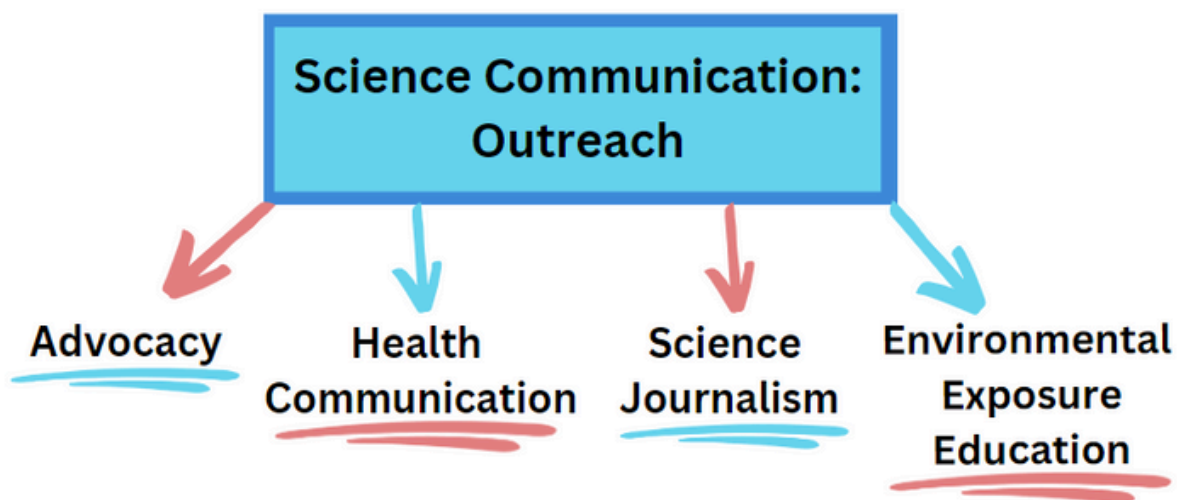# Science Communication Workbook

What is "Science Communication" in this context?

The primary focus of this **Science Communication Workbook** is on outreach to public audiences. The workbook provided below offers a comprehensive set of tools designed to help students develop the skills necessary to engage confidently with their communities.

We aim to empower students to become effective advocates for change, specifically in promoting public health improvements related to drinking water quality. By equipping students with these essential communication and advocacy skills, we aim to foster a more informed and proactive community, ultimately leading to healthier and safer drinking water for all.

Workbook - Background & Funding Sources

The Science Communication Workbook was created as part of a secondary school-based citizen science project supported by the National Institutes of Health Science Education Partnership Award (NIH SEPA). This project is titled "[Promoting Environmental Health Literacy through Science Communication and Intergenerational Learning in a K-12 Safe Drinking Water Citizen Science Project (Communicating Data)](#)" and is supported by grant # 1R25NR021077 from the National Institute of Nursing Research awarded to the MDI Biological Laboratory. It serves as a curriculum guide for teachers participating in the "Communicating Data" project and supports student efforts to share their message about safe drinking water in their communities and beyond.

How To Use This Workbook

Begin with the seven-page document, [Science Communication Workbook](#). This is the "core workbook" and contains six steps that teachers and students participating in the SEPA "Communicating Data" project must complete.

[Step 1](#) involves collecting drinking water samples and [Step 2](#) entails analyzing the data.

Step 3 - [Choose an Audience](#) - involves a lesson in this workbook, which then prepares you for Step 4 - [Choose an Action](#). Step 5 - [Frame a Message](#) - also involves a lesson in this workbook.

Step 6 entails [Choosing a Medium](#), which includes a flowchart to help guide teachers and students in choosing an effective medium for their outreach. Additionally, within step 5, there are optional lessons and resources. There are teacher and student versions of:
- Trifold, Poster, & Brochure Checklist
- Lesson - Writing a Science-based Op-ed
- Lesson - Science Storytelling
- Resources for Video Production & Editing
- Video Planning Sheet

Step 7, the final phase, involves students creating their [Outreach Plan](#). After moving through the resources and lessons contained within this workbook, students should be well-equipped to accomplish this task and ultimately share their data-supported stories with their local community and beyond.

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Table of Contents

Science Communication Workbook

Goal: This workbook will direct teachers and their students in the process of how to communicate data through outreach.

Steps 1 and 2: Required Actions Before Outreach Begins
<u>Step 1:</u> Collect drinking water samples.

<u>Step 2:</u> Analyze the data and determine what the data is telling you.
Use these <u>TUVA activities about what data can tell you</u> to get started.

Steps 3 - 7: Choose your Audience, Choose an Action, Frame a Message, Choose a Medium, Create an Outreach Plan

Step 3
Step 4
Step 5

Step 6
Step 7

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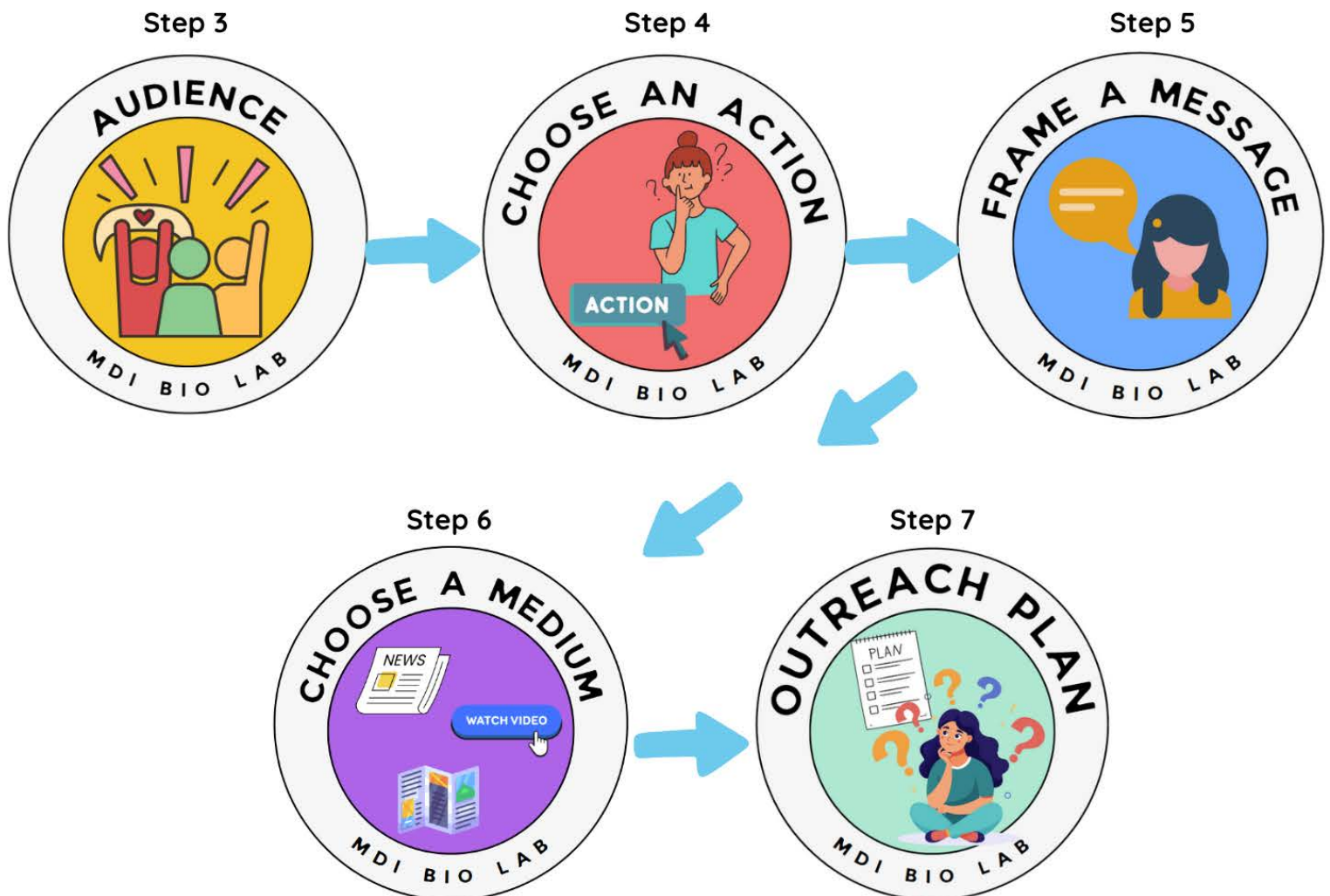
Step 3: Audience

Complete the lesson on "Audience." Then, select a specific audience to share a relevant message relating to the results of the drinking water project (completed in step 2). Consider these questions:

- Based on your data analysis, which group of people do you believe would benefit most from receiving your message?
- Considering current circumstances and potential impact, where do you see opportunities to effectively disseminate your data? For instance, are there upcoming community gatherings, legislative sessions, or other relevant events where sharing your findings could be particularly impactful? If so, this can help inform who you decide your audience should be.

Now choose your audience. Who do you want to reach with your message? (check all that apply)
- ☐ Legislators
- ☐ Municipal Leaders
- ☐ Neighbors/Community Members
- ☐ Peers
- ☐ Schools

Step 4: Choose An Action

What do you want to accomplish by sharing your data supported story? (check all that apply)
- ☐ Encourage water filtration
- ☐ Increase water testing
- ☐ Raise awareness about environmental health
- ☐ Start a legislative action
- ☐ Other _____

Step 5: Frame A Message

Complete the lesson on "Framing a Message." Then decide on what frame you want to use to guide the story about the issue you are addressing.
- ☐ Public Health Protection
- ☐ Environmental Protection
- ☐ Human Equity
- ☐ Economics
- ☐ Other _____

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Step 6: Choose A Medium

Investigate the flowchart on the next page. Deciding on a relevant and effective medium for your outreach depends on your audience, action, and frame. For example, it would not make sense to go to your student peers expecting them to start a legislative action.

Note to Teachers: There are optional lessons for Storytelling, Writing an Op-Ed, and Videos. Additionally, there is a student checklist and teacher rubric for Brochures/ Tri-fold Display/ Posters.

How will you reach your audience? (check all that apply)
- ☐ Email
- ☐ Letter
- ☐ 1:1 Meeting
- ☐ Attend Public Hearing
- ☐ Letter to Editor
- ☐ Op-Ed
- ☐ Presentation
- ☐ Talk
- ☐ Brochure
- ☐ Tri-Fold Display
- ☐ Poster
- ☐ Video
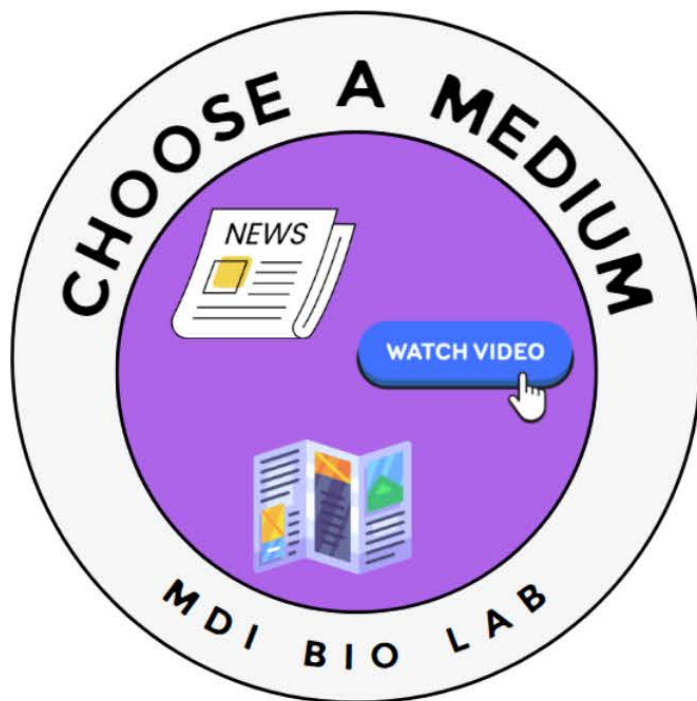
Audience →	Action →	Frame →	Medium
Legislators	• Raise awareness • Start a legislative action • Other	• Public Health Protection • Environmental Protection • Human Equity • Economics • Other	• Email/ Letter • 1:1 Meeting • Attend Public Hearing • Other
Municipal Leaders	• Raise awareness • Fund water testing • Distribute information on water filtration • Other	• Public Health Protection • Environmental Protection • Human Equity • Economics • Other	• Email/ Letter to Town Manager • Letter to the Editor • Op-Ed • Presentation at a town council or selectman meeting • Other
Neighbors/ Community Members	• Raise awareness • Help with water testing • Encourage water filtration • Other	• Public Health Protection • Environmental Protection • Human Equity • Economics • Other	• Email/ Letter • Letter to the Editor • Op-Ed • Brochure • Video • Other
Peers	• Raise awareness • Invite participation in water testing project • Inform about water filtration • Other	• Public Health Protection • Environmental Protection • Human Equity • Economics • Other	• Presentation in School Assembly • Give a Talk to a Class • Other
Schools	• Raise awareness • Share information about water testing & filtration • Other	• Public Health Protection • Environmental Protection • Human Equity • Economics • Other	• Tri-fold Display or Poster in Library • Video on School YouTube Channel • Other

How to Use This Process - An Example

You've decided that you want to communicate with your legislative representative (**AUDIENCE**) because they are proposing x bill. You want to persuade them that the bill is harmful, and they should vote against it (**ACTION**).

To develop your message, you need to understand the following:

- The science that demonstrates the harm
- What your legislator seems to care about
- The type of information that legislators usually gravitate toward (such as statistics and stories).

After reading their webpage, you learn that your legislator often is sponsoring bills that address economic issues. You decide that you should frame your message using an economic frame (**FRAMING**), which means that you'll emphasize the financial impact of the bill on families or the amount of money that it will cost municipalities.

Finally, you learned that legislators are really busy and get A LOT of information every day. So, you've decided that an email with bulleted points and a link to an informative video or podcast will work best (**MEDIUM**). The email provides a brief overview of the issue, and the links allow them to learn more while also doing other things, like driving, exercising, and taking care of their homes.

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Step 7: Create Your Outreach Plan

Now, begin creating an outreach plan. Include the following:

- Who is your audience?
- What action do you want them to take?
- What is your core message? In other words, what is the key takeaway you want your audience to remember after engaging with your outreach effort?
- What frame will you use to guide the story about the issue?
- How will you tailor your message to resonate with your audience's interests and concerns?
- What medium(s) will you use and why (why is your chosen medium the best way to deliver your message to your specific audience)?
- What data will you present to your audience that supports your message?
- In what format will you present the data?
- How will you make the data understandable and relevant to your audience? Will you use visuals, analogies, or real-life examples?
- How will you verify the accuracy and reliability of the data you present to your audience?
- Are there any potential biases or limitations in the data that you should acknowledge to your audience?
- How will you encourage active participation and dialogue with your audience?

My Outreach Plan:
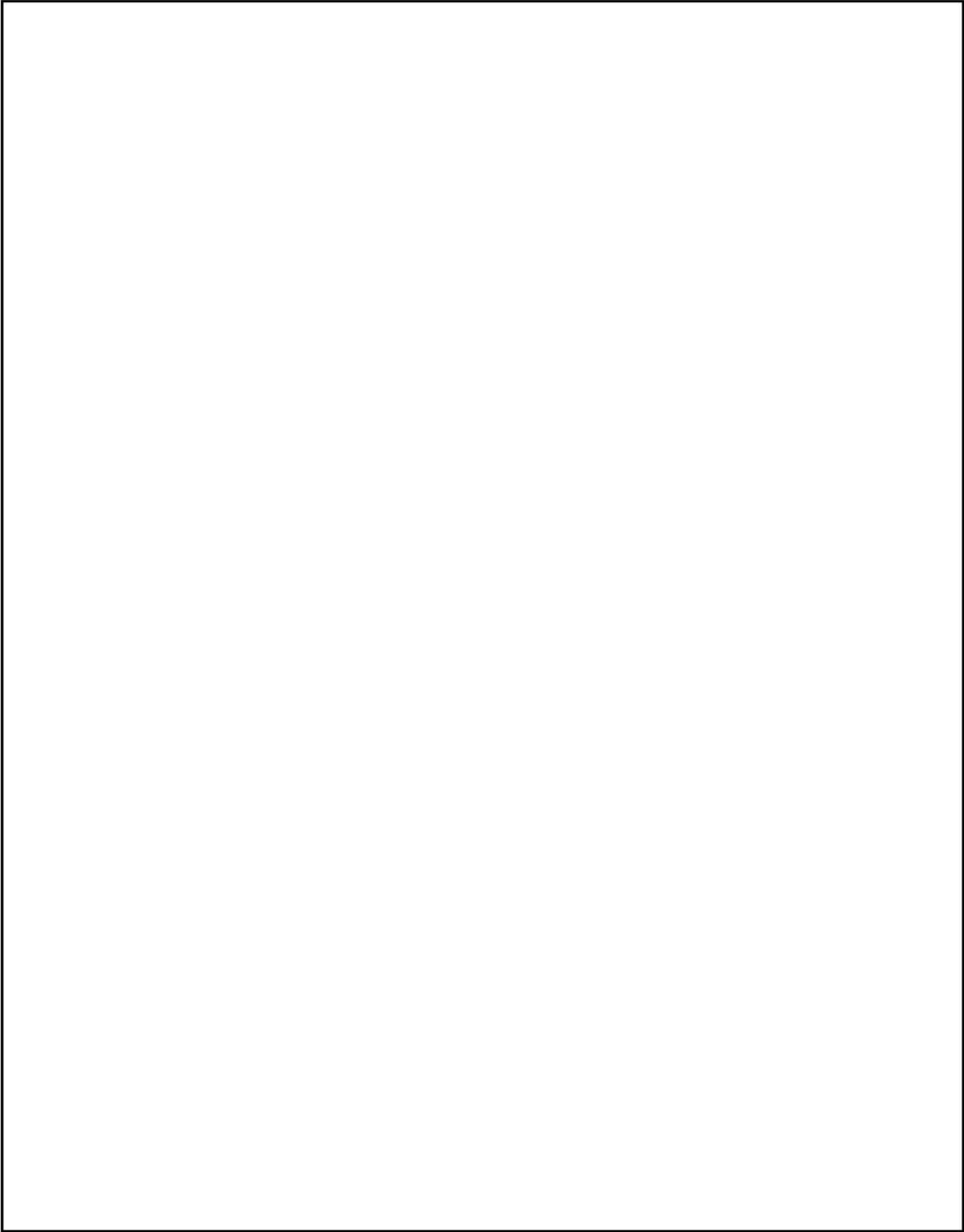
Science Communication: Teaching to Your Audience
Lesson: Teaching One Topic at 4 Different Levels

Objective: Students will learn to effectively communicate scientific concepts to audiences of different ages, backgrounds, and levels of understanding.

Instructions:
1. Play the video for the class:
"Drinking Water Explained at 4 different levels"

2. Have students answer the following questions individually or in small groups, and then discuss as a class. Answers will vary, and some suggested answers are included below.

1. How does Morgan (The Expert) engage her audience and maintain their interest throughout the presentation?
Suggested Answer: Morgan engages her audience by using visual aids, asking questions, and encouraging participation. She also adjusts her tone and pace to keep her audience interested and involved.

2. Although Morgan discusses the topic of drinking water to people of four different ages with different levels of prior knowledge, she changes the exact topic for each audience. Why do you think she does this?
Suggested Answer: Morgan changes the exact topic for each audience to tailor the information to their specific level of understanding and interest. This ensures the content is relevant and engaging for each group, maximizing comprehension and retention.

3. Do you see any method Morgan uses exclusively for one of the audience levels and not the others?
Suggested Answer: One method Morgan uses exclusively for the two younger levels is the use of visual aids, which help to simplify complex concepts and make information more accessible and engaging. By contrast, when Morgan speaks to her fellow expert, she uses more technical concepts and in-depth explanations, thus adapting the content to meet her audience's expertise level.

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4. Do you think there is anything Morgan could have done better in teaching any of the four levels?

Suggested Answer: Elementary-aged audience—explain the visual aids further, including using one's hands on the images to show the movement of water. Middle-school-aged audience—(1) explain the reasons why people have public vs. private water, and (2) show a town's drinking water map that has both systems to demonstrate this concept. High-school-aged audience—include a visual aid, such as an EPA list of metals and their maximum contaminant levels.

Now think more broadly!

1. As a science communicator, how can you ensure that your audience understands the main points of your explanation, regardless of their level of scientific literacy?

Suggested Answer: Science communicators should use clear and concise language, avoid jargon, use analogies and real-life examples, and engage the audience through interactive elements such as visuals and demonstrations.

2. Why is it important for science communicators to be able to adapt their message for different audiences?

Suggested Answer: Audiences vary significantly in terms of their background knowledge and level of scientific literacy. Adapting the message ensures that it is relevant, understandable, and engaging for the specific audience, leading to better comprehension and retention of the information.

3. Reflecting on broader society, can you provide real-life examples where poor science communication or a lack of effective distribution of scientific information has resulted in confusion or misunderstanding among the public? How might these instances have been mitigated with clearer communication strategies?

Suggested Answer: One example of poor science communication is the misinterpretation of vaccine information, leading to vaccine hesitancy and outbreaks of preventable diseases (i.e., measles). Clearer communication strategies, such as providing accurate and accessible information through trusted sources, addressing common misconceptions, and engaging with communities to address concerns, could help mitigate confusion and improve public understanding of vaccination.

4. In what ways can you apply the principles of effective science communication in your own life, both inside and outside the classroom?

Suggested Answer: Students can use effective science communication principles in a wide variety of settings—the classroom, everyday interactions, their communities (i.e., a community meeting), and future careers. Students can practice effective science communication by:
- Communicating with clarity and conciseness
- Using analogies and real-life examples to explain complex concepts
- Actively listening to others' perspectives
- Critically evaluating information before forming opinions or making decisions

3. Small Group Activity - Roleplay

1. Brainstorming: In small groups, students will choose a scientific concept learned during the school year to teach at 4 different levels.
2. Roles: Assign or have students choose the roles of "The Expert" and audience members for each level.
3. Planning: Students will plan and organize the lesson for each level considering engagement strategies, language adjustments, teaching methods, and topic variations.
4. Roleplay: Each group will perform their roleplay for the class, presenting their lesson at each level.

Instructions for the Roleplay:
- Each group will have a designated time to perform their roleplay.
- After each presentation, allow for brief feedback and discussion from the class.
- Encourage students to reflect on what worked well and areas for improvement in each presentation.
- Emphasize the importance of clear communication and audience engagement throughout the roleplay activity.

Conclusion:
- Summarize key takeaways from the roleplay activity.
- Reinforce the importance of effective science communication in conveying complex ideas to diverse audiences.
- Encourage students to apply the principles learned in their future communication endeavors.

Science Communication: Teaching to Your Audience
Lesson: Teaching One Topic at 4 Different Levels

1. Watch the Video

"Drinking Water Explained at 4 different levels"

2. Answer the Following Questions

1. How does Morgan (The Expert) engage her audience and maintain their interest throughout the presentation?
2. Although Morgan discusses the topic of drinking water to people of four different ages with different levels of prior knowledge, she changes the exact topic for each audience. Why do you think she does this?
3. Do you see any method Morgan uses exclusively for one of the audience levels and not the others?
4. Do you think there is anything Morgan could have done better in teaching any of the four levels?

Now think more broadly!

1. As a science communicator, how can you ensure that your audience understands the main points of your explanation, regardless of their level of scientific literacy?
2. Why is it important for science communicators to be able to adapt their message for different audiences?
3. Reflecting on broader society, can you provide real-life examples where poor science communication or a lack of effective distribution of scientific information has resulted in confusion or misunderstanding among the public? How might these instances have been mitigated with clearer communication strategies?
4. In what ways can you apply the principles of effective science communication in your own life, both inside and outside the classroom?

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3. Small Group Activity - Roleplay

1. Brainstorm and choose a <u>scientific concept</u> that you have learned about during this school-year. Your group will teach this concept at 4 different levels.
   a. Level 1: elementary-aged student
   b. Level 2: middle school-aged student
   c. Level 3: high school-aged student
   d. Level 4: professional
2. Everyone in your group will play the role of "The Expert" at least once. Decide who will teach each level and who will be the audience at each level.
3. As a group, plan and organize the lesson for each level and consider the following:
   a. How will you engage your audience at each level and maintain their interest?
   b. How will you adjust your language for each level?
   c. What teaching methods will you use to enhance your audience's understanding, and will those differ depending on the level to which you are teaching?
   d. Will you teach the same exact topic for each level?
4. Now you will do the roleplay for the class!

Science Communication happens in diverse ways and in different settings!

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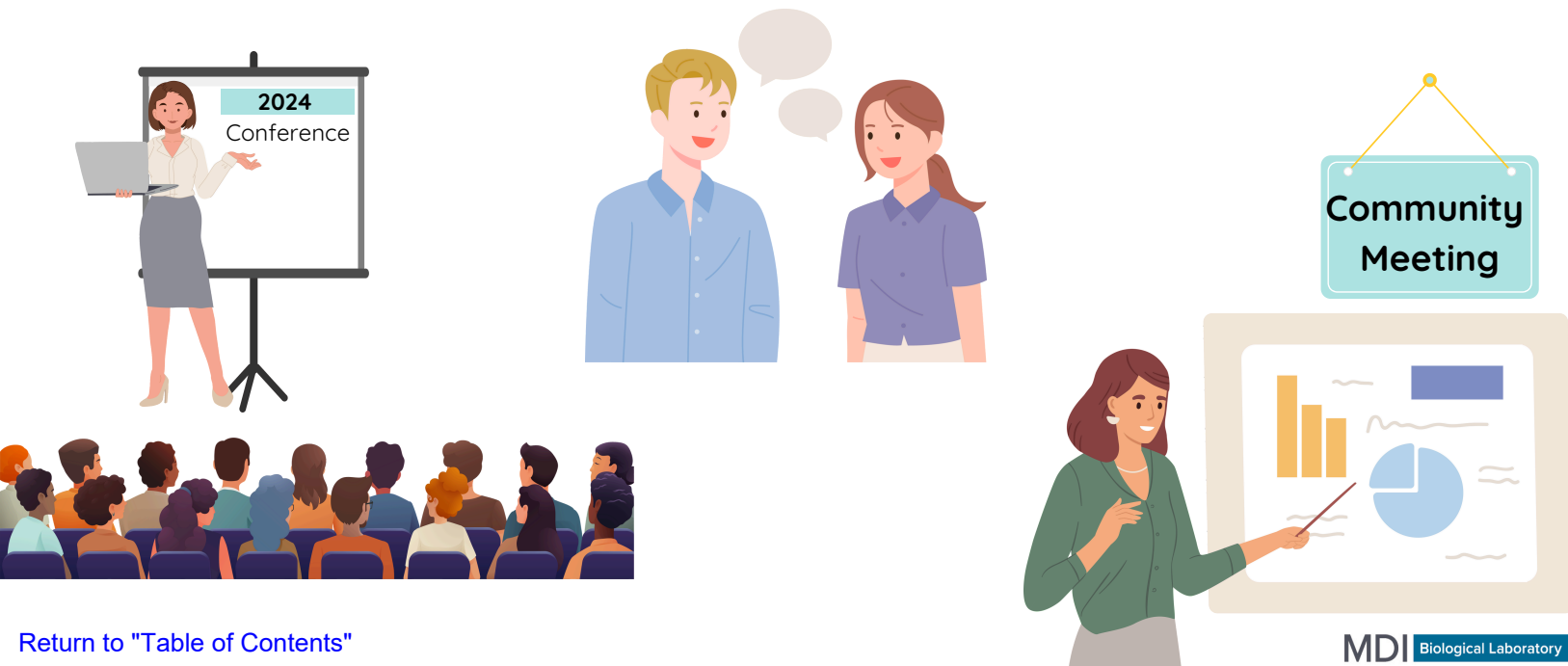
Framing your Message

Objectives
- Understand the importance of framing one's message in science communication
- Practice framing scientific messages effectively
- Practice communicating a data supported message in a debate format

Introduction
- Begin the class by explaining—How information is framed can significantly impact how it is understood and received by one's audience.
- Provide examples of how different framing can influence perception, such as:
  - presenting scientific findings in terms of benefits versus risks
  - using language that emphasizes uncertainty versus certainty
- Ask students to think of real-life examples of scientific topics that are framed in different ways, depending on who is presenting them to the public. Emphasize the idea that how scientific ideas are framed shapes how the public perceives and responds to complex issues, thereby influencing attitudes, beliefs, and policy decisions. Examples of topics—

Robotics in Manufacturing:
- Framing as Innovation and Efficiency: Robots improve precision, reduce human error, and increase productivity—helping industries grow and remain competitive in a global market.

- Framing as a Job Displacement Concern: Automation is changing the nature of jobs—workers need re-skilling and access to training programs to adapt to evolving industries.

Ocean Exploration:
- Framing as a Scientific Frontier: We've only explored 5% of the ocean—discovering new species and ecosystems could unlock knowledge about Earth's climate, geology, and life itself.

- Framing as an Economic Opportunity: The deep ocean may hold resources like rare minerals or potential medicines—sustainable exploration could benefit future generations.

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Drones in Environmental Monitoring
- Framing as a Conservation Tool: Drones help us monitor wildlife, track deforestation, and respond quickly to environmental changes—enabling better protection of ecosystems.

- Framing as a Technological Education Tool: Using drones in schools helps students learn about geography, coding, and engineering—making science engaging and hands-on.

Part I—Practice Framing Scientific Messages In A Variety of Ways (Worksheet)
- As a class, brainstorm different topics relating to drinking water, including locally relevant issues. Write the list on the board so that students can use it for the worksheet.
- Divide students into small groups of 3-4 and have them complete the associated worksheet.

Part II—Frame Opposing Messages of a Drinking Water Topic (Communal Class Exercise)
- As a class, brainstorm drinking water issues that could have opposing sides. Then, for each topic, identify two clear opposing viewpoints. Have students practice framing messages for each viewpoint.
- Examples of topics are below. A list containing each topic and their associated pros and cons is on the following pages. It can help you guide students as they prepare for the debate in the next part of the lesson.

  - Should water testing for private homes with wells be mandatory?
  - Who should bear the responsibility of paying to test private well water—the homeowner or the government?
  - Discuss the pros and cons of public versus private control of water resources.
  - Maine's primary drinking water standard for arsenic is 10 micrograms per liter (10ug/L), while New Hampshire's is 5 ug/L. Should Maine change its standard for arsenic to 5 ug/L?
  - Should there be stricter regulations on agricultural runoff to protect drinking water sources?
  - Is water a human right or a commodity?

Part III—Debate
1. As a class, decide which drinking water related issue you would like to debate.

2. Divide the class into two teams, assigning each a side to argue (pro or con).

3. Research and Preparation: Allow time for teams to choose a frame and research their assigned positions. They should gather data, statistics, expert opinions, and real-world examples to build strong arguments that support their frame.

4. Execute the debate in a structured format. A suggested structure is as follows—

- **Opening statements:** Each side will have the opportunity to make an opening statement. The order of which team presents first will be chosen at random. Opening statements will not exceed 1 minute. The opening statement can be given by one member of the group or divided among multiple members.

- **Further Argument**: After the opening statement from both teams, the first group will be given 3 minutes for further argument. Then, the second group will have 3 minutes for their argument. Responsibility to present can be given to one speaker or divided among the group members, but only one speaker may talk at a time.

- **Rebuttal Preparation:** Allow students 5 - 10 minutes to prepare rebuttals.

- **1st Rebuttal:** The first group will defend their case and attempt to defeat the opposing team's arguments without adding new information (4 minutes). Then, the second group will do the same (4 minutes).

- **2nd Rebuttal:** There will be a second rebuttal (3 minutes) from each team.

- **Discussion:** Allow an opportunity for back and forth discussion.

- **Closing Statement:** Similar to an opening statement, each team will support their case using evidence (2 minutes).

5. Reflection and Discussion: After the debate is completed, hold a class discussion to reflect on the arguments presented. Discuss what was learned, which arguments were most convincing, and the overall importance of the issues debated.

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Five Drinking Water Issues and their Pros & Cons

Should well water testing for private homes be mandatory?

Pro (Mandatory well water testing):
- Public Health Protection: Regular testing can identify harmful contaminants such as bacteria, nitrates, heavy metals, and pesticides, preventing health issues. This ensures that homeowners are aware of potential health risks in their drinking water, reducing the incidence of waterborne diseases and chronic health conditions. Regular testing also reduces the risk of contaminated water affecting nearby homes and communities, promoting overall public health and safety.
- Environmental Benefits: Regular testing can help track and mitigate environmental pollution, ensuring the long-term sustainability of groundwater resources. Moreover, mandatory testing provides valuable data that can be used to identify and address broader environmental issues affecting water quality.
- Equity and Safety: Mandatory testing ensures that all private wells meet minimum safety standards, protecting vulnerable populations (i.e., children, immunocompromised individuals) who may not have the knowledge to test their water regularly.

Con (Mandatory well water testing):
- Cost and Financial Burden: Mandatory testing can be costly, placing a financial burden on homeowners, particularly those in rural or low-income areas. Additionally, government programs to enforce and subsidize testing could be expensive, diverting funds from other critical public services.
- Privacy and Autonomy: Some homeowners may feel that they should have the right to decide whether to test their water, rather than being compelled by government regulations. Mandatory testing could be viewed as an overreach of government authority, infringing on individual property rights and personal freedoms.
- Logistical and Practical Challenges: Implementing and enforcing mandatory testing regulations can be challenging, requiring significant resources for monitoring and compliance. Moreover, ensuring that all testing is conducted to a high standard can be difficult, and there may be disparities in the quality and reliability of tests performed by different providers.

Who should bear the responsibility of paying to test private well water—the homeowner or the government?

Pro (Government should pay):
- Public Health: Ensuring clean water is a public health priority, and government funding should guarantee consistent and thorough testing to protect entire communities.
- Equity: Not all homeowners can afford testing, and government-funded programs ensure that all citizens, regardless of income, have access to safe drinking water.
- Prevention: Government involvement can lead to early detection of widespread issues, preventing larger public health crises.

Con (Homeowner should pay):
- Personal Responsibility: Homeowners should take responsibility for their own water quality, especially if they choose to use private wells.
- Financial Burden: Government funds are limited and could be better spent on other public services. Homeowners testing their water reduces the financial burden on the state.
- Efficiency: Private testing may be more efficient and less bureaucratic than government programs, leading to quicker results and actions.

Discuss the pros and cons of public versus private control of water resources.

Pro (Public control):
- Public Good: Water is a public resource, and public control ensures that it is managed in the best interest of all citizens, not for profit.
- Equity: Public control can ensure fair distribution and access to clean water for all, regardless of socio-economic status.
- Accountability: Public agencies are accountable to the public, ensuring transparency and responsiveness.

Con (Private control):
- Efficiency: Private companies can often operate more efficiently, reducing waste and improving service delivery through innovation and competition.
- Investment: Privatization can attract significant private investment, leading to better infrastructure and service improvements.
- Flexibility: Private companies may be more flexible and quicker to adapt to changing circumstances and technologies.

Maine's primary drinking water standard for arsenic is 10 micrograms per liter (10ug/L), while New Hampshire's is 5 ug/L. Should Maine change its standard for arsenic to 5 ug/L?

Pro (Lowering the standard to 5 ppb):
- Health Benefits: Lowering the arsenic standard decreases exposure to a known carcinogen, potentially reducing the incidence of cancers and other health problems linked to arsenic. It also enhances protection for vulnerable populations, such as children and pregnant women, who are more susceptible to the harmful effects of arsenic.
- Long-term Cost Savings: Investing in cleaner water now can reduce healthcare costs in the future by preventing arsenic-related illnesses.
- Environmental Protection: Lowering the allowable arsenic level encourages better environmental practices and monitoring, improving overall water quality.
- Alignment with Neighboring States: Aligning with New Hampshire's standard can simplify regulations for companies operating in both states and can foster regional cooperation on water quality issues.
- Increased Public Confidence: Stricter standards can increase public trust in water safety and regulatory bodies.

Con (Lowering the standard to 5 ppb):
- Increased Costs: Water treatment facilities and private well owners may face significant expenses to upgrade systems and meet the stricter standard. More resources will be needed for monitoring and enforcement, which could strain state and local budgets. The financial burden of compliance may be especially challenging for small communities and low-income households.
- Economic Impact on Industries: Industries that rely heavily on water, such as agriculture and manufacturing, may face higher operational costs, potentially affecting their competitiveness.
- Public Resistance: Homeowners and businesses may resist the change due to the perceived or actual increase in costs and regulatory burden.
- Logistical Challenges: Achieving and maintaining the lower standard requires more frequent and rigorous testing, as well as enhanced infrastructure and technology.

Should there be stricter regulations on agricultural runoff to protect drinking water sources?

Pro (Stricter regulations):
- Health Protection: Stricter regulations reduce the risk of contaminants like pesticides and fertilizers entering drinking water, protecting public health.
- Environmental Benefits: Reducing runoff improves the overall quality of water bodies, benefiting ecosystems and biodiversity.
- Long-Term Savings: Cleaner water reduces the need for expensive water treatment, leading to long-term cost savings for municipalities and taxpayers.

Con (Stricter regulations):
- Economic Impact: Stricter regulations can increase costs for farmers, potentially reducing their competitiveness and profitability.
- Productivity: Farmers may face reduced productivity if they are required to limit the use of certain chemicals or implement costly runoff prevention measures.
- Implementation Challenges: Ensuring compliance with stricter regulations can be difficult and costly, requiring significant monitoring and enforcement resources.

Is water a human right or a commodity?

Pro (Water is a human right):
- Basic Need: Access to clean water is essential for survival, health, and well-being, and should be guaranteed for all individuals.
- Equity: Treating water as a human right ensures that even the poorest and most vulnerable populations have access to safe drinking water.
- Moral Responsibility: Society has a moral obligation to provide essential resources like water to all people, regardless of their ability to pay.

Con (Water is a commodity):
- Value Recognition: Treating water as a commodity recognizes its value and encourages responsible use and conservation through pricing mechanisms.
- Investment and Innovation: Viewing water as a commodity can attract private investment, leading to improved infrastructure, efficiency, and technological advancements.
- Sustainability: Pricing water appropriately can discourage waste and overuse, promoting sustainable management of water resources.

Directions: Read each question and its example answer. Then, (1) decide your own answer, (2) write a frame and (3) write a message. It may be helpful to work backwards - try writing your message, then describing your frame in 2-3 words. Example answers for each question are given below to help guide you. Lastly, check the box(es) of the goal(s) that each of your messages achieves.

1. Should well water testing for private homes be mandatory? Example -
Answer: Yes
Frame: Equity and Safety
Message: Mandatory testing ensures that all private wells meet minimum safety standards, protecting vulnerable populations like children and immunocompromised individuals who may not have the knowledge to test their water regularly.

Does your message achieve any of the following goals? Check all that apply.
☐ Encourage water filtration
☐ Increase water testing
☐ Raise awareness about environmental health
☐ Start a legislative action

2. Who should bear the responsibility of paying to test private well water—the homeowner or the government? Example -
Answer: The government should pay.
Frame: Public Health Priority
Message: Ensuring clean water is a public health priority, and government funding should guarantee consistent and thorough testing to protect entire communities

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Does your message achieve any of the following goals? Check all that apply.
☐ Encourage water filtration
☐ Increase water testing
☐ Raise awareness about environmental health
☐ Start a legislative action

3. Should water resources be publicly or privately controlled? Example -
Answer: Privately
Frame: Efficiency & Innovation
Message: Due to profit motives, private companies may have more incentive to innovate and implement efficient technologies and practices that will ultimately save them money, but will simultaneously benefit the environment and consumer.

Does your message achieve any of the following goals? Check all that apply.
☐ Encourage water filtration
☐ Increase water testing
☐ Raise awareness about environmental health
☐ Start a legislative action

4. Maine's primary drinking water standard for arsenic is 10 micrograms per liter (ug/L), while New Hampshire's is 5 ug/L. Should Maine change its standard to 5 ug/L? Example -
Answer: Yes
Frame: Health Benefits
Message: Lowering the arsenic standard decreases exposure to a known carcinogen, potentially reducing the incidence of cancers and other health problems linked to arsenic.

Does your message achieve any of the following goals? Check all that apply.
☐ Encourage water filtration
☐ Increase water testing
☐ Raise awareness about environmental health
☐ Start a legislative action

5. Should there be stricter regulations on agricultural runoff to protect drinking water sources? Example -
Answer: No
Frame: Economic
Message: Stricter regulations can increase costs for farmers, potentially reducing their competitiveness and profitability.

Does your message achieve any of the following goals? Check all that apply.
☐ Encourage water filtration
☐ Increase water testing
☐ Raise awareness about environmental health
☐ Start a legislative action

6. Is water a human right or a commodity? Example -

Answer: A human right

Frame: Moral Responsibility

Message: Society has a moral obligation to provide essential resources like water to all people, regardless of their ability to pay.

Does your message achieve any of the following goals? Check all that apply.

☐ Encourage water filtration

☐ Increase water testing

☐ Raise awareness about environmental health

☐ Start a legislative action

Debate!!!

Group Research & Preparation: For your side of the issue, as a group decide on a frame (such as public health, economic, environmental, etc.). Then work together to gather data, statistics, expert opinions, and real-world examples to build a strong argument around your frame. Write all relevant information that you plan to use during the debate in the box below.

Now that you've done your research, you will create the following—

Opening statement: Each team will make an opening statement. Opening statements will not exceed 1 minute. The opening statement can be given by one member of the group or divided among multiple members. Write your opening statement below, and include who will deliver it and the order (if there are multiple people). Include the following:

- Introduction: A brief overview of the topic and your team's stance.
- Thesis Statement: Clearly state your core position.
- Main Arguments: Briefly present the key points that your team will elaborate on throughout the debate.

Aim to be clear, concise, and engaging to grab the audience's attention. You also want to be logical and well-organized to provide a roadmap for the rest of the debate.

Further Argument: After the opening statement from both teams, you will have 3 minutes to present your main arguments (you will have given an overview of these in your introduction). Responsibility to present can be given to one speaker or divided among group members, but only one speaker may talk at a time. Based on the research you did, write your argument in the box below. Be sure to include who will deliver what part of the argument and in what order.

Closing Statement: Create a closing statement that supports your case. Your team will have 2 minutes to present it. Write your statement in the box below and include the following:

- Summary: Recap the main arguments presented by your team.
- Refutation: Highlight and counter the most significant points made by the opposing team.
- Conclusion: Restate your thesis in light of the arguments and refutations, underscoring why your team's position is superior.
- Final Appeal: Make a persuasive and memorable closing appeal to the audience.

Aim to be persuasive and impactful to ensure the arguments resonate with your audience. Be confident and assertive, reinforcing your team's stance and undermining the opposing team's case.

Rubric for Student Poster, Trifold, or Brochure

1. **Clarity of Title**: The title is clear, concise, and easily readable from a distance.

1   2   3   4   5

Comments:

2. **Consistent Font Usage**: The same font is used throughout the poster for uniformity and readability.

1   2   3   4   5

Comments:

3. **Readable Text**: The text is large enough to be easily readable from a distance, with concise wording and bullet points for clarity.

1   2   3   4   5

Comments:

4. **Organization**: The content is logically organized with clear sections such as *Introduction, Methods, Results*, and *Conclusion*.

1   2   3   4   5

Comments:

5. **Visual Appeal**: The poster is visually appealing with a balanced layout, appropriate use of colors, and eye-catching graphics or images.

1   2   3   4   5

Comments:

6. **Consistency in Design**: The poster maintains consistency in design elements such as spacing, alignment, and formatting.

1   2   3   4   5

Comments:

7. **Engagement**: The poster includes engaging visuals or interactive elements to capture the audience's attention and encourage interaction.

1   2   3   4   5

Comments:

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8. **Data Presentation**: The data is presented clearly using graphs, charts, tables, or diagrams, with clear labels and titles.

1   2   3   4   5

Comments:

9. **Accuracy**: All information presented is accurate and supported by evidence or references.

1   2   3   4   5

Comments:

10. **Conciseness**: The poster is not overcrowded with excessive text or visuals. It is concise and focused on key points.

1   2   3   4   5

Comments:

11. **Relevance**: All content is relevant to the topic and contributes to the overall understanding of the research or project.

1   2   3   4   5

Comments:

12. **Spellcheck & Grammar**: There are no spelling or grammatical errors.

1   2   3   4   5

Comments:

13. **Acknowledgments**: The poster includes acknowledgments for any funding sources, collaborators, or assistance received during the research.

1   2   3   4   5

Comments:

14. **Contact Information**: The poster provides contact information (such as email or website) for further inquiries or discussions.

1   2   3   4   5

Comments:

Poster, Trifold, or Brochure – Student Checklist

☐ 1. **Clarity of Title**: Is my title clear, concise, and easily readable from a distance?

☐ 2. **Consistent Font Usage**: Did I use the same font throughout?

☐ 3. **Readable Text**: Is the text large enough to be easily readable from a distance, with concise wording and bullet points for clarity?

☐ 4. **Organization**: Is the content logically organized with clear sections (such as *Introduction, Methods, Results*, and *Conclusion)?*

☐ 5. **Visual Appeal**: Is my project visually appealing with a balanced layout, appropriate use of colors, and eye-catching graphics or images?

☐ 6. **Consistency in Design**: Is my project consistent in its design elements such as spacing, alignment, and formatting?

☐ 7. **Engagement**: Does my project include engaging visuals or interactive elements to capture my audience's attention and encourage interaction?

☐ 8. **Data Presentation**: Is the data presented clearly using graphs, charts, tables, or diagrams, with clear labels and titles?

☐ 9. **Accuracy**: Is all information presented accurately and supported by evidence or references?

☐ 10. **Conciseness**: Is my project concise, focused on key points, and NOT overcrowded with excessive text or visuals?

☐ 11. **Relevance**: Is all content relevant to the topic and does it contribute to the overall understanding of the project?

☐ 12. **Spellcheck & Grammar**: Did I ensure there are NO spelling or grammatical errors?

☐ 13. **Acknowledgments**: Does my project include all necessary acknowledgments (i.e., funding sources, collaborators, or assistance received during the research)?

☐ 14. **Contact Information**: Does my project provide contact information (such as email or website) for further inquiries or discussions?

Writing about Science:
Crafting an Op-Ed

Objectives:
- Read a published op-ed about a scientific topic.
- Learn how to structure an op-ed about a scientific topic.
- Understand the importance of credibility and evidence in persuasive writing.
- Practice critical thinking by considering different perspectives and addressing counter arguments.

Instructions:

Introduction

Engage with Relevance: Start by asking the class a question that relates to their lives or current events, such as:
- "Have you seen news articles or opinion pieces discussing scientific topics like climate change or the COVID-19 pandemic?"

Explain the Focus: This lesson will focus on a specific type of writing called an op-ed (an "opinion editorial"), which is a way for individuals to express their opinions on important topics, including science. Op-eds are often published in newspapers and magazines, or on online platforms.

Outline the objectives (above) for the lesson.

Part I: Read and discuss an op-ed about a scientific topic

Read the free, open-access article in The Guardian - The world has a chance to end plastic pollution – the petrochemical giants mustn't spoil it - by Steve Fletcher.
https://www.theguardian.com/commentisfree/2024/apr/29/world-plastic-pollution-petrochemical-giants-un-treaty-2015-paris-lobbyists

As a class, discuss the op-ed by asking students the following questions:

1. **Do you think the author was effective at getting his readers to trust him?**
- What makes him more of an authority on the topic of plastics compared to the general public?

Suggested Answer: Being a professor of ocean policy and economy at the University of Portsmouth and the editor-in-chief of Cambridge Prisms: Plastics gives him credibility and expertise in the field. This background would likely lead readers to trust his insights and opinions more than those of the general public.

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2. **How did the author back up his point?**
- What evidence did he provide, which even those individuals who may disagree with his opinion, will interpret as credible?

Suggested Answer: Fletcher backs up his points with a combination of scientific evidence and logical reasoning. He references a recent scientific paper advocating for a reduction in virgin plastic production as the most effective way to tackle plastic pollution. Additionally, he highlights the complex nature of the plastics economy and the need for a range of supporting interventions alongside production cuts. These arguments are supported by facts and reasoning, making them credible even to individuals who may initially disagree with his perspective.

3. **What's new about what the author is sharing?**
- Is there any new information for the public?

Suggested Answer: The author presents several new aspects regarding the approach to tackling plastic pollution. He emphasizes the need to address plastic pollution at its source by reducing virgin plastic production, rather than solely focusing on end-of-life waste management techniques. This approach shifts the focus to preventing pollution before it occurs, which may be a novel concept for some readers. Additionally, Fletcher discusses the lobbying power of the global plastics industry as a major impediment to implementing production cuts, shedding light on the political and economic challenges involved in addressing plastic pollution.

4. **Why should the author's readers care?**
- How does the topic of plastic pollution impact the author's readers in their daily lives? How are the author's ideas helpful for his audience?

Suggested Answer: Plastic pollution impacts the author's readers in various ways, ranging from environmental concerns to public health issues. Fletcher argues that plastic pollution contributes to the climate crisis, biodiversity loss, and chronic pollution, with harmful effects on human health. By providing solutions to tackle plastic pollution at its source, such as reducing virgin plastic production and implementing policies to promote reusable products, Fletcher offers actionable ideas for his audience to address these pressing issues. Therefore, readers should care about the topic as it directly affects their daily lives and the health of the planet.

5. **Is the author's language effective for all his readers, regardless of their opinion?**
- Does his choice of language utilize empathy and respect in pursuit of reaching all readers, giving them a better chance at changing minds?

Suggested Answer: Fletcher's language is likely effective for most readers, regardless of their opinion on the topic. He uses a combination of factual information, logical reasoning, and persuasive language to make his case. While he acknowledges the benefits of plastic in certain contexts, such as medical and food uses, he also emphasizes the negative impacts of plastic pollution on people and the planet. Overall, his language appears to be respectful and empathetic, aiming to engage readers in a constructive dialogue rather than alienate them.

Part II: Class Brainstorming
As a class, brainstorm drinking water related topics that are relevant to the public. Write a list on the board. Alternatively, you can also do this activity with any scientific concept you have learned about this year.

Part III: Student Worksheet
Have students complete the associated worksheet (next page) individually or in small groups.

Part IV: Presentations & Feedback
After students have completed the worksheet and their op-ed, they will present it to the class.

Before anyone shares their op-ed, distribute the "Feedback Sheet for Students" (the final page of this lesson plan) and give the class time to read it. Then, allow time after each op-ed for the class to give feedback.

Student Worksheet: Writing Your Own Op-ed

1. Pick a TOPIC: Using the class-generated list, choose a topic for your op-ed.

2. **STRUCTURE your op-ed**: Begin writing your op-ed by filling in its structure using the template below.

Hook your audience: Write the beginning of your op-ed and focus on creating a "hook" for your audience—grab your reader's attention. Be bold, authentic, and accurate. Consider telling a relevant story (keep it brief) or citing a new study.

Thesis: What is your core argument? Make it clear and concise, aiming for 1-2 sentences.

Argument:
1. First Point:
     a. Evidence
     b. Conclusion
2. Second Point:
     a. Evidence
     b. Conclusion
3. Third Point:
     a. Evidence
     b. Conclusion

Acknowledge Gaps & The Other Side: Address any flaws in your position, as well as any apparent counter arguments.

Conclusion: Reiterate your thesis in an impactful way that your audience will remember.

3. STRENGTHEN your op-ed: Answer the following questions. Based on your answers, add relevant sentences to your op-ed that will make your argument more robust.

Why should the readers trust you?
What makes you more of an authority on the topic you are writing about compared to the general public (your readers)?

Can you back up what you say?
What evidence can you provide, which even those individuals who may disagree with your opinion, will interpret as credible?

<u>What's new about what you are sharing?</u>
Is there something novel in what you are writing about? Is there new information for the public?

<u>Why should your readers care?</u>
How does your topic impact your readers in their daily lives? How are your ideas helpful for your audience?

<u>Is your language effective for all your readers, regardless of their opinion?</u>
Does your choice of language utilize empathy and respect in pursuit of reaching all readers, giving you a better chance at changing minds?

4. COMPLETE your op-ed: Finalize your op-ed, aiming to make it -
- Clear
- Concise
- Organized
- Impactful
- Convincing

Reference: https://www.theopedproject.org/resources

Feedback Sheet for Students

Instructions: Before you and your classmates present your op-eds, read the following. You will use these questions to help give your classmates constructive feedback about their op-ed.

✓ 1. **Clarity and Coherence:**
- Was the main argument clearly stated and easy to understand?
- Did the op-ed flow logically from one point to the next?
- Were the ideas well-organized and connected?

✓ 2. **Use of Evidence:**
- Did the presenter provide sufficient evidence to support their argument?
- Were the sources credible and relevant?
- Did the evidence effectively strengthen the argument?

✓ 3. **Engagement and Persuasiveness:**
- Did the presenter effectively engage the audience and maintain their interest?
- Were persuasive techniques, such as storytelling or compelling language, used effectively?
- Did the presenter anticipate and address potential counterarguments?

✓ 4. **Language and Style:**
- Was the language clear, concise, and appropriate for the intended audience?
- Did the presenter use vocabulary and terminology accurately and effectively?
- Was the tone appropriate for an op-ed (e.g., persuasive but respectful)?

✓ 5. **Overall Impact:**
- What was the most compelling aspect of the op-ed presentation?
- What could be improved to make the presentation more effective?
- Did the op-ed leave a lasting impression or inspire further thought?

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Read an op-ed about a scientific topic

Read the free, open-access article in The Guardian - The world has a chance to end plastic pollution – the petrochemical giants mustn't spoil it - by Steve Fletcher.
https://www.theguardian.com/commentisfree/2024/apr/29/world-plastic-pollution-petrochemical-giants-un-treaty-2015-paris-lobbyists

Discuss the op-ed

Discuss the op-ed by reflecting on and answering the following questions in a class discussion format.

✓1. **Do you think the author was effective at getting his readers to trust him?**
- What makes him more of an authority on the topic of plastics compared to the general public?

✓2. **How did the author back up his point?**
- What evidence did he provide, which even those individuals who may disagree with his opinion, will interpret as credible?

✓3. **What's new about what the author is sharing?**
- Is there any new information for the public?

✓4. **Why should the author's readers care?**
- How does the topic of plastic pollution impact the author's readers in their daily lives? How are the author's ideas helpful for his audience?

✓5. **Is the author's language effective for all his readers, regardless of their opinion?**
- Does his choice of language utilize empathy and respect in pursuit of reaching all readers, giving them a better chance at changing minds?

Student Worksheet: Writing Your Own Op-ed

1. Pick a TOPIC: Using the class-generated list, choose a topic for your op-ed.

2. **STRUCTURE your op-ed**: Begin writing your op-ed by filling in its structure using the template below.

<u>Hook your audience</u>: Write the beginning of your op-ed and focus on creating a "hook" for your audience—grab your reader's attention. Be bold, authentic, and accurate. Consider telling a relevant story (keep it brief) or citing a new study.

<u>Thesis</u>: What is your core argument? Make it clear and concise, aiming for 1-2 sentences.

<u>Argument</u>:
1. First Point:
    a. Evidence
    b. Conclusion
2. Second Point:
    a. Evidence
    b. Conclusion
3. Third Point:
    a. Evidence
    b. Conclusion

<u>Acknowledge Gaps & The Other Side</u>: Address any flaws in your position, as well as any apparent counter arguments.

<u>Conclusion</u>: Reiterate your thesis in an impactful way that your audience will remember.

3. STRENGTHEN your op-ed: Answer the following questions. Based on your answers, add relevant sentences to your op-ed that will make your argument more robust.

<u>Why should the readers trust you?</u>
What makes you more of an authority on the topic you are writing about compared to the general public (your readers)?

<u>Can you back up what you say?</u>
What evidence can you provide, which even those individuals who may disagree with your opinion, will interpret as credible?

<u>What's new about what you are sharing?</u>
Is there something novel in what you are writing about? Is there new information for the public?

<u>Why should your readers care?</u>
How does your topic impact your readers in their daily lives? How are your ideas helpful for your audience?

<u>Is your language effective for all your readers, regardless of their opinion?</u>
Does your choice of language utilize empathy and respect in pursuit of reaching all readers, giving you a better chance at changing minds?

4. COMPLETE your op-ed: Finalize your op-ed, aiming to make it -
- Clear
- Concise
- Organized
- Impactful
- Convincing

5. PRESENT your op-ed: You will present your op-ed to the class by reading it aloud. Imagine the class is the general public and you want to convince them of your position. Avoid simply reading your op-ed. Instead, aim to "present" it in a convincing and impactful way.

Feedback Sheet for Students

Instructions: Before you and your classmates present your op-eds, read the following. You will use these questions to help give your classmates constructive feedback about their op-ed.

✓ 1. **Clarity and Coherence:**
- Was the main argument clearly stated and easy to understand?
- Did the op-ed flow logically from one point to the next?
- Were the ideas well-organized and connected?

✓ 2. **Use of Evidence:**
- Did the presenter provide sufficient evidence to support their argument?
- Were the sources credible and relevant?
- Did the evidence effectively strengthen the argument?

✓ 3. **Engagement and Persuasiveness:**
- Did the presenter effectively engage the audience and maintain their interest?
- Were persuasive techniques, such as storytelling or compelling language, used effectively?
- Did the presenter anticipate and address potential counterarguments?

✓ 4. **Language and Style:**
- Was the language clear, concise, and appropriate for the intended audience?
- Did the presenter use vocabulary and terminology accurately and effectively?
- Was the tone appropriate for an op-ed (e.g., persuasive but respectful)?

✓ 5. **Overall Impact:**
- What was the most compelling aspect of the op-ed presentation?
- What could be improved to make the presentation more effective?
- Did the op-ed leave a lasting impression or inspire further thought?

Science Storytelling: Bridging the Gap Between Knowledge and Audience

Part 1

Objective: To analyze and discuss the effectiveness of storytelling in science communication.

Instructions:

Step 1: Introduction—The Importance of Storytelling in Science
- Begin the class by discussing storytelling in science.
- Ask students questions such as:
  - Do you think there is a place for storytelling in science?
  - In what situations could it be an effective method to share science and why?
  - What potential challenges or drawbacks could there be in using it?
- Give examples of scientists and their discoveries that were popularized by stories, citing examples such as:
  - Alexander Fleming's discovery of penicillin
  - Charles Darwin's theory of evolution
  - Watson and Crick's discovery of the DNA double helix

Step 2: Before starting the video, distribute the questions (on the next page) and give students time to read them.

Step 3: Watch the video "Sharing Science Through Story: Fergus McAuliffe at TEDxDublin."
https://www.youtube.com/watch?v=cXJJvvjSB9c
Play the entire video (~13 minutes), or if you are pressed for time, begin at 7 minutes—when the speaker shares the science of a wood frog through storytelling.

Step 4: After finishing the video, have students answer the questions individually or in small groups.

Step 5: Class Discussion—Facilitate a discussion based on students' responses to the questions, encouraging them to provide examples and insights from the video. Emphasize the importance of storytelling in science communication and its potential to engage and connect with diverse audiences.

Questions—Sharing Science Through Storytelling

1. **Hooking the Audience**:
How does the speaker initially engage his audience when starting his story about the wood frog?

Suggested Answer: The speaker hooks the audience by addressing a universal theme—life and death—to which all people can relate. He poses intriguing questions such as "What if you didn't need a beating heart to be alive?" This creates curiosity and excitement among the listeners. Finally, to explore the questions he asks, the speaker tells the audience they must go on *a journey*, which elicits a sense of anticipation.

"How clear is the line between life and death? Everyone here has something in common—a beating heart that keeps us alive….What if you didn't need a beating heart to be alive? To answer this question, we must go on a journey…"

2. **Core Message & Meaningfulness**:
What is the speaker's central message in telling the story of the wood frog? And why would the audience care about his message?

Suggested Answer: The core message of the speaker's story about the wood frog is to challenge our perception of what it means to be alive. By describing how the wood frog adapts to survive in the cold without a beating heart, the speaker prompts us to reconsider our understanding of life and death.

The theme of life and death is universally relatable, and the question of what it means to be alive resonates with all humans. Therefore, the audience would care about this message as it addresses fundamental aspects of their existence.

3. **Relatability**:
How does the speaker frame his message to make it relatable for his audience?

Suggested Answer: Throughout his story, the speaker draws parallels between humans and the wood frog, making the scientific concepts relatable to the audience's own experiences and understanding.

4. **Accessibility & Engagement Strategies**:
What techniques does the speaker employ to make his talk accessible to his audience? And how does he keep his audience engaged throughout the talk?

Suggested Answer: The speaker uses humor and props, such as the frog and plastic cell models, to simplify complex scientific concepts and keep the audience visually and mentally engaged. Furthermore, the speaker maintains an engaging tone and pace, which helps to immerse the audience in his story.

5. **Effective Ending**:

How does the speaker conclude his story about the wood frog, and what makes this an effective ending?

Suggested Answer: The speaker ends by restating the theme of life and death in a thought-provoking way—"That's how the wood frog blurs the line between life and death. Not by freezing to death. But by freezing to live." This conclusion effectively reinforces his central message and leaves a lasting impact on the audience.

6. **Overcoming Barriers in Science Communication**:

After telling the wood frog story, the speaker talks about overcoming barriers in science communication through storytelling. How does he propose to overcome:

a. The objective language barrier?
Suggested Answer: By using emotional terms and discussing concepts (like life and death) to which all people can relate, while explaining the science.

b. The context barrier?
Suggested Answer: By embedding scientific information within a compelling story.

c. Presenting details in a familiar way?
Suggested Answer: By structuring the presentation like a simple story with a beginning, middle, and end, making it familiar and easy to follow for the audience.

7. **Key for Scientists to Engage the Public**

At the end of his talk, what does the speaker say is key for scientists to do to engage the public?

Suggested Answer: The speaker emphasizes the importance of reconnection between scientists and the public. He suggests that scientists should engage the public through the simple language of storytelling to foster understanding and appreciation for science.

"For scientists to reconnect with the public, we must not be afraid to use the simple language of storytelling. Because simple language does not mean simple thinking. To reconnect, we use the oldest communication tools we have—the voice, the ear, and the Story."
- Fergus McAuliffe

Part 2

Objective: Students will practice sharing science through storytelling, thereby exploring a useful technique to bridge the gap between scientists and their lay audience.

Activity:

1. **Before class**: Create a list of drinking water related topics (or another scientific topic the class has learned about during the year). Students will use these topics to share science through storytelling.

2. **Introduction**: Explain to students that they will be practicing sharing science to a lay audience through storytelling. Emphasize the importance of making scientific concepts accessible and engaging when speaking to the general public.

3. **Group Formation**: Divide students into small groups and assign each a different topic from your list.

4. **Worksheet Completion & Presentation Preparation**: Have groups work on completing the associated worksheet (next page) and crafting their science story. Encourage students to collaborate and brainstorm ideas together.

Emphasize that they should focus on making their story engaging and understandable for a lay audience. Encourage students to prepare visual aids or props to use while telling their story.

Circulate among groups to provide guidance and assistance as needed.

6. **Group Presentations**: Have each group present their science story to the class.

7. **Class Discussion**: Facilitate a discussion with the class about the effectiveness of each group's storytelling. Encourage students to reflect on what made certain stories engaging and how they could improve their storytelling skills.

**Storytelling –
The most powerful way to put ideas into the world?**

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<p style="text-align: center">Worksheet for Students:
Sharing Science with the General Public through Storytelling</p>

1. **Scientific topic**: What scientific concept will your story be about?

2. **Crafting your story**:
- What is the <u>core message</u> you want to convey to your audience?
- Develop a <u>brief outline</u> of your story, including a beginning, middle, and end. Do not include details yet—you will develop your story more after answering the following questions.

3. **Understanding your audience**:
- How much prior knowledge does the audience have about your topic and what is their level of familiarity with science?
- Why would your audience care about your message? Reflect on how your message relates to their lives.
- What aspects of your scientific topic will be most interesting or meaningful to your audience?

4. **Making the science accessible**:
- How can you simplify or clarify the scientific details of your topic for your audience?
- Are there any relevant analogies or metaphors that can be used?

4. **Engaging your audience**:
- Write the beginning of your story, thinking about how you can hook your audience.
- Write the ending of your story, thinking about how to reiterate your core message in an effective, engaging way.
- What techniques can you use throughout your story to keep your audience engaged?

5. **Visual aids or props**: What visual aids or props can you use in your story to make the science more accessible?

6. **Fill in your story & and plan your presentation**:
- Now that you understand your audience, have simplified the science, and created engagement strategies—next, fill in the details of your story as a group.
- Each group member must participate in the presentation. Plan who will share what part of the story.
- Each group member should write down their part of the story so they can familiarize themselves with it before presenting to the class.

7. **Practice and rehearsal**:
- As a group, rehearse your story.
- Aim to become comfortable with your part so that you use your notes minimally during the presentation.

8. **Present your story:** Now you will present your story to the class!

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Science Storytelling: Bridging the Gap Between Knowledge and Audience

Part I: Questions—Sharing Science Through Storytelling

1. **Hooking the Audience**:
How does the speaker initially engage his audience when starting his story about the wood frog?

2. **Core Message & Meaningfulness:**:
What is the speaker's central message in telling the story of the wood frog? And why would the audience care about his message?

3. **Relatability**:
How does the speaker frame his message to make it relatable for his audience?

4. **Accessibility & Engagement Strategies**:
What techniques does the speaker employ to make his talk accessible to his audience? And how does he keep his audience engaged throughout the talk?

5. **Effective Ending**:
How does the speaker conclude his story about the wood frog, and what makes this an effective ending?

6. **Overcoming Barriers in Science Communication**:
After telling the wood frog story, the speaker talks about overcoming barriers in science communication through storytelling. How does he propose to overcome:

a. The objective language barrier?

b. The context barrier?

c. Presenting details in a familiar way?

9. **Key for Scientists to Engage the Public**
At the end of his talk, what does the speaker say is key for scientists to do to engage the public?

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7. **Effective Ending**:
How does the speaker conclude his story about the wood frog, and what makes this an effective ending?

8. **Overcoming Barriers in Science Communication**:
After telling the wood frog story, the speaker talks about overcoming barriers in science communication through storytelling. How does he propose to overcome:

a. The objective language barrier?

b. The context barrier?

c. Presenting details in a familiar way?

9. **Key for Scientists to Engage the Public**
At the end of his talk, what does the speaker say is key for scientists to do to engage the public?

Part II: Practice Sharing Science with the Public through Storytelling

1. Scientific topic: What scientific concept will your story be about?

2. Crafting your story:
What is the core message you want to convey to your audience?
Develop a brief outline of your story, including a beginning, middle, and end. Do not include details yet—you will develop your story more after answering the following questions.

3. Understanding your audience:
How much prior knowledge does the audience have about your topic and what is their level of familiarity with science?
Why would your audience care about your message? Reflect on how your message relates to their lives.
What aspects of your scientific topic will be most interesting or meaningful to your audience?

4. Making the science accessible:
How can you simplify or clarify the scientific details of your topic for your audience?
Are there any relevant analogies or metaphors that can be used?

4. Engaging your audience:
Write the beginning of your story, thinking about how you can hook your audience.
Write the ending of your story, thinking about how to reiterate your core message in an effective, engaging way.
What techniques can you use throughout your story to keep your audience engaged?

5. Visual aids or props: What visual aids or props can you use in your story to make the science more accessible?

6. Fill in your story & and plan your presentation:
Now that you understand your audience, have simplified the science, and created engagement strategies—next, fill in the details of your story as a group.
Each group member must participate in the presentation. Plan who will share what part of the story.
Each group member should write down their part of the story so they can familiarize themselves with it before presenting to the class.

7. Practice and rehearsal:
As a group, rehearse your story.
Aim to become comfortable with your part so that you use your notes minimally during the presentation.

8. Present your story: Now you will present your story to the class!

Video
Production & Editing

PBS Newshour – Student Reporting Labs:
A hands-on youth journalism training program

PBS has created wonderful resources to support young people in building media literacy and reporting skills, ultimately enabling them to create and share data-supported stories about important issues in their local communities and beyond.

StoryMaker is a free, self-directed online curriculum and resource tool for teachers and students. It provides technical instruction on the use of cameras and editing equipment, as well as lessons plans that focus on media literacy and communication skills (i.e., listening, asking questions, writing scripts, public speaking, etc.).

The stories students produce through the Student Reporting Lab curriculum are shared with local media outlets and the national PBS NewsHour.

Visit studentreportinglabs.org/curriculum to get started!

Additionally, visit studentreportinglabs.org/tutorials for short video lessons your students can watch on topics such as lighting, audio, how to make footage pop, and more.

Ready for your students to create and edit videos?

For a free, user-friendly video-editing app, try CapCut.

• Available on Apple and Android devices
• Offers premade templates and customizable features
• Works well for creating video montages for social media
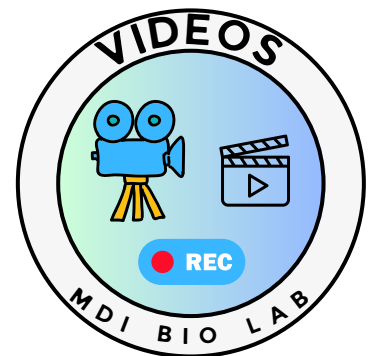
To learn the basics of creating and editing videos in Cap Cut, explore this tutorial.

Video
Planning Sheet

Before you start producing your story, it's important to have a clear description of your MESSAGE, what CHARACTERS it includes, and why it's IMPORTANT. A "pitch" helps you hone your story to its best and essential parts, and keeps you focused during the production process.

HEADLINE MESSAGE:

What is your headline or title? Make sure it's **accurate, clear, and grabs attention**. Write something that would make *you* want to click on that story.

A "Pro Tip" from NewsHour co-anchor, Amna Nawaz, about defining your story: **If you can't describe the story in one sentence, you don't yet know what it is.**

Write your story's headline the box below:

Headline Message:

AUDIENCE:

Understanding your audience is vital in science communication because it allows you to shape your message in a way that maximally engages your audience. In the box on the following page, answer the following questions:

- Who is your audience/ What group of people do you want to reach with your message?
- What necessary background information do you need to include so that your audience fully understands your message?

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Audience:

ONE PARAGRAPH SUMMARY:

Imagine you are explaining your story to someone and only have 30 seconds (also known as the "elevator pitch"). Summarize your story in the box below.

Summary of your Story/Video:

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NEWSWORTHINESS

Why does this story matter? Why tell it now?

Why do you care about this story?

Why will others care about this story?

What will people learn from this story?

How can you make the story surprising in some way?

Why tell this story right NOW?

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MAKING A PLAN

What hooks the audience at the beginning—what will happen in the first 7 seconds that will make a viewer want to see or hear more? What's the tension, mystery, or conflict? What emotions are your characters feeling? What is the ending—how is the story resolved? Use the space below to map out your video plan.

Video Plan:

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CHARACTER(S)

Who are you including in your story? And why are they ideal for your story? What do you want to ask them? Do you have the three "E's": an expert, experience, emotion?

Character's Name and Title:

What role do they play in your story and why are you including them?

Interview questions you want to ask:

Character's Name and Title:

What role do they play in your story and why are you including them?

Interview questions you want to ask:

Character's Name and Title:

What role do they play in your story and why are you including them?

Interview questions you want to ask:

Character's Name and Title:

What role do they play in your story and why are you including them?

Interview questions you want to ask:

If necessary, use the space below to write a script or more detailed plan for your video pitch.

Script/Detailed Plan:

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B-ROLL

What imagery will support the story visually? Learn how to shoot sequences of B-Roll in **this first lesson**. You don't need expensive equipment. **This second lesson** covers how to film B-Roll with your phone.

Make a shot-list of potential B-roll in the table below. Refer to the table on the following page to complete your shot, angle, and movement descriptions.

Shot List

Description	Shot Type	Angle	Move-ment	Location

SHOT SIZE	ANGLE	MOVEMENT
CU (Close-Up)	Eyelevel	Static
MCU (Medium Close-Up)	Low Angle	Pan (rotate up or down)
ECU (Extreme Close-Up)	High Angle	Tilt (rotate up or down)
MS (Medium Shot)	Extreme Low	Handheld
WS (Wide Shot)	Extreme High	Tracking Shot (follows action)
MWS (Medium Wide Shot)	POV	Zoom/ Dolly (in or away)
EWS (Extreme Wide Shot)	Unusual	
OTS (Over The Shoulder)		
Hands		
Depth		

Source: This lesson was modified from the PBS Newshour site.

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Amy Steckel (MPH, MBA) is the Project Coordinator of the NIH SEPA Grant. She has spent the majority of her 25-year career as a Project Manager working with not-for-profits. As the SEPA Project Coordinator, she works with Dr. Disney, helping to coordinate all aspects of this project. She coordinates teachers and scientist partners from 20 schools in Maine and New Hampshire, working with hundreds of students to collect drinking water samples each year.

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Jane Disney (PhD) is the principal investigator on the NIH SEPA grant. She has experience as a classroom teacher and research scientist. As the founder of the Community Environmental Health Laboratory, she has engaged community members, including teachers and students, as citizen scientists in collecting data to address questions about the world around them.

Contact

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Citation

Oliver-Olsen, C., Steckel, A., Dunbar, S., Disney, J. (2024). Science Communication Workbook. https://www.allaboutarsenic.org/sepa/teachers-partners/science-communication-toolkit/

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