This is their first immersion in the world of media creation for these four students, and they've independently composed replies to a set of questions, articulating what they've learned and why that is important as they continue their programs of study.

After reviewing the students' individual reflections, we can proffer some key takeaways, resulting from a basic textual analysis. The students:

- Underestimated the amount of time and effort that typically goes into documentary production. This provides anecdotal support of the

Dunning-Kruger Effect, which is a type of cognitive bias where people are overconfident in what they know about a topic in spite of their lack of experience with it (Cherry, 2019).

- Acknowledged arsenic as a naturally occurring toxin in Indiana's drinking water supply, although it is not of paramount concern to the public.
- Noted a general trajectory where their better understanding of media practice leads to better communication of their own scientific findings, sometimes resulting in increased knowledge among the general public. This anecdotally supports the need for interdisciplinary classroom settings and projects.
- Stated a noticeable increase in their own media literacy, making them more knowledgeable and discerning in their media-consumption habits.

STUDENT REFLECTIONS

Role: Producer

What did this role contribute to the overall documentary production?

As producer, I was in charge of finding people and places to be involved in our documentary throughout the community and verifying their participation. I was also responsible for keeping the team on track in order to get necessary tasks done in a timely manner.

What was particularly challenging about this role?

I found the lack of professional connections the most challenging part of this role. As a student with little to no media background, it was tough for me to find credible people willing to participate in the documentary and help with the distribution of it.

What did you learn from your contribution to the documentary?

I have a newfound appreciation for people in the media industry. I have learned through this experience that their work is more challenging than society typically thinks it is. After doing this documentary, which is far out of my comfort zone, I have learned that media differs from science in that networking and connections can be much more important in media than what you know.

What did you learn regarding Earth science?

I have learned throughout this documentary process that arsenic is present in Indiana's water, but, overall, it is not considered an issue unless the "professionals"

state that it is an issue. It is very rare to find toxic amounts of arsenic in drinking water in Indiana, and when it is present, it is typically taken care of very quickly and successfully.

Why is it important, in general, for aspiring science professionals to better comprehend media-production processes?

In science, it is very easy for us to think that we can rely solely on facts. However, where we get those facts and how they are presented to us are just as important. By understanding the media-production process, we can better understand the source of the information and subsequently the credibility of it. Most science professionals are so caught up in their own field of work that they do not think about what it takes to be successful in other areas, including media production. Additionally, most people are in science to help people directly or indirectly. By better understanding other professions, we can also better understand the people who are affected by our work.

How will this documentary production experience impact you occupationally but also as a typical media-literate consumer?

I plan to become a medical doctor, and this process has helped me to better understand people in general. I now understand the work that some people do in a way that I would have never been able to without this experience. The biggest part of being a good doctor is understanding your patient and their body—not necessarily understanding the human body. I believe that this documentary-production experience has given me skills that will ultimately make me a better doctor. Additionally, I now feel that I can decide for myself what media-produced information I can trust.

Natalie Sipes is a junior at Ball State University studying pre-med biology through the Honors College with plans of becoming an obstetrician/gynecologist.

Role: Director

What did this role contribute to the overall documentary production?

As director, my main role was to be the central figure throughout the creation of the documentary. This included working simultaneously with the producer, cinematographer, and editor to make sure everyone understood the direction of the documentary, including the overarching story arc. I also contacted and hired outside sources that could improve our documentary such as an animator for our graphics.

What was particularly challenging about this role?

The main challenge with this role was timing. Being a college student and attending other classes as well as participating in clubs around campus, I couldn't devote all of my attention to the documentary. Usually directors only have the project they are working on their plate in order to produce a great product, but with my schedule, I had to work around being director as well as being a full-time college student.

What did you learn from your contribution to the documentary?

Over the course of the semester, I learned more than I anticipated in terms of the creation of a documentary. I knew that these types of video productions can often take longer to produce than a traditional movie that is shown in theaters, but just the amount of careful planning and research surprised me. Stepping into the role as director, I learned there are more elements than just being "the person in the chair." You must make sure everything runs smoothly, everyone is doing their job correctly, and that the documentary itself is efficiently moving toward completion.

What did you learn regarding Earth science?

Before making this documentary, I had no idea that arsenic was contaminating Indiana's water supply and how dangerous a toxin it could be. I knew that the state had water-quality issues through a water-resource class I was taking at the same time of filming, but I never knew it could be a problem.

Why is it important, in general, for aspiring science professionals to better comprehend media-production processes?

Many aspiring science professionals are told they must write professional research papers in order to report their findings. While that might benefit the scientific community, everyday citizens don't sit down and read research papers about problems that could affect their everyday lives, especially when it comes to water quality. Having a background in media-production provides those scientists who want to make their findings accessible to all an easier way to present their findings and can provide an easier way to digest the information presented through a short video or documentary.

How will this documentary production experience impact you occupationally but also as a typical media-literate consumer?

As a political science major, I found many parallels while participating in the documentary-production

experience. Many assignments and class experiences rely on group projects and discussions, which play a huge role in creating a documentary. I was able to translate these skills to my role as director, as political science also touches on the basis of leadership since many of us aspire to represent our peers through governmental means. Being someone who also likes watching documentaries in my spare time, this production experience has opened my eyes to just how much time and effort goes into making one. The process has helped me appreciate documentaries even more and better understand just how many people pour their hearts and souls into creating the perfect piece of visual art that can be consumed by the masses.

Halley Kissel is a sophomore at Ball State University, studying political science and natural resources and environmental management through the Honors College.

Role: Cinematographer*What did this role contribute to the overall documentary production?*

As a cinematographer, I contributed by filming the documentary. To that end, I was constantly checking the lighting and the sound to ensure that there were no distracting shadows or sounds.

What was particularly challenging about this role?

This role was extremely challenging for me because I'm a microbiology major, and I had no prior knowledge of cameras beyond the rudimentary basics. Over the semester, I have learned about camera angles and different types of camera shots as well as how to use equipment that I'd never been exposed to before. Remembering all of the processes and lingo associated with camera use was difficult at first, but it really broadened my education outside of the world of microbes.

What did you learn from your contribution to the documentary?

Throughout the process of creating this short documentary, I learned the importance of conveying scientific knowledge into terms that the public will understand and be receptive to. I also discovered how to translate scientific terminology into lay terms so it's better understood by all.

What did you learn regarding Earth science?

From the Earth science perspective, I learned that arsenic can be a serious problem in Indiana's water supply, but I also learned that it isn't as scary as many make it out to be. I learned that arsenic is naturally

found in some water supplies (especially in Indiana) and that there are precautionary and treatment options that concerned individuals can make. Reverse osmosis systems and getting your water checked can be easy solutions to the scary possibility of arsenic poisoning through drinking water.

Why is it important, in general, for aspiring science professionals to better comprehend media-production processes?

As a scientist, I can say that this class was extremely beneficial and that science professionals should take the time to become familiar with media processes. As a community, we need to find ways to communicate with one another in order to improve health and safety standards and to ensure public health safety. Film is an extremely popular means of communication that can reach to people of all ages and backgrounds. Therefore, familiarity with media processes is essential for the scientific community so that we can learn to communicate and inform the public about safety concerns and education.

How will this documentary production experience impact you occupationally but also as a typical media-literate consumer?

This experience has broadened my education, because now I am more familiar with new communication and teaching methods that I had previously never been exposed to. This platform of communication is effective and fast. As a consumer, I have started viewing films and commercials from the viewpoint of a cinematographer and am easily able to distinguish different media methods and strategies. Overall, I have taken a lot from this experience, and I think it will set me apart from other candidates in my future career field. Overall, I believe that this experience will give me a unique advantage in the field of science.

Sam Apsley is a senior at Ball State University, studying microbiology through the Honors College and will pursue a Master's of Public Health degree in epidemiology at the University of Michigan.

Role: Editor

What did this role contribute to the overall documentary production?

The editor's primary function in documentary production is to compile the captured footage along with supplemental graphics and editor-generated graphics and synthesize these components into a coherent product that manages to deliver the intended information. This process naturally occurs later in the

post-production process; however, it is critical for the editor to be active in the earlier pre-production and production processes. In these earlier processes, the editor must create a mental image of how the documentary will play out visually in coordination with the director's anticipated story angle, and communicate recording, interview, and creative strategies to achieve this image.

What was particularly challenging about this role?

This role demands that the editor is flexible to challenges such as missing supplemental content, correcting interviewee mistakes, and other general content issues, and they must find solutions to satisfy the visual and informational needs of the final product on a tight time allowance. These issues are usually faced within the post-production stage. At the beginning of the production process, the biggest challenge is deciding what the direction should be visually, whether or not to try to go for a specific "look," and how to approach and pin down the look based on how other documentaries succeed in presenting their content.

What did you learn from your contribution to the documentary?

I learned that the process of documentary storytelling is incredibly involved and requires strong communication skills within the production team as well as communication to the audience from the editor's side, as in how to deliver a proper synthesis of information that is easily digestible.

What did you learn regarding Earth science?

Through the research, pre-interview, and recorded interview process, I learned much about the natural flow of arsenic through ecological processes. Arsenic is sourced from both naturally occurring and anthropogenic sources, the naturally occurring being glacial sediments and minerals such as arsenopyrite, and anthropogenic sources including wood-treatment materials and poultry antibiotics. Because of the chemistry of arsenic, the arsenic ions within these arsenic-containing compounds can leach into groundwater, and contamination levels can reach upwards to 300+ ppb, whereas the EPA limit for drinking water is 10 ppb.

Why is it important, in general, for aspiring science professionals to better comprehend media-production processes?

Science professionals must understand that the general public generally does not have the knowledge, willingness, or the ability to synthesize research articles about pertinent issues that are studied that may affect

their daily lives. To fill this information gap, science professionals must understand how to communicate this information to the public effectively through digital media formats. In producing digestible digital content, science professionals should be proficient in media-production principles such as storytelling, defining target audiences, and condensing information.

How will this documentary production experience impact you occupationally but also as a typical media-literate consumer?

This experience has provided me with a good understanding of how to simplify information to communicate better and synthesize information while weeding out extraneous details that may not contribute to a better synthesis. As a consumer, this experience has helped me recognize content that is well-articulated and that has a good understanding of its goal in order to recommend or promote those strong media deliverables.

Ignacio Rodriguez is a freshman at Ball State University, studying environmental issues through the Honors College as they pertain to public safety and human health.

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