

Short-Form Videos as an Emerging Social Media Tool for STEM Edutainment

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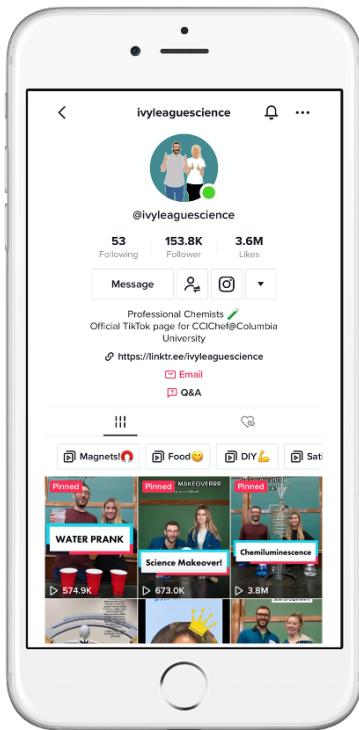
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Abstract:

As social media platforms continue to grow in popularity, there is an increasing need for science outreach teams to bring STEM content to the virtual landscape. Here, we highlight the use of short-form videos on our TikTok channel – @IvyLeagueScience – as a new way to approach science outreach. Through a combination of content production and data analytics, we were able to build an online platform with > 150k followers, 3.6 million likes, and 18 million views. By bringing science to social media, we engage with students across the world, allowing them to experience science-based content. In this case study, we hope to encourage other scientific outreach teams to employ social media as a means of increasing visibility of scientists and STEM careers on social media.



Introduction:

Public outreach plays a vital role in improving societal confidence in science, in communicating the importance of science/technology, and in increasing public interest in scientific careers.¹⁻³ Traditionally, most scientific outreach is conducted through in-person events such as classroom visits, symposia, or community programs. However, due to the COVID-19 pandemic, many of these in-person programs became difficult or impossible to continue, thereby prompting us and many others to explore alternative ways to engage the public. As a result, remote learning became popularized in educational settings.^{4,5} Many virtual platforms and applications, including Zoom, Google (Teams, Classroom), Slack, Blackboard, Canvas, and Kahoot, have aided STEM educators in reaching students and the general public. By using these different remote modes of learnings, educators have been able to engage students in ways that were not previously possible. For example, while classrooms and auditoriums have intrinsic size and geographic constraints,

virtual learning spaces can accommodate larger student bodies and make educational content accessible at home. Additionally, previous studies have suggested that virtual platforms can engage more neurodiverse populations by increasing learner agency.⁶ By enabling students to define their own participation in learning, they can utilize the learning style that is most amenable to them which increases student involvement. These advantages suggest that virtual outreach spaces hold great promise for improving the way students engage with science.

Despite all of the established and potential advantages of virtual teaching and outreach platforms, there remains one significant drawback—student engagement.⁷⁻¹² A recent article suggests that video conferencing applications, which are commonly used in classrooms, such as *Zoom*, can cause increased fatigue, cognitive load, and difficulty paying attention.¹³ While these remote tools hold great promise in the realm of virtual learning, rising frustrations among both educators and students alike highlighted a growing need for a new remote method for engaging students in science education and outreach.

One proposed solution to the growing problem of virtual engagement is the use of social media. The use of social media has grown astronomically across all demographics, especially younger populations (**Figure 1**).¹⁴ In particular, TikTok has emerged as an extremely popular platform in recent years.¹⁵ On TikTok, users create videos between 15 seconds to 3 minutes long, often to popular music or trending audio sounds. While these videos were originally centered around popular dance trends and entertainment, they have increasingly been used as a source of news and educational content (for example, NPR’s “Planet Money”). With the rise of TikTok and its potential to promote viral videos, our outreach team decided to explore whether TikTok could be used as a new platform to engage students through a social media outreach campaign.

In this article, we demonstrate how we have successfully implemented our TikTok channel, @IvyLeagueScience, as a virtual outreach platform to engage students in science. We discuss the design of our channel, our successes and failures, and the challenges we met in our initial attempts to develop entertaining science content. We further assess the success of our channel through data metrics provided by TikTok analytics, and demonstrate how these tools provide a feedback loop for content development. The success of our channel, as we will demonstrate, is not just limited to TikTok but can be applied to any other video-based social media platform. By presenting our channel as a test case, we aim to inspire other outreach teams to explore the social media landscape and promote scientific content online.

Combining Education and Entertainment: Edutainment

While most social media platforms are dominated by content targeted purely at the viewers' entertainment, both viewers and platform developers are fueling a growing demand for content with educational value.¹⁶ This content – edutainment – is a form of entertainment intended to educate, amuse, instruct and/or socialize an audience by embedding lessons in media such as television programs, computer/video games, films, music, websites, or multimedia software.^{17,18} Previous studies have shown that edutainment can increase confidence, engagement, and critical thinking, and growth mindsets.^{19,20} Edutainment has long permeated television and online games (e.g., “Sesame Street” and “Leapfrog”), but recently edutainment has begun to infiltrate social media. Given that children and adolescents spend innumerable hours consuming digital entertainment,²¹ social media offers exciting new opportunities for incorporating educational value through edutainment. According to the search statistics provided by the TikTok app, currently trending hashtags such as *#football* (at 921.7 billion uses), *#GRWM* (an acronym standing for “Get

Ready with Me” and covering daily fashion, at 105.7 billion uses), and *#celebrity* (at 45.4 billion uses) are similar in popularity to edutainment hashtags such as *#learnontiktok* (at 592.6 billion uses), *#science* (at 66.6 billion uses) and *#STEM* (at 8.0 billion uses) (see **Figure 1**). Furthermore, TikTok recently launched a new feature called the “STEM feed,” where viewers can be part of a dedicated space to explore STEM content (which has accumulated over ~100 billion views to date).²² As science edutainment continues to rise in popularity on social media, short-form video platforms have become an exciting new medium through which science communicators can engage with the public. While discussions of social media edutainment have begun to appear in the literature,^{15, 16, 23} our goal is to provide some fundamental guidelines for building social media science outreach channels through short-form video platforms.

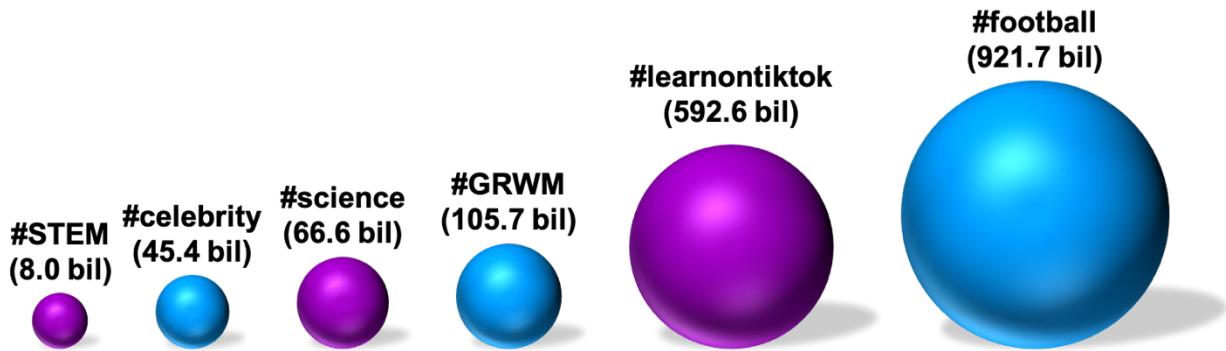


Figure 1. Comparison of trending TikTok hashtags related popular culture (blue) and edutainment (pink). Edutainment hashtags have similar usage compared to popular culture hashtags, highlighting the growing interest in edutainment on the social media platform.

Our Inspiration: Science Edutainment Creators

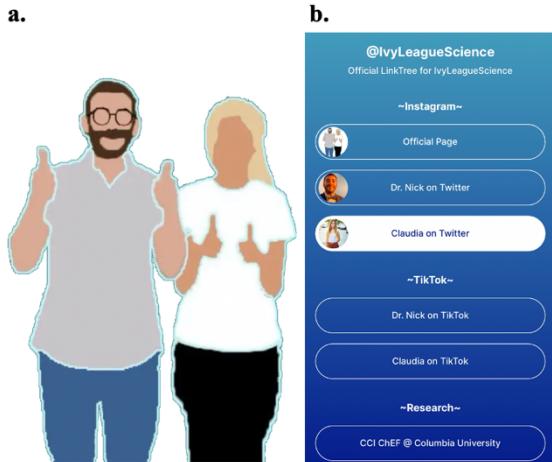


Figure 2. a) Logo and profile picture for @IvyLeagueScience on TikTok. b) Linktree for @IvyLeagueScience. This includes links to the affiliated Instagram account, Twitter accounts, TikTok accounts, as well as research website. Each of these includes videos, posts, or further information about the scientific content posted on the @IvyLeagueScience TikTok account.

It is important to acknowledge that we are not the first, nor the only, science edutainment outreach creators on TikTok. Other creators include former or current STEM students (such as @spadaniel44, @labshenanigans, @coolchemistryguy, and @science.bae), educators and professors (such as @chemteacherphil, @chemicalkim, and @drdre4000) and media personalities (@bill nye, and @impossible science). While these are a few examples of edutainment creators on TikTok, there are many other that continue to make profound impacts on students through their channels. These creators have helped science merge with popular culture on social media, and are what ultimately inspired us to create content. We hope that these channels inspire others to bring their science outreach campaigns to the virtual sphere.

TikTok for Beginners: Launching a Channel

For those with no prior social media experience, we can offer some key steps for creating and designing an educational outreach channel on TikTok. This process begins simply by downloading the social media platform of your choice (in our case, TikTok) and setting up an

account. In the case of TikTok, an email address specific to the channel is required (for us, this was ivyleaguescience@gmail.com) which we generated to provide a dedicated inbox for viewers and potential collaborators. After signing up with an email address, strive to create a TikTok username that will attract the intended audience for your channel. For example, our username—@IvyLeagueScience—was intended to (1) target audiences with interests in science and higher education, (2) be recognizable and unique, and (3) avoid infringing on any particular institution or group. Finally, features such as profile pictures (**Figure 2a**) and Linktrees (**Figure 2b**) can help visualize the account, as well as link the channel to other personal pages and websites that provide additional educational content and resources.²⁴

Once these basics are established, the account can also be registered as a business account (a free service) through TikTok to access data analytics. TikTok business accounts offer many advantages over personal accounts, including use of the Business Suite. The Business Suite features a Business Creative Hub which highlights trending accounts, hashtags, and music, enabling creators to take advantage of current trends to maximize engagement with online audiences. There is also a Creator Portal which offers tips on content strategy and video production, as well as best practices for posting (including things like the best times to post a video and how to moderate content). Most importantly, switching to a business account allows the user to view TikTok’s analytic tools, offering information regarding engagement (video and profile views, likes, comments and shares), follower demographics (age, gender, location), and top trending videos posted by the creator. All of these analytics are collected over time and can be displayed with reference to different specified time periods. By monitoring these analytics, an outreach team can track the success of their channel over time and modify their content strategy accordingly.

The strategy that we deployed was as follows: script and film an experiment, post a video, then monitor the number of likes/follows/comments on that post through app analytics. By doing this several times, we could develop a sense of which themes, stylistic choices, and video production techniques resulted in “popular” posts (high volume of likes/follows/comments), then apply those qualities to design and script future videos for better engagement. Through this feedback loop, which we will share below, we establish a method of monitoring and evaluating the performance and success of our channel’s videos (see **Figure 3**).

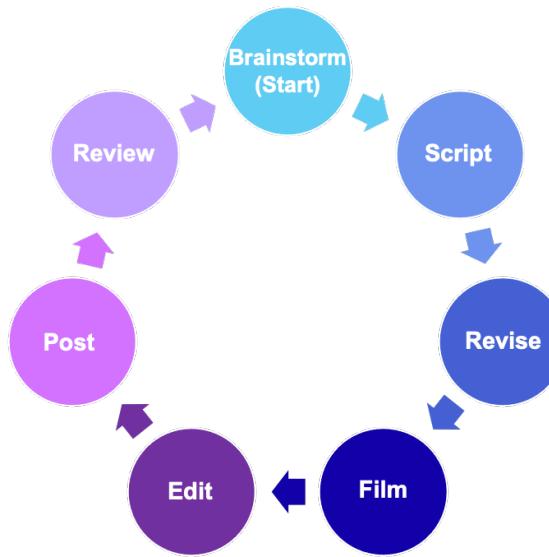


Figure 3. Feedback loop demonstrating the various stages of creating TikTok videos. Notably, evaluation of video performance through TikTok’s analytics help to inform future design.

The loop begins with a brainstorming session. It’s important to keep this session open to creative ideas, but our team typically focuses first on a scientific concept we’d like to explore or a demonstration we’d like to film. After building a clear tie between a scientific concept and an exciting demonstration, the key to a successful post is to discuss recent trends on social media and package that concept/demonstration within that context. With a concept in mind, a script can then be drafted which should go through some rounds of editing with your team. The filming session typically takes under two hours, and there is an economy of scale of filming several demonstrations

at once. It generally requires some preparation time prior to filming to both practice the demonstration and to prepare a few trials of each demonstration to save time during filming. We encourage filming each demonstration multiple times to have some options during editing, and we often make modifications to the script and add new jokes as we go about filming. Once satisfied with the clips, these need to be edited together and layered with audio and text. We use Adobe Premier Pro (though free tools also exist for this purpose) to edit our clips together into a single coherent video, and layer over any audio or music we want to include (these audios needed to be provided by TikTok's library in order to avoid copyright infringement). At this point, it is also critical to generate closed captioning to increase accessibility of our content. Closed captioning can also be added through the TikTok app during the uploading process, though we prefer to incorporate this in advance so that the captions are included in the video file if we choose to post to other social media platforms (Instagram or Twitter, for example). Once satisfied with the final cut, your team can check online for optimal times to post on TikTok (based on usage metrics) and release your video out into the virtual world. From there, begin to monitor the success of your content through views, shares, and likes. We've also found it particularly important to spend some time immediately after a post is uploaded to reply to comments from our viewers and generate discussion in the comments section. Views and shares will typically continue to increase rapidly for a few days, before slowing down as newer content is posted on the app. After a few days, your team have a good sense of the reach that a particular video has and can assess whether you felt a post was successful. With these analytics, you can return to brainstorming with a better sense of what your viewers were looking for and begin the cycle anew.

Case Study: From Failures to Eventual Success

During the launch of our TikTok channel, our initial strategy was to perform science demonstrations that could not be replicated at home. We wanted to take advantage of the online nature of TikTok by conducting science experiments in a laboratory setting and making them available to viewers at home. In doing so, we would no longer be limited by tedious equipment transport or safety protocols that are typically enforced in classrooms or other public settings. Additionally, by circumventing safety concerns, we could perform experiments that could really impress and excite audiences. We could use more dangerous (i.e., exciting) chemicals and equipment, set off explosions, and start fires all without the fear of endangering our audience. With these considerations, we decided that our first TikTok video would be the hydrogen balloon experiment. This experiment involves adding different inorganic salts to balloons, filling these balloons with hydrogen, then igniting the balloons to produce loud and colorful explosions.^{25, 26} We purchased professional film equipment—a boom microphone, lighting equipment, and Go-Pro cameras—to help capture and showcase this shocking and dazzling experiment. After filming three different explosions with three different inorganic salts, we set the videos to trending music provided by the TikTok app (see **Figure 4a**) and sent our first post out into the virtual world. However, after monitoring the analytics for this post, we noticed that the video wasn't gaining much traction online. It only received a handful of likes and views, and didn't cultivate much of a following for our channel. With this in mind, we decided to revise our strategy and try again.

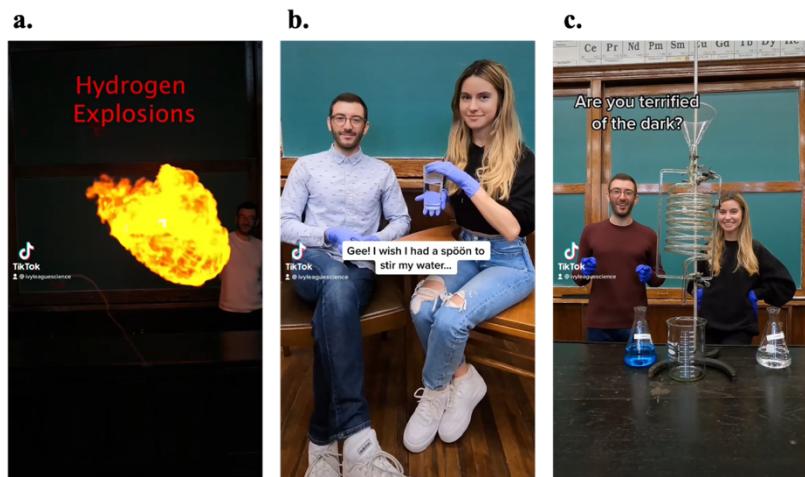


Figure 4. TikTok video demonstrations of a) hydrogen balloons containing different inorganic salts exploding to produce different colored flames, b) the gallium spoon experiment, where the spoon is submerged into hot water and melts upon stirring, and c) chemiluminescence, in which a solution of luminol (5-amino-2,3-dihydro-1,4-phthalazinedione) is oxidized by hydrogen peroxide (H_2O_2), causing it to glow.

The next experiment that we chose to perform and film was the Gallium Spoon experiment. (see **Figure 4b**). This experiment involves molding gallium metal into a spoon and stirring it in a hot liquid, causing the spoon to melt. This produces the illusion that the spoon is disappearing while stirring it, making this a type of scientific parlor trick.²⁷ However, unlike the last video, we decided to incorporate dialogue into the experiment. One of us would be the “trickster” and the other would be the “tricked.” We decided to assume two different characters with two different goofy personalities, and we filmed and posted the video. To our surprise, the views, likes, and comments began to amass and the video accrued hundreds of thousands of views and tens of thousands of likes. People were commenting because of the jokes and dialogue incorporated into the video. By engaging with our video and tagging their friends in the comments, more and more people were being funneled to our page. This, we realized, was the key to our success—sprinkling our humor and personalities into our content. We then decided to revisit the hydrogen balloon experiment, this time curating a funny dialogue (“making humidity” with hydrogen and oxygen)

with a silly dance (performing an Irish jig at the end of the experiment). By implementing our new strategy with a previously unsuccessful video, we were able to produce another viral video with thousands of views and likes.

Successful Science TikToks: Science with Humor

For the next several videos that we posted, we adopted the same video model: perform an experiment, have the scientists assume different comedic roles, and incorporate humor. In general, this strategy was relatively successful. Many of the videos posted after the Gallium Spoon experiment accrued thousands of views and likes, which is overwhelmingly more than our first attempt. However, over time we noticed that our video views and likes were not increasing—generally around tens of thousands. While initially puzzled, the analytics TikTok provides showed us that viewers were swiping away from videos after the first couple of seconds. In response, we decided to slightly modify our approach. Our new plan was to add a “hook” intended to immediately captivate our audience within the first few seconds of the video. After the “hook,” we hoped our humorous science demonstration would continue to engage our viewers per usual. Additionally, we intended to incorporate viral trends and dances in a comedic way to capture the attention of our viewers. Our first attempt at using our “hook” strategy was in our TikTok video on chemiluminescence, in which we combined luminol with chemical oxidant hydrogen peroxide to produce a blue glowing solution (see **Figure 4c**).²⁸ In the introduction of the video, we asked our audience “Are you terrified of the dark?” By beginning our video with a question, we hoped our audience would be curious enough to continue watching to see the eventual answer and outcome. Additionally, at the end of the video, we performed the popular dance “nae nae” in an exaggerated and humorous way. As it turned out, this new strategy of “hook” *plus humor* was our most successful to date. Our video on chemiluminescence was viewed over 3.8 million times,

received almost 1 million likes, and thousands of comments. With continued implementation of this strategy, we were able to curate and produce videos with high levels of interaction and engagement.

Expanding to Live Content

In addition to standard TikTok posts, we also explored other variations of content. For example, we participated in public demonstrations where we travelled around our university campus and performed experiments for students in-person. In these experiments, we would set up a table with a demonstration, and students would be invited to come and participate in a scientific demonstration for a TikTok video. While students loved to engage in these demonstrations hands-on, these videos did not perform as well as our scripted content. Additionally, we also created and hosted TikTok Live events. This format allows creators to speak and engage with their viewers in real time, facilitating communication and engagement. In our TikTok Live videos, we performed science demonstrations and answered questions that viewers asked as they came up. This gave us the unique opportunity to engage directly with our viewers. Interestingly, viewers would not only ask questions regarding the demonstrations being performed, but they would also ask questions about scientific subjects and careers (e.g., What is grad school like? How do you apply?). As a result, the TikTok Live functionality allowed us to uniquely talk to large audiences in real time, explain scientific experiments and concepts, and present information regarding general scientific topics and careers in STEM.

Reaching Diverse Audiences Globally: A New Kind of Outreach

Overall, our channel @IvyLeagueScience on TikTok proved to be a successful avenue for virtual science outreach, as evidenced by the analytics collected through TikTok's business suite. Over the lifetime of our channel, we accrued a total of $> 153\text{k}$ followers, > 18 million views, 3.6 million likes, $\sim 51\text{k}$ comments, $\sim 39\text{k}$ video shares, and $\sim 121\text{k}$ video saves. While these numbers attest to the large audiences that we were able to engage in science education, we also were able to reach diverse audiences as well. As shown in **Figure 5a** and **b**, the majority of our viewers are female and between the ages of 18-24 years old. These analytics show that we were able to reach younger students – which are generally the target of in-person science outreach – as well as women, which are generally underrepresented in STEM. In addition to reaching large and diverse audiences, we were also able to reach audiences across the globe. Not only did we reach followers across the United States, but our videos were also popular in Philippines, the United Kingdom, Malaysia, and Canada (see **Figure 5c**). While in-person outreach is typically limited by audience size and demographic (i.e., within a single a classroom or auditorium), our channel was able to reach millions of people all over the world. Despite the difficulties and hurdles of continuing chemical education in post-COVID world, using short-form video platforms such as TikTok for outreach have proven to have important significant benefits, advantages, and outcomes.

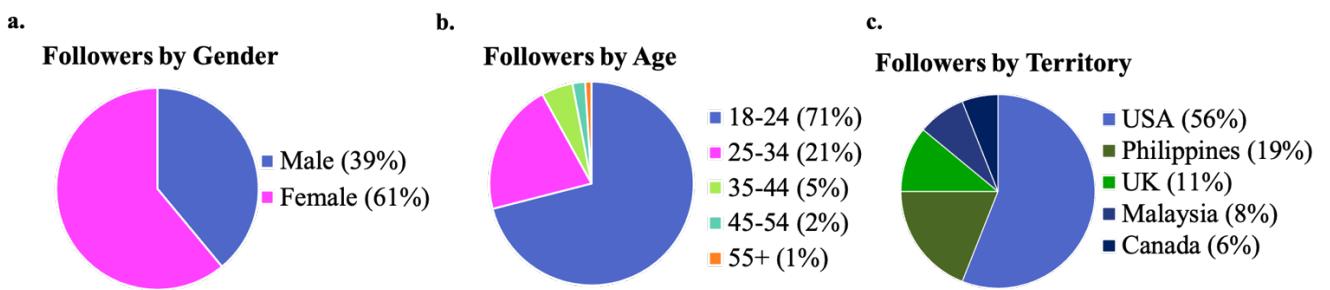


Figure 5. Followers of @IvyLeagueScience by a) gender and b) age and c) territory. The channel reaches audiences of diverse backgrounds and demographics.

Conclusions and Future Outlooks

Overall, based on our case study channel @IvyLeagueScience on TikTok, short-form video platforms have proven to be an effective and engaging means to perform science outreach, education, and communication. TikTok specifically provides creators with many tools, such as viewer demographics and engagement statistics. These features help creators produce videos that are most likely to reach their target audiences. Additionally, we developed a strategy and protocol for the success of our own content. We implemented a “*hook plus humor*” method – beginning the video with a captivating statement, then incorporating humor and popular trends throughout the rest of the video and demonstration. This method helped us accrue thousands of followers, and millions of views. We believe that our case study channel can serve as a helpful example for outreach teams not just on TikTok, but on other social media platforms in the future.

Data Availability

The data that support the findings of this study are available only on request from the corresponding authors.

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Notes

There are no conflicts of interest to declare.

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