PART 1

STEAM Fundamentals

Let's begin by discussing the philosophical concepts and tools that are important to developing a successful STEAM learning environment. The way we frame our STEAM learning can make a huge impact on how we learn. In this section, we will discuss how to lay the groundwork to facilitate great STEAM projects, from approaching the work with the appropriate mindset to using the creative process to boost innovation, as well as how to set the tone with the learning environment.

CHAPTER 1

The STEAM Mindset

Harnessing our own creativity offers a new perspective on the world around us; in the world of education, the impact is limitless.

Creativity

I often hear both students and adults say, "I'm not creative." That fixed mindset isn't just prevalent but also contagious. As someone well-versed in creativity, I always try to challenge that idea and help people develop and strengthen their creative skill set.

If you think about the term "creativity," it's hard to define clearly and can be even more difficult to assess. For our educational purposes, we'll define creativity as bringing a new, unique, and valuable approach to making something or solving a problem.

As an artist, I am very in touch with my ability to be creative because it's a skill I've learned to harness and focus over the years. I often challenge students to produce creative results using the same creativity exercises that have helped me, including making a sculpture with nonart materials, drawing a blind contour (without looking at the paper), or photographing a self-portrait without incorporating their face.

When other educators ask me how they can add more creativity to their teaching, I'll respond with a counterintuitive reply: I suggest they add more limitations. This is one of the easiest ways to inspire creativity, and it can be done in any learning environment. I find that limiting materials and obvious solutions forces my students to find more creative solutions. The same principle of imposing limitations can be used in any of the STEAM disciplines—for example, in projects such as using popsicle sticks to engineer a bridge that can support a heavy weight or estimating the number of windows in a school based on the number in one classroom. This limitation-based approach models challenges in real-world STEAM scenarios, such as how do we build a space station on Mars using only available resources, or what can fit on a spaceship? The idea is simple, but it's an effective way to get learners thinking in new ways. The projects featured in this book all have great potential for bringing out creativity, some through limitations and others through process and design. When you see students making creative choices, point them out to inspire others.

ADMINISTRATOR'S ANGLE

Mark Gura

Any activity in any subject may foster a degree of student creativity. For activities to nourish and grow student creativity predictably and for all students, however, teachers have to plan to produce that outcome. Simply assigning an activity that seems "creative" will not likely produce that result—and that includes arts activities. But well-planned music and visual art, for instance, may engage students in doing things that will result in learning things other than creativity: technique, arts appreciation, arts history, and response to art, to name a few.

PROFESSIONAL PERSPECTIVE

Sophia Georgiou

It's hard to imagine having STEM without the *A* in it. I think creative thinking is needed in all of these fields, and they're all equally important and interconnect with each other.

Art

Creativity is closely related to art, but what is art? It is a necessary question to tackle before proceeding because we don't want to move forward without addressing preconceived ideas that might limit the potential impact of our STEAM learning.

I find many people first associate art with drawing, but it is much more than that. Art comprises various disciplines, but at its core are creative expression and communication. As an artist, I love exploring all its facets, from drawing and painting to theater, music, dance, and design. The definition of art has continued to evolve and expand, but whether it's sharing conceptual ideas, documenting history, or skillful decorating by means of sound, images, words, or movement, it's often all about feeling. Art allows for interaction, and like a language, it can communicate and connect ideas.

The writer and philosopher Elbert Hubbard said in his book *Little Journeys to the Homes of Great Teachers*, "Art is not a thing—it is a way." This may give some insight as to why art pairs well with STEM.

Failure

We often fear and avoid failure. This is understandable because failing has a host of negative associations and might bring forth bad feelings and shame. But we learn more through failure than we do through success. Experiencing failure is especially important in STEAM learning because it deals with difficult questions without easy solutions. To innovate and be creative, failure needs to be embraced. To promote creativity, we need to model and share how failing is a part of the process.

> If you persevere and learn from your failures... they aren't failures, it's learning

We all fail, but not everyone likes to admit their mistakes, and even fewer people are open to sharing them. The problem is that avoiding failure means avoiding progress—it keeps us in a safe and familiar area but at a cost. Some people may judge you for your failure and hold it against you, but to move forward, it's sometimes necessary to be brave and put your work out there anyway. If we own and accept our failures and share them as a teaching tool to connect with others, we can rise above any negativity. Remember, no one can make you feel bad unless you allow them. Early in my career, I was averse to failure, and it insulated me from growth. I was asking students to take risks and learn from failure and share their process, but I was holding back; I made a choice to be more authentic and practice what I preach in its entirety. How can we ask students to embrace and learn from their failures if we don't model it first? We all have fears, and we learn from facing them; it's empowering to take them on and learn to persist through failure.

Resilience

We all face adversity, some more than others, but how we choose to deal with and learn to endure it underscores who and what we are. Nelson Mandela said, "Do not judge me by my success; judge me by how many times I fell down and got back up again," which is true for us all. There are many fantastic examples of how essential this is in STEAM, from Thomas Edison's many attempts and eventual success with his inventions—and modern-day versions such as Boeing's Starliner test flight with the International Space Station and SpaceX's numerous exploding rockets leading to a successful designs—to stories such as that of Katherine Johnson, who became one of the first Black scientists at NASA, and who was made famous in the book and film *Hidden Figures*.

As a veteran teacher, I've had the opportunity to see students (and colleagues) move on into amazing careers and flourish, and one of the consistent elements that connect them is their ability to be resilient. There are many different ways to speak about the idea of resilience in education: I've heard it described as grit, toughness, and emotional fortitude, but regardless of the terminology, there is a direct correlation with how we are motivated, how we perceive and process failure, and how we reflect and move forward with new insights.

STEAM educators can be great role models for resilience because we often start somewhere else in a different role or discipline, and then our work and attitudes lead the way to interdisciplinary STEAM teaching, whether we are teachers, librarians, coaches, administrators, museum educators, or informal educators. In supporting student perseverance, we can share our stories and help give students creative outlets to share theirs. Our role is to teach them the skills and build their creative confidence so they understand a setback is not a failure. According to entrepreneur and author Scott Belsky, "We stand out with our ideas and our ability to express them," which is more important than ever in our emerging technological world, where so much of what we do can be automated or completed with artificial intelligence. Helping students understand and tell their stories empowers them and allows for personal strength and perseverance.

Perseverance also comes into play for educators in terms of setting and maintaining realistic goals and our own wellness. It's necessary to be realistic about what you want to accomplish with each project and school year. Not every project will be a huge success, but being honest and getting feedback about what works and what doesn't allows us to make the necessary changes to help students succeed and learn. We are not always in a supportive environment, so we need to advocate for ourselves and maintain a self-care routine, which we'll explore further in part III.

Curiosity

A core element of the STEAM mindset is being mindful of your curiosities and encouraging it in others. Have you ever been going through your day and found yourself wondering about something you've encountered? We all have those moments, which can be terrific ways to develop new STEAM lessons. It's important to take note of the questions that come up in class, as well as the random curious notions that arise during your day, because they can lead to terrific learning. Questions are a great place to begin a project, especially if you can't find the answers with a simple internet search.

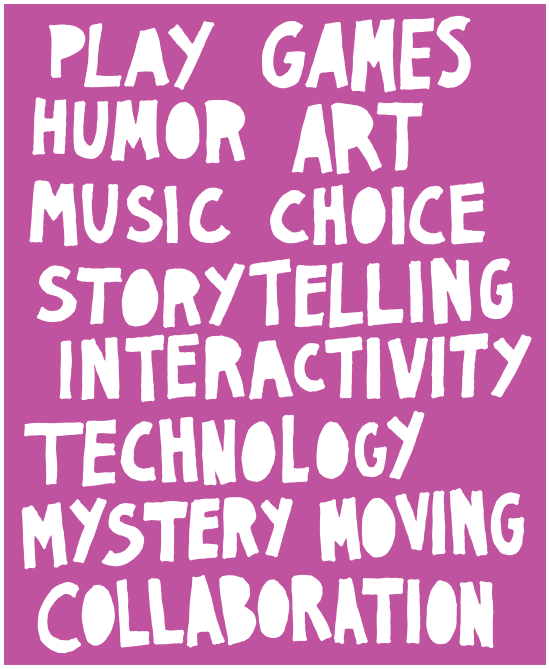
Even seemingly trivial questions can develop into interesting STEAM projects. As an example, I was in the shower shampooing my hair when I had the thought:

"How does shampoo work? I know it's soap, but why are some shampoos more expensive or more effective? What's the science behind it?"

I tried a quick search on the internet and read how detergent molecules bind with the natural oils in our hair. I realized that this might make an interesting question to pose to my students. It's focused on something we all do, generally without thinking too much about it, and it contains an intriguing element of science. If we include the design of a shampoo bottle, the lesson also includes math, art, engineering, and technology. A question such as this can inspire learners to reconsider a part of their daily life, which helps the information to stick.

The framing and implementation of this kind of question will make a big impact on whether it's a success or failure. It's not enough to ask an interesting question; it's all about the audience and their interests or curiosities. This is why giving students an element of choice always benefits both the educator and the students. I find sharing my curiosities and the process I take for inquiring about the answers is a great way to inspire learners to be curious and develop their own questions.

Fun



Fun is one of the best tools that teachers have in their arsenal. Think back to a time when you were learning something and having fun. It may not have been in school, but it's likely that those memories are positive and that you can recall the learning in detail. Don't be afraid of having fun. It sounds like a strange statement to put out there, but I have found a few educators resistant to fun learning out of fear that it might devalue the learning. I've also found some educators fear that they'll be judged if they incorporate fun activities into learning, but have faith that good administrators know when they see impactful, engaging teaching. It's okay to be serious as an educator, but it's also okay to give yourself permission to make learning fun.

Never underestimate the impact fun has on students, especially in a classroom environment. Having fun also frees students to take creative risks and try something new. STEAM can be a terrific hook to make learning more engaging and memorable. When the learning is fun, the information

sticks because it is associated with a positive moment. That makes it more meaningful, and therefore, it becomes more ingrained.

We've established that fun is a great teaching tool, but what's the next step? Knowing your audience is key, because what may seem fun and exciting for one group doesn't necessarily translate to another. Fun, like humor, can be subjective, so it's essential to know and feel out the group you're working with. I understand that some educators might be hesitant or inexperienced in this arena, so let's look at the elements that help make a fun project.

Here are a few elements that make for a fun STEAM lesson:

- play
- art
- humor
- games
- choice
- music
- movement
- interactivity
- collaboration
- storytelling
- mystery
- spontaneity
- technology

Design

We are surrounded by design every day—from the clothes we wear to the spaces we occupy—so even if we're unaware of it, we all have extensive experience in the subject. This is why design is such an important and impactful element of art to incorporate into STEAM learning. Design offers a way to bring a creative aspect of art into any lesson or project and add problem-solving, innovation, and hands-on making, which can be educationally transformative. When working with design in STEAM projects, it helps to know and incorporate the basic elements and principles of design to make the work more functional and successful. These include elements such as line, shape, direction, balance, and proportion, which also relate to math and can help students in every type of making. In the Resources section at the end of this book, I've included descriptions of all the elements and principles of design as well as some tools that I use to teach them. In teaching art, I always point out that it is okay to break the rules as you see fit, but it helps to know and comprehend those rules and principles first.

PROFESSIONAL PERSPECTIVE

Lloyd Nelson

I'm an engineer and an artist, so to me there's the creativity part and the vision part. Architects are people who are strong on the engineering side, but they're not engineers; they're strong on the design side but they need to have that vision to make it attractive.

Design Thinking

My favorite way to demonstrate how design thinking works is to share examples of bad design and examine how they might be designed better. One example uses human movement: Most sidewalks are created in straight geometric grids, so sidewalks meet in perpendicular corners at the intersections where streets cross. But often, pedestrian foot traffic leaves the sidewalks, creating diagonal shortcuts that cut off the corner. The sidewalk design fails because it doesn't incorporate the user; it might be more successful if the user's movements were studied and integrated into the design.

One of the benefits of the design thinking process is that it promotes essential critical thinking and problem-solving skills in students and allows them to incorporate different viewpoints. Using a design thinking perspective and comparing it with a computational thinking point of view (finding solutions through logic, automation, algorithms, and patterns) can also be an interesting comparison for students that offers them context. Teachers who also use computational thinking in their work may notice how it and design thinking interrelate. The beginning of the design-thinking process is similar to the start of the scientific process: It involves observation and exploration of the situation at hand, which leads to understanding. But the first step in design thinking also includes empathy. Rather than simply looking at the situation, product, or problem, the designer imagines

the user's experience, what's involved, and why it matters. It's all about communicating with anyone involved and ensuring all perspectives and motivations are considered before moving forward. Though often overlooked in real-world designs, this empathy phase may be the most important because it allows us to make the design more meaningful and personal.

Many teachers may comprehend the need for empathy because they have experienced both good and bad design. At times, I've been a part of conversations about making changes in my classroom and been able to share my perspectives. Even if the results weren't exactly what I had envisioned, I felt as though I had a voice in the process and was happy with the design changes. Other times, I've been in situations where classroom decisions were made for me without consultation, and sometimes without even notification, and the design changes made it more difficult for me to teach. As educators, we design lessons and learning for students, so just as we like to contribute our own input and perspectives to situations that affect us, we need to include the voices of our students if we want the best results.

The ISTE Student Standards are helpful to implement in design thinking. Standard 1.4, which is focused on students becoming Innovative Designers, states that "students use a variety of technologies within a design process to identify and solve problems by creating new, useful, or imaginative solutions." Standard 1.4c specifically concentrates on prototypes and is particularly useful in the creation process, as it states that "students develop, test and refine prototypes as part of a cyclical design process." This is a great model, mimicking the real world of engineering in which

TEACHER TIP

Kevin McMahon

Design thinking is more than a methodology for problem-solving. It allows the magical "Aha!" moment of creativity to come more readily and to be more useful.

products generally go through alpha and beta testing periods before they're released, an approach I also like to use in class projects.

Computational Thinking

In our digital world, computational thinking (CT) has become a foundational element for computer science, as a systematic approach aids in problem-solving. In life, examples include creating recipes, instructions for making furniture, or online map directions—all examples of CT algorithms. Let's explore the increasingly popular process of computational thinking and how it can be used in conjunction or in contrast with design thinking. This process can benefit students and offer another perspective on the STEAM work you are doing in the classroom. There is also an ISTE Standard focused on this, 1.5 Computational Thinker, which states that "students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions."

Computational thinking is often explained as "thinking like a computer," but that doesn't fully encompass it, as it might be better characterized as "thinking like you're creating a set of instructions to program a computer." The approach relates to computers because it's predicated on logic with a step-by-step focus similar to coding and debugging (fixing errors) with computers. Computational thinking consists of four basic elements: decomposition, pattern recognition, abstraction, and algorithms.

The first step, decomposition, involves breaking down a problem into pieces. This is followed by pattern recognition, which focuses on finding patterns in the pieces. The next step, abstraction, can be difficult for students to understand, but I like to explain it as viewing a problem from different perspectives and focusing on the most integral elements of the problem, putting aside factors that are irrelevant. Then, the final step is incorporating algorithms to guide the way and creating steps to solve the problem.

There are times when one thinking process might be a better fit than others. I lean toward design thinking when creating something for people

because it begins with empathy, and toward computational thinking for more data-driven problems. There are areas where they overlap, though, and it's almost always beneficial to use more than one thinking process to gain different perspectives. There are additional processes, such as systems thinking, which can also be helpful if you are tackling a more complex problem that involves networking.

When introducing these thinking systems to students, it's always helpful to use real-world and classroom examples and applications. A great example of how computational thinking can be implemented is in addressing automobile accidents in cities. While humans are behind the wheel, it's often the design of the roadways and intersections that is a factor, so taking all the accident data and then applying the computational thinking process could help address intersections and roadways with frequent incidents. This is also an area where artificial intelligence can be an enormous help, because it can very quickly sort through the enormous amount of traffic data over the years, speeding up the analysis process.

When teaching students about multiple processes in conjunction, I like to use Netflix as an example because the company has used both computational and design thinking in important and effective ways. Design thinking led to decisions such as the switch from mailing DVDs to streaming and how a series automatically starts the next episode and cuts out the introduction to make it easier for viewers. Computational thinking led to features such as the different ways Netflix suggests what you would like to watch based on previous viewings and what shows and movies they buy based on their viewership. There are great uses for these approaches in classroom problem-solving as well, from seat design and curriculum progression to class scheduling and suggested projects and classes for students.

Inquiry and Project-Based Learning

Approaching STEAM with creativity and curiosity engages students and helps ignite authentic learning. While both concepts begin with questions or challenges, inquiry-based learning (IBL) is focused on discovering an answer, while project-based learning (PBL) is about exploring the concept

and creating to arrive at an answer. The philosophy is similar in both concepts, but they require different materials and resources. These concepts both allow learners to guide their learning, which is more active and effective. The role of the educator shifts: The traditional emphasis on facts and memorization is replaced with discussion and self-motivated exploration. This type of learning can help foster curiosity while offering students the chance to take ownership of their learning, but it requires solid modeling. The educator needs to embrace their own curiosity and authentically share their enthusiasm and love of learning for it to be successful. It requires educators to act more like guides than traditional teachers. Students learn greater self-reliance and independence as they follow their educational path while collaborating, communicating, and learning from other students.

Inquiry-based learning is terrific in building self-direction, but it also offers an opportunity to teach students about data and how to identify quality data, organize it, and summarize it effectively. Project-based learning can be more creative and hands-on and lead students to a deeper understanding of subjects. These approaches tend to be less structured and can appear like chaos from the outside, so it becomes important for learners to document and share their learning and check in on their progress regularly. The ISTE Standard 1.3 Knowledge Constructor has a subsection, 1.3d Explore Real-World Issues, which can be helpful in this regard as it states, "Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions."

PROFESSIONAL PERSPECTIVE

Lloyd Nelson

My biggest advice is to keep an open mind. You want to have the ability to keep that learning principle going throughout your life because this opens up opportunities you never knew were going to be around.

Standards and Principles

When we teach STEAM subjects, it's important to align the learning we do with the various national and state standards in our disciplines. There are national and state standards, as well as other principles that educators may want to align their work to, such as Computer Science and Digital Fluency standards, elements of digital citizenship, CAST's UDL guidelines, or CASEL's Fundamentals of SEL. This alignment has become easier with the aid of collaborative communities and artificial intelligence tools, but the core should always center on meaningful student learning. Regardless of the discipline, the ISTE Standards are key in making sure the most important learning and teaching benchmarks are reached. The ISTE Standards are a way to ensure the learning reflects appropriate digital age technology skills and practices and that the learners are provided with fair, safe, and meaningful instruction.

The ISTE Standards have multiple sections—for students, educators, education leaders, coaches, and computer science educators—but in this book, we will focus on alignment with the Student and Educator Standards, both of which can be found online at iste.org/standards. I find that most great lessons naturally align with the ISTE Standards, but it's helpful to refer to the ISTE Standards to confirm that all the essential elements are being covered.

The STEAM projects featured in this book have been created with the ISTE Standards in mind; to make it clear how each project addresses the ISTE Standards, there is an ISTE Standards Project Mapping Guide in the back of the book. You can use this to help you select projects, or you can use it for inspiration as you design your own lessons using the ISTE Standards.

The ASCD Transformational Learning Principles are also useful in implementing meaningful STEAM learning and offer a helpful framework for engaging students and enhancing projects. The principles are focused on empowering students, sparking curiosity, and creating a sense of belonging, so they fit well with the student-centered approach in *STEAM Power* because they encourage educators to create engaging, relevant, and collaborative learning environments. Teachers can effectively infuse these

principles by fostering a culture of inquiry in which students are empowered to explore real-world problems through interdisciplinary projects. This not only enhances critical thinking and creativity but also promotes social-emotional learning by connecting students to their communities. When we as educators integrate technology as a tool for collaboration and creativity, it allows for a more personalized learning experience and supports each student's unique interests and strengths. We don't know exactly what the future holds, but by embracing ASCD's Transformational Learning Principles within STEAM learning, educators can help cultivate a generation of innovative thinkers who are prepared to tackle complex challenges in our ever-evolving world.

PART II

STEAM Projects and Technologies

In the following chapters, I'll share some of my favorite STEAM projects that I've used with students. I organized this section based on the technology used in the projects. Each chapter contains two projects, but additional projects and resources are available on my website, which you can access through the resource section.

CHAPTER 4

Film and Video

I have a dream that after I retire from teaching, I'll have a second career in film and television. That's how much I love this subject.

We are all surrounded by media, so working with film, video, and animation offers enormous potential for STEAM learning. In this chapter, we'll explore creating work for the various forms of video and digital screens using traditional methods, apps, and emerging digital tools. One of the benefits of working with film, video, and animation is that the work created can be easily shared and can teach others. There are many platforms for sharing the work, from student film festivals to the internet. The medium also is inherently collaborative, so students can work together to create larger works. Another plus is that in our culture, we consume an enormous amount of the many forms of digital media that encompass film and video; students tend to be knowledgeable about the media and excited to learn the process and share the work. In my experience, this topic tends to unite students as they work together, and it plays to students' strengths because there are so many different roles involved.

I've seen several students so excited by working with film and video that it changed their lives and gave them a new sense of purpose. Students who were at one point underperforming in school pull it together, thanks to working in the media. Not only has it helped some students graduate, but it's also become a career for former students who work in a vast range of occupations within the film industry.

This medium has been evolving ever since it began in the late 1800s, and it continues to evolve today. Giving some historical perspective can be beneficial. The film industry used to be a closed profession that required a good amount of training, but technology has democratized the medium so that anyone, anywhere can create a great product. The tools are accessible, and the learning curve is quick, so it's often amazing to see what young learners can create once they learn the basics. Technology has made a huge impact on the world of film and video, and what once required days in a studio with a great deal of skill can now be done in minutes on a mobile device.

CREATIVE CHALLENGE

Write and Film a Four-Frame Story

I've always loved micro-fiction, and bringing it into the classroom is a fantastic creative challenge for students. The challenge is to write a four-frame story and then visualize it using some type of photography, film, or animation tool. I like to make it more specific and offer students a genre: In my example (linked below), I chose a long-distance romance as the genre, but it could be a sci-fi thriller, a big-budget action-adventure, or anything that interests the students. This project can incorporate different educational technology tools: Initially, I used Adobe Spark, now known as Adobe Express, but it can be done in a plethora of ways. Here's a link to the video instructions: tinyurl.com/m3s3uk24

Thanks to these new technologies, the following two projects are adaptable and can fit any educational setting. Don't be deterred if you're working with a small budget or trying to create in limited circumstances: It just takes one smartphone or tablet to create. When working with film and video, it's important to consider the final product and how it might be shared; there are so many possibilities that it takes planning. Because the media is so impactful, I suggest that students create work that can help teach others in the future and support STEAM education in general. I often create smaller projects that can combine into a larger collaborative endeavor that connects with the school, community, or the larger education community. This is a great way to explore larger, more global ideas such as the environment, sustainable living, or whatever topics are prevalent in your community.

PROJECT

Video Poem

TEACHER TIP

Michele Haiken

Poetry is about saying more with less. Word choice is key to effectively communicate a specific message. Sharing lots of models of poetry with students helps them see how poets play with format, emphasis, and word choice to create meaning.

We'll begin with one of my favorite projects: creating a video poem. I love the creativity in this project because it can pair STEAM with English, creative writing, or foreign languages. The poem that inspires the video can be an original written by the students or it can be a poem or micro-story by another author. If you ask students to write an original poem, it allows them to do some creative writing, and I've also shared some writing prompts in the Resources section. Even if you don't have students use their own work for the video, it's always nice to have them do some writing so they connect better with the material.

The source material doesn't need to be a poem at all, as I've used the same premise with quotes from important STEAM icons. Whatever text element you use, it should be brief. The students will need to interpret the text visually. Depending on their focus, interests, and skill level, they can choose whether to include the words or show a visual interpretation of the poem. The final product can range from kinetic typography to a narrative art film.

I've found that when students are asked to creatively interpret learning from disciplines such as science, math, or engineering in the form of fine art, poems, or music, it helps them retain the information. This approach is especially successful with special education students and learners who are more visual, auditory, or physical.

One of the great things about this lesson is that the resulting video poems are perfect to share on social media. I like to share them to celebrate National Poetry Month in April. A benefit of sharing during an event such as this is that while celebrating the event with excellent student work, it's also a way to promote both literacy and technology in education.

This version of the lesson is focused on STEAM, but it's versatile, so you can adapt it to whatever focus you want.

Here are the lesson basics:

Overview: Students will write a short original poem or take a poem by another author on a science theme. Possible topics include natural phenomena such as waves, seasons, the colors in the sky, or the distance to the sun. They will then add sound (music, narration, or both) and create visuals to pair with the writing as a video poem. Finally, they will design and construct a method of showing the video in a gallery-type setting by creating an installation with video monitors. This isn't necessary if there isn't time, but it does implement all the STEAM disciplines, so I'll include it as a project extension. The video poems created can then be shared during National Poetry Month to support technology, art, and literacy. The lesson is centered on student choice, and technology options are outlined with examples. It is a cross-curricular lesson, so it would be great for art, technology, literature, writing, foreign language, or English classes.

Timeline: 45 minutes to 2 hours

Age/Skill Level: This project can be modified to fit all ages and skill levels.

Extended Version: Once the video poetry is completed, you can incorporate all the STEAM disciplines by designing and constructing a video installation. This can be achieved by upcycling older televisions and creating a sculptural work that encases them. The work of artist Nam June Paik is a great example as he combined multiple old televisions and monitors for an impact.

Materials:

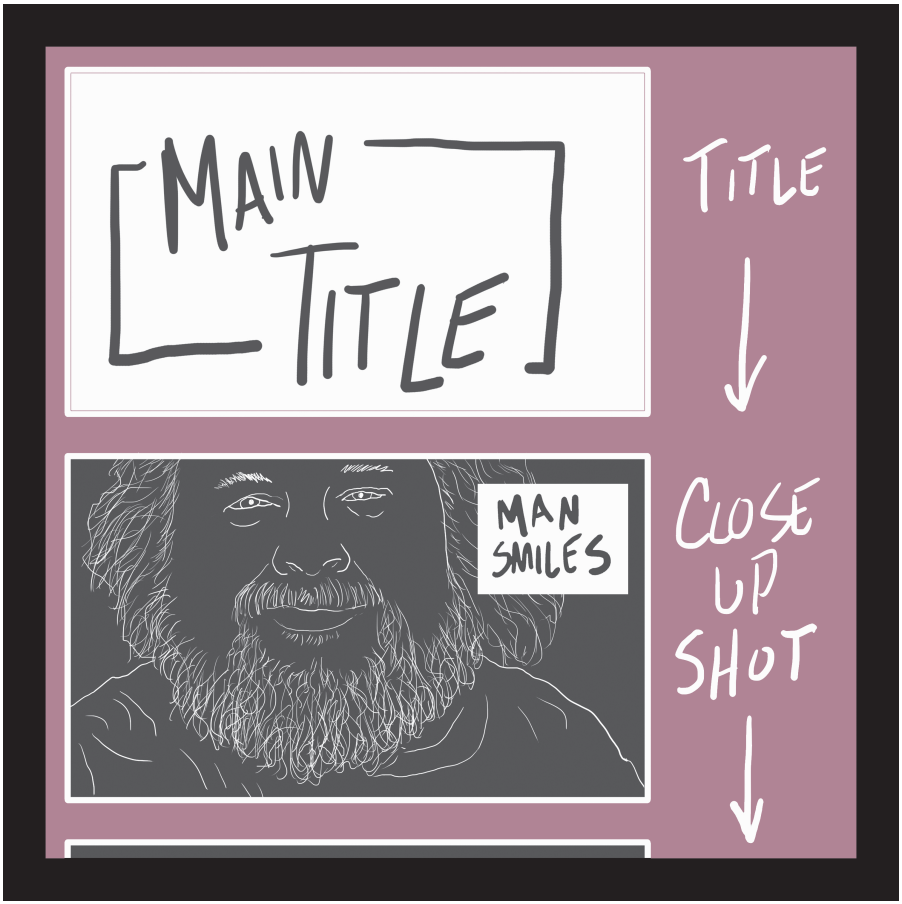
- video camera or smartphone with video capabilities
- computers or smartphones with video editing software (Adobe Premiere Pro, Apple Final Cut Pro X, etc.)

Instructions:

1. Begin with a warm-up writing activity to get the students in the right mindset for writing poetry. In the Resources section at the end of this book, I've included a link to a list of prompts, or you can make your own. Allow students to write for at least five minutes before starting the activity. Some styles of poetry incorporate mathematics, such as haiku, which is constructed of three lines: the first with five syllables, the second with seven syllables, and the third with five syllables. (I find this structure is easier for students to begin with because it takes the focus off the content and puts it on the structure.) During the warm-up, I include a range of writing forms to make it more accessible to everyone.
2. Ask the students to create or find a poem or quote they can use for their video poem. Either they can write a poem about the chosen topic (science, nature, STEAM, and so on), or they can choose a short piece of writing by someone else.
3. Next, the students will create images to support the writing by taking photographs or shooting video clips that they can collage together. This can be done with video cameras or smartphones, but make sure the images are all the same size and orientation—either landscape (horizontal) or portrait (vertical).
4. Import the photos or videos into a video editor on a computer (Adobe Premiere, Final Cut, etc.) or smartphone (Splice, Filmmaker Pro, etc.), then collage and edit the photos and videos into a sequence.
5. Add the text from the poem either with words on screen, audio narration, or both.
6. Share and critique the work.

PROJECT

Educational Public Service Announcement



This project can have a big impact on the community if it is successful, and it's also a great lesson in collaboration. The project is to write, film, and edit a public service announcement based on a STEAM issue in your community. Public service announcements tend to be short, usually 30 seconds, and because this project is collaborative, it can suit almost any skill level as long as someone in the group has the technical knowledge to film and edit.

The best part of the project is that it is a terrific opportunity to research a problem in the community, brainstorm solutions, and collaborate to create a project that has an important message. It's an excellent way to differentiate instruction and have students work together, playing to their strengths and learning about collaboration. In the past, I've created PSAs that have aired in my school, and I've had some air on television and in local film festivals, so it's also a great opportunity to pass on the learning. Depending on how the product turns out, there may be multiple ways to reach a wider audience with an important message, but it's always a great opportunity for STEAM learning.

This is also a project where you can create a great deal with few supplies, such as a smartphone, a green screen, and an app. Here's the project outline:

Overview: Learners collaborate to write, film, and edit a public service announcement (PSA) focused on a STEAM-based issue in the local community. Students identify the issue and suggest solutions that they can present to viewers in a short timeframe (usually 30 seconds to 2 minutes).

Timeline: 2 to 6 hours

Age/Skill Level: This project can be modified for any age and skill level.

Extended Version: Once the PSA is created, try to get it viewed by the public to create change. Learners can brainstorm ideas for sharing the PSA and approach local television about getting it aired. They can then follow up by organizing some group activities.

Materials:

- paper and writing utensils or computers for writing and research
- cameras or smartphones/devices with cameras
- computers or smartphones with digital video editing/compositing software or apps

Instructions:

1. Begin by researching STEAM issues that exist in your community, then choose a topic to focus on for your public service announcement.
2. Research and brainstorm possible solutions for the issue you chose. You may want to divide the learners into different groups to approach the topic from different perspectives.
3. Discuss ways to communicate the issue clearly to an audience in a short video. At this point in the process, it's helpful to show good examples. You can find some of my favorites in the Resources section.
4. Create a storyboard and draw out the most important frames of the video, accompanied by text explanations. (If you're unfamiliar with storyboards, there are some examples in the Resources section, but it's much like a very simple comic book.)
5. Once the concept is complete, divide the learners into different groups to collaborate on filming. There may need to be camera operators, directors, actors, lighting engineers, sound people, etc. I model the crew structure on those found in the film and television industry and follow the same process you might find on a professional set.
6. Film the public service announcement. It's helpful to film a few takes of each scene so there are options to choose from during editing.
7. Divide students into postproduction groups to work on editing the film, doing any special effects that might be necessary, editing the sound, and creating any necessary graphics or titles.
8. Once the groups have completed their work, view a rough cut of the public service announcement with all the learners. Discuss it and give feedback.
9. After the critique, make any changes that might be necessary.
10. Share the film and have the students organize an action campaign to get the word out about the issue and promote solutions.

Video, animation, and media arts have become the dominant art forms of our time, so there are many lesson opportunities with these media. Check out the resource section for more project ideas, such as short documentaries, sticky note animations, kinetic typography, animated lessons, pixelations, and 8-bit animations.

ISTE STANDARDS PROJECT MAPPING GUIDE

PROJECT	ISTE Standards for Students
Chapter 3: Classic Construction: Upcycled Self-Watering Planter	**4. Innovative Designer** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. a. Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
Chapter 3: Classic Construction: Cardboard Chair Design	**4. Innovative Designer** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. c. Students develop, test and refine prototypes as part of a cyclical design process.
Chapter 4: Film and Video: Video Poem	**1. Empowered Learner** Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. c. Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
Chapter 4: Film and Video: Educational Public Service Announcement	**1. Empowered Learner** Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. d. Students publish or present content that customizes the message and medium for their intended audiences.
Chapter 5: Animation: Animation Games	**1. Empowered Learner** Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. c. Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.

PROJECT	ISTE Standards for Students
Chapter 5: Animation: Collaborative Animation	**1. Empowered Learner** Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. a. Students use digital tools to connect with peers from a variety of backgrounds recognizing diverse viewpoints and broadening mutual understanding.
Chapter 6: Digital Photography: Cyanotype	**1. Empowered Learner** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. b. Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
Chapter 6: Digital Photography: Light Painting	**1. Empowered Learner** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. c. Students develop, test and refine prototypes as part of a cyclical design process.
Chapter 7: Web Design, Social Media, and Podcasting: STEAM Trading Cards	**3. Knowledge Constructor** Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. c. Students curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
Chapter 7: Web Design, Social Media, and Podcasting: STEAM Podcast Interview	**1. Empowered Learner** Students recognize the responsibilities and opportunities for contributing to their digital communities. a. Students manage their digital identity and understand the lasting impact of their online behaviors on themselves and others and make safe, legal and ethical decisions in the digital world.
Chapter 8: Coding: Code Art	**1. Empowered Learner** Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. d. Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.
Chapter 8: Coding: Video Games	**5. Computational Thinker** Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. c. Students break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.

PROJECT	ISTE Standards for Students
Chapter 9: Digital Drawing and Design: Digital Self-Portrait	**6. Creative Communicator** Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. a. Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
Chapter 9: Digital Drawing and Design: STEAM Infographics	**1. Empowered Learner** Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. a. Students choose the appropriate platforms and digital tools for meeting the desired objectives of their creation or communication.
Chapter 10: 3D Design, Printing, and Construction: 3D Architecture	**7. Global Collaborator** Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. d. Students explore local and global issues and use collaborative technologies to work with others to investigate solutions.
Chapter 10: 3D Design, Printing, and Construction: 3D Fashion Design	**4. Innovative Designer** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. b. Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
Chapter 11: Robotics and Drones: Random Drawing Robot	**4. Innovative Designer** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. d. Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.
Chapter 11: Robotics and Drones: Drone Photography	**1. Empowered Learner** Students recognize the responsibilities and opportunities for contributing to their digital communities. a. Students manage their digital identity and understand the lasting impact of their online behaviors on themselves and others and make safe, legal and ethical decisions in the digital world.
Chapter 12: Augmented and Virtual Reality: Augmented Reality Career Exploration	**1. Empowered Learner** Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. a. Students articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.

PROJECT	ISTE Standards for Students
Chapter 12: Augmented and Virtual Reality: Virtual Reality Drawing	**1. Empowered Learner** Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. d. Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.
Chapter 13: Artifical Intelligence: Creative AI	**1. Empowered Learner** Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. d. Students understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.
Chapter 13: Artifical Intelligence: The AI Classroom	**1. Empowered Learner** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. a. Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
Chapter 14: Connections: Interview with a STEAM Professional	**1. Empowered Learner** Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. b. Students build networks and customize their learning environments in ways that support the learning process.
Chapter 15: Collaboration: STEAM Icebreaking	**1. Empowered Learner** Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. b. Students build networks and customize their learning environments in ways that support the learning process.
Chapter 16: Authenticity: Classroom Redesign	**1. Empowered Learner** Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. a. Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
Chapter 17: Sustainability: Enviornmental Murals	**1. Empowered Learner** Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. b. Students use collaborative technologies to work with others, including peers, experts and community members, to examine issues and problems from multiple viewpoints.