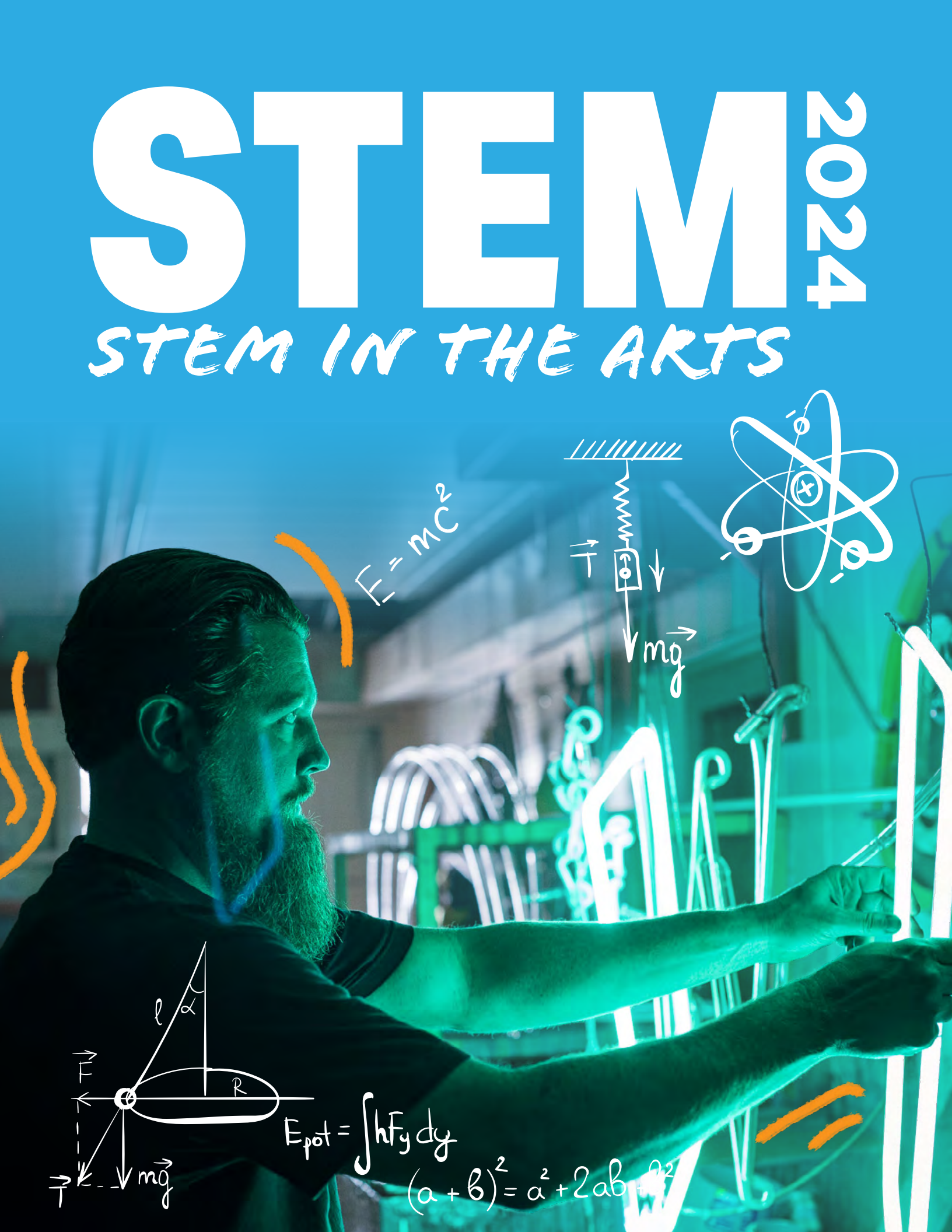
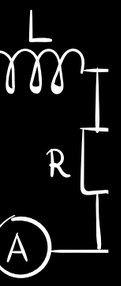
# STEM 2024

## STEM IN THE ARTS



# EDITOR'S LETTER



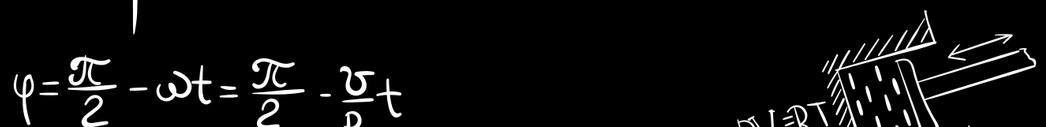

**The acronym STEM did not exist when I was a kid, but obviously science, technology, engineering, and math were part of my educational experience.**

I knew from an early age that I was going to pursue a career in STEM and I was convinced that I was going to be an archaeologist. Science fairs provided the opportunity to explore everything from bugs to trees to the brain. I even forced my brother to play school as I gave being a science teacher a try (trust me, the sibling torture was a give and take). In the grown-up part of my life I have been able to use my love of STEM in so many ways from biomedical research in cancer to education and even state policy. I know that there is considerable creativity in STEM, and innovation is at the heart of STEM pursuits, but I never really saw myself as an "artsy" person.

Then something really cool happened for me. I took a chance and tried something that I have always thought looked fun. I decided to take a welding class. I fell in love with it and have been welding for about four years. The ability to use my knowledge of STEM to create sculptures has been amazing. I have developed an appreciation for the importance of the design process, as well as learning new areas of STEM. I also learned something about myself. There has been a part of my brain just waiting to be used for art.

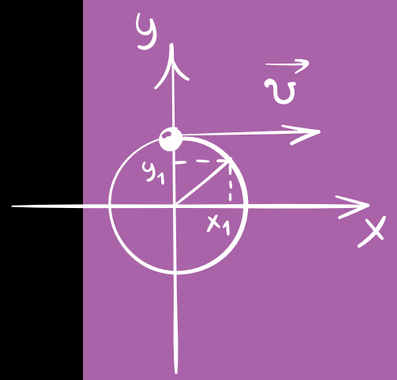
I have seen students trying to figure how to balance their love of STEM with other interests and passions. My advice to them has always been that they are lucky because STEM overlaps with so many other education and career paths. I hope that you enjoy the stories in our magazine that highlight how STEM is critical to many facets of art, music, and dance.

***Dr. Tami Goetz, Director***
***Utah STEM Action Center***




# TABLE OF CONTENTS







STEM ACTION CENTER
U · T · A · H

# ENGINEERING THE PERFECT CHAIR

**The fusion of art and design within STEM transforms these disciplines into STEAM, emphasizing the essential role that creativity and aesthetics play alongside technical innovation.**

One prominent figure who exemplifies this integration is architect Frank Gehry, whose cardboard furniture designs in the 1970s challenged traditional perceptions of materiality in both art and design. Today, the traditional Cardboard Chair Project, rooted in this spirit, offers students a similar opportunity to explore engineering principles while embracing creativity and aesthetics.

## THE PROJECT: A MODERN HOMAGE TO GEHRY

The Cardboard Chair Project implemented in many higher education institutions, embodies many of the principles behind Gehry's innovative work with cardboard. At Snow College, students are specifically tasked with constructing a functional and aesthetically pleasing chair using only four 4'x8' sheets of corrugated cardboard and craft glue. This project emphasizes the duality of form and function, pushing students to create a chair that can support 150 lbs or their own body weight, while remaining visually striking.

Students are encouraged to design beyond replication, avoiding simply copying existing chairs and instead crafting something unique, functional and soundly engineered.

## THE DESIGN PROCESS: FROM SKETCHES TO STRUCTURAL ART

The creative process behind the cardboard chair project begins with extensive thumbnail sketches, where students produce 30 to 50 different design ideas. This step is crucial in promoting lateral thinking.

Brad Taggart, professor of visual art at Snow College, challenges his students to experiment with different textures, thicknesses, and layers of cardboard to create a material that is not only structurally sound but also visually compelling. This same spirit of experimentation is at the heart of STEAM — where students must interact with the material, pushing it to its limits and learning how it behaves under various conditions. As they sketch and refine their ideas, students come to understand cardboard's flexibility, strength, and potential for sculptural beauty.

## MATERIAL EXPERIMENTATION

The success of the cardboard chair project hinges on material experimentation. Students must familiarize themselves with the properties of corrugated cardboard, testing its limits through bending, folding and layering.

In the same vein, students in this project are challenged to think critically about how their design choices impact both the functionality and appearance of their chairs. Will they use flat planes or curved surfaces? Will the cardboard be layered for strength or cut to create patterns? Each choice contributes not only to the chair's stability but also to its visual appeal.

## PROTOTYPING: FROM SKETCHES TO MAQUETTES

Once students refine their design concepts, they build maquettes, or small-scale models, from

pizza boxes or other materials. The maquettes allow students to test the proportions, angles, and structure of their chairs on a smaller scale before committing to full-scale production.

> IN THE END, STUDENTS COME AWAY WITH A DEEPER UNDERSTANDING OF HOW ART AND ENGINEERING CAN WORK TOGETHER TO CREATE SOMETHING THAT IS NOT ONLY USEFUL BUT ALSO A FORM OF CREATIVE EXPRESSION.

In the art world, Gehry's models became objects of fascination in their own right, often considered works of art even before they were scaled up to full-size structures. The use of maquettes in the cardboard chair project introduces students to this aspect of artistic design: the idea that preliminary models are not just stepping stones but integral parts of the creative process. It's an iterative process where function and form constantly influence each other, ensuring that the final product balances strength and beauty.

### PRODUCTION AND THE CHALLENGES OF FULL-SCALE DESIGN

The process to full-scale production requires meticulous planning and problem-solving; students must carefully execute their designs under tight material constraints. Creating a chair that not only holds significant weight but also looks visually compelling is no small feat. Students must set a production schedule that allows time for problem-solving and adjustments.

Throughout this process, the STEAM methodology is evident: engineering and technical design are paired with aesthetic considerations.

### FINAL EVALUATION: AESTHETIC AND FUNCTIONAL SUCCESS

In the final evaluation phase, students assess their work, reflecting on the successes and shortcomings of their designs. In the end, students come away with a deeper understanding of how art and engineering can work together to create something that is not only useful but also a form of creative expression.

This project pushes students to think beyond utility and embrace the full potential of design. In the process, they learn that engineering and creativity are not opposing forces but complementary ones. Like Gehry's iconic cardboard chairs, the students' designs are symbolic of how STEAM can unlock the creative potential of human ingenuity, transforming simple materials into works of functional art.

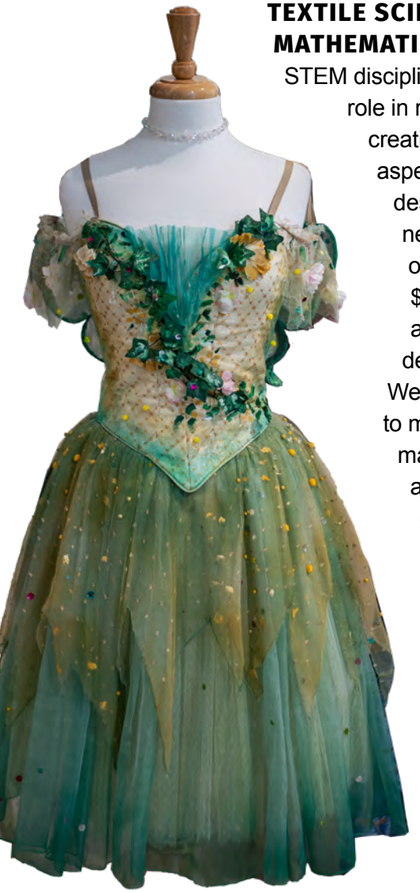
***For more information on the Visual Art Program, visit Snow.edu/academics/fineart/art/***

# THE ROLE OF STEM IN BALLET WEST'S 1,000 COSTUMES

*By Dana Rimington, Director of Communications and Publications for Ballet West*

**Ballet West's Costume and Wardrobe departments have been underway for months preparing more than 1,000 costumes that will be worn by company dancers for the upcoming season.**

**THIS YEAR MARKS THE 80TH ANNIVERSARY OF AMERICA'S FIRST NUTCRACKER, WHICH INCLUDES APPROXIMATELY 350 COSTUMES, INCLUDING THE INTRICATE TUTU OF THE FAMOUS SUGAR PLUM FAIRY.**



## TEXTILE SCIENCE AND MATHEMATICS

STEM disciplines play a pivotal role in redefining the creative and technical aspects of fashion design. Aside from nearly 600 hours of build time and $56,000 in fabric and labor, costume designers at Ballet West often resort to mathematics and material science to assemble intricate costumes.

"Every day, I'm literally converting numbers into a two-dimensional flat pattern that will become a three-dimensional garment. Building costumes is all math, from beginning to end," said Ballet West Director of Costumes Jason Hadley.

Each Sugar Plum Fairy tutu has 10 layers of netting, all individually hand-dyed in three different shades of pink, not to mention more than 8,000 crystals and rhinestones added to their bodices and skirts. For the delicate silk material required in one of the Utah premieres this season, "Pictures at an Exhibition," the fabric is so fragile that it requires meticulous handling and precise dyeing to achieve the exact shade envisioned by the designer. It is a laborious process. In order to achieve the desired results, the costume makers must know the fundamentals of textile science, color science, and meticulous measuring. Understanding the properties of different textiles — such as stretch, weight, and resistance — requires knowledge of materials science. Additionally, ratios and proportions are important to the clothing-making process to affect the visual appeal of a garment. Designers draw geometric shapes, lines, and angles in their outlines while ensuring symmetry or intentionally avoiding it. The study of these patterns and their sizes, as well as how they relate to one another in space, is a fundamental branch of math.

## PROBLEM-SOLVING WITHIN THE ART OF DESIGN

STEM and design-based thinking go hand in hand within the means of adapting an analytical problem-solving mindset. Costume design is a complex, multifaceted problem-solving activity led by a process of trial and error. When a costumer purchases fabric, they have to determine how much is needed to build a certain number of costumes. When Hadley purchased fabric to build the costumes for Ballet West's upcoming production of "Pictures at an Exhibition," he thought the fabric would fit one direction on the pattern. However, when the fabric arrived, the pattern needed to be turned a different direction, which changed the yardage by 80 inches.

"I create mockups from the fashion designs, then start from scratch, literally draping fabric on a body form to see what it looks like, then cutting away, or adding more fabric," Hadley said. "It's all about taking a two-dimensional design on paper into a three-dimensional design. I have to do the math, which has taken a lot of time and experience to learn."



*IN ORDER TO ACHIEVE THE DESIRED RESULTS, THE COSTUME MAKERS MUST KNOW THE FUNDAMENTALS OF TEXTILE SCIENCE, COLOR SCIENCE, AND METICULOUS MEASURING. UNDERSTANDING THE PROPERTIES OF DIFFERENT TEXTILES — SUCH AS STRETCH, WEIGHT, AND RESISTANCE — REQUIRES KNOWLEDGE OF MATERIALS SCIENCE.*

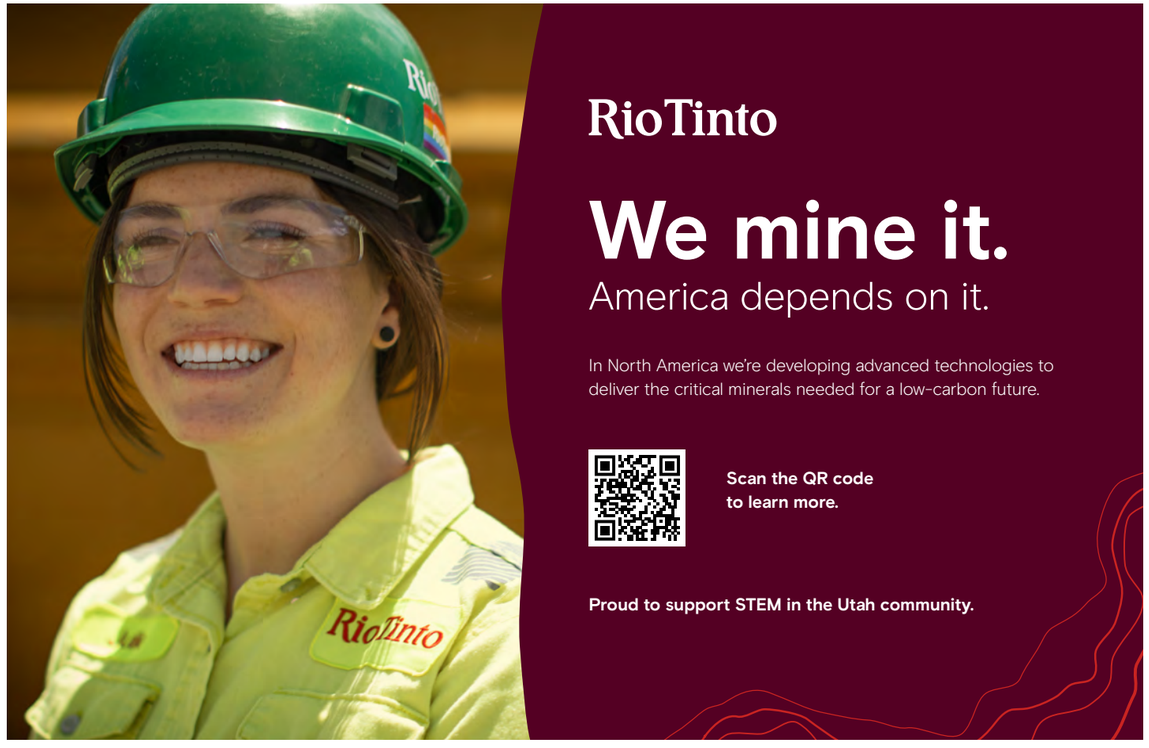
Costume Shop Manager Cindy Farrimond learned early in her career with Ballet West how important the tiniest details can be for costumes when a designer kept adding more sequins to the Snow Queen costume in "The Nutcracker." "Sure enough, when the curtain went up and Snow was there, it was just amazing. All of those sequins were needed to bring in the effect of the beautiful shimmer of the snow costumes. I didn't quite understand before then that everything you add on has an effect."

In such instances when materials fall short or patterns don't line up, Hadley's team uses creative problem solving. Sometimes patterns can be adjusted and folded in certain directions, called dovetailing, where patterns are laid on top of each other to conserve fabric.
In other situations, when a costume needs to fit several dancers of varying sizes, the costume team readjusts the pattern, which can get tricky when the costumes have to look the same to the audience, but the dancers have different bodies. "The lines on the body have to be the same for every person, so if you have a dancer with a 23-inch waist and the other dancer has a 26-inch waist, you can't just make it all up in the back because then the lines would go in a different direction," Hadley said. "We have to problem-solve so that, for instance, the side seam matches perfectly on both dancer's right side, and proportionately, it will be different on every person."

Whether lavish or simple, each costume tells a story of dedication and passion.

***Visit BalletWest.org for more information.***

Meta





## Educator Support

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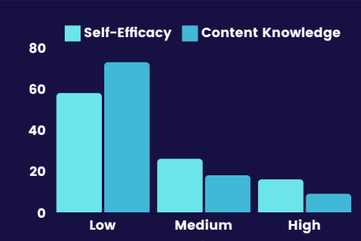
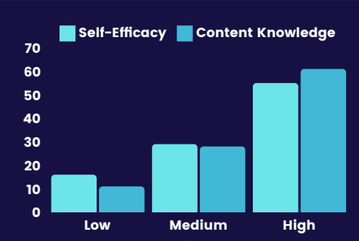
## Impact Study Findings

**83%**
of students show an increase in STEM content knowledge

**93%**
of students show an increase in improved behavior, STEM engagement, and healthy eating habits

2022-2023 School Year: teachers reported a significant increase in growth over the course of the year, rating themselves highly confident and knowledgeable in their ability to teach hydroponics with support and coaching provided by Green Our Planet.



# TEACHING MATHEMATICS THROUGH MOVEMENT

*By Erik Stern and Rachel Bachman*

## QUICKLY RESPOND TO THESE TWO QUESTIONS:

**When you are working on developing a physical skill — like shooting a basketball, cooking, or playing the piano — do you expect that sometimes you'll make mistakes? Or do you think you'll get it right away, that the ball will go through the hoop all the time?**

**When you are working on a math problem, how do you feel about mistakes? Do you feel that mistakes are just part of the process, or is it a sign of not being good at it?**



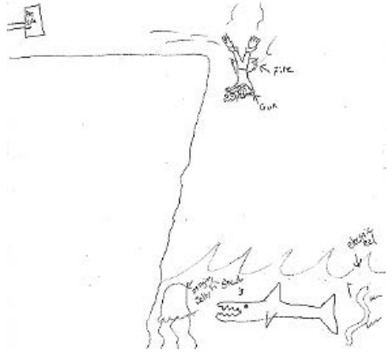
**IN ALL FIELDS, LEARNING INVOLVES MAKING MISTAKES. MISTAKES ARE HOW WE GROW, HOW THE BODY AND MIND LEARN. THIS IS TRUE FOR MATHEMATICS, TOO.** However, many students in high school and college feel that mistakes in math class are bad.

This is one of the many reasons Rachel Bachman and I teach a course at Weber State University called Mathematics and Movement for the Whole Person. The class gets students "solving" physical problems as a way to experience patterns that are also part of mathematics. For many students, negative feelings about math go beyond being bad at math – they feel they are the only ones who are bad at it. Sometimes they panic and experience brain freeze.

My colleague Rachel Bachman has come up with an elegant way to find out how people feel about mathematics. It's called "draw-yourself-doing-math." Here are a few examples.

*THE ARTS GET PEOPLE THINKING IN MANY WAYS: MOVING, BUILDING, DISCUSSING, DRAWING PICTURES, WORKING ON THEIR OWN, AS WELL AS WRITING DOWN SYMBOLS ON PAPER. THEY ARE ABOUT EXPRESSING.*

*THE FUNNY THING IS, MATH IS ALSO ABOUT EXPRESSING. AFTER ALL, MATHEMATICIANS CALL AN EQUATION A "MATHEMATICAL EXPRESSION."*



As you can see, some people feel good about math, and many do not feel good about math. Why is that?

In her research, Rachel has learned that some math classes give students the impression that math is not a way of thinking – it's a way of memorizing what to do, a way to imitate the teacher, even if you're not sure why you're doing it and why it works. To help students get a feeling for the patterns that mathematics deal with, it's important to first encounter those patterns. This can take place in many ways, such as building something, experimenting with objects, and through movement.

Students warm up physically. They are asked to explore: Play with ways to move your arms and shoulders. Then they are asked to figure out

different ways to move their arms and shoulders (it's not as easy as it sounds – it takes thinking). From there, each student creates their own move. In this session, they are inventing unusual ways to shake hands. After the movement part of the class, students work in groups on a sheet of questions.

This class is very different from a normal beginning dance class. It doesn't involve imitating the teacher's moves; it involves exploring parameters of movement, or working with guidelines.

Each group is working together on a sheet of questions. The questions are related to the movement sequences they made up and performed. One question is: "How many ways can you shake hands?"

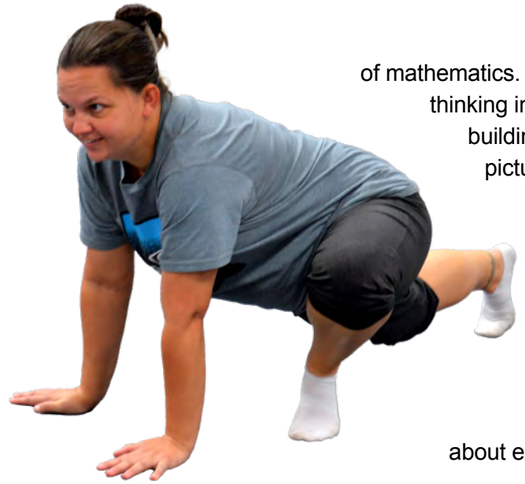
In college, students are required to take courses in many subjects: science, humanities, social science, computers, and more. Mathematics and Movement for the Whole Person satisfies the mathematics requirement for certain majors. One area of mathematics is "counting problems" (the fancy math word is "combinatorics").

Eventually, students are given a very specific question: "How many ways can two people shake hands, if each person can only use one hand at a time?" Groups are free to solve this question any way they want: stand up and move, draw pictures, use math symbols like "x" or "+", or discuss.

When the math is presented in a way that allows students to think in different ways (or different modes), it can be more accessible. Rachel has documented that students are more successful at learning mathematics this way. Students get to do the same things that real scientists and mathematicians do: experiment, experience trial and error, practice creative and critical thinking, and work together in order to solve a given problem.

Most people who study how we learn mathematics say that we should begin with real experiences. By real they mean something other than mathematical symbols.

Why do we say the class is for the whole person" Let me answer that with a quote from S.A. Stolz (2015): "We need to recognise that a large part of our interest in the world is emotional, practical, aesthetic, imaginative and so on." In this class, students are encouraged to share how they feel about math. That's because recognizing a fear (such as math anxiety) is the first step to dealing with it. Besides introducing mathematical patterns, moving and dancing can also be a way to address one's fears. Breathing warm ups are used when students begin to panic.



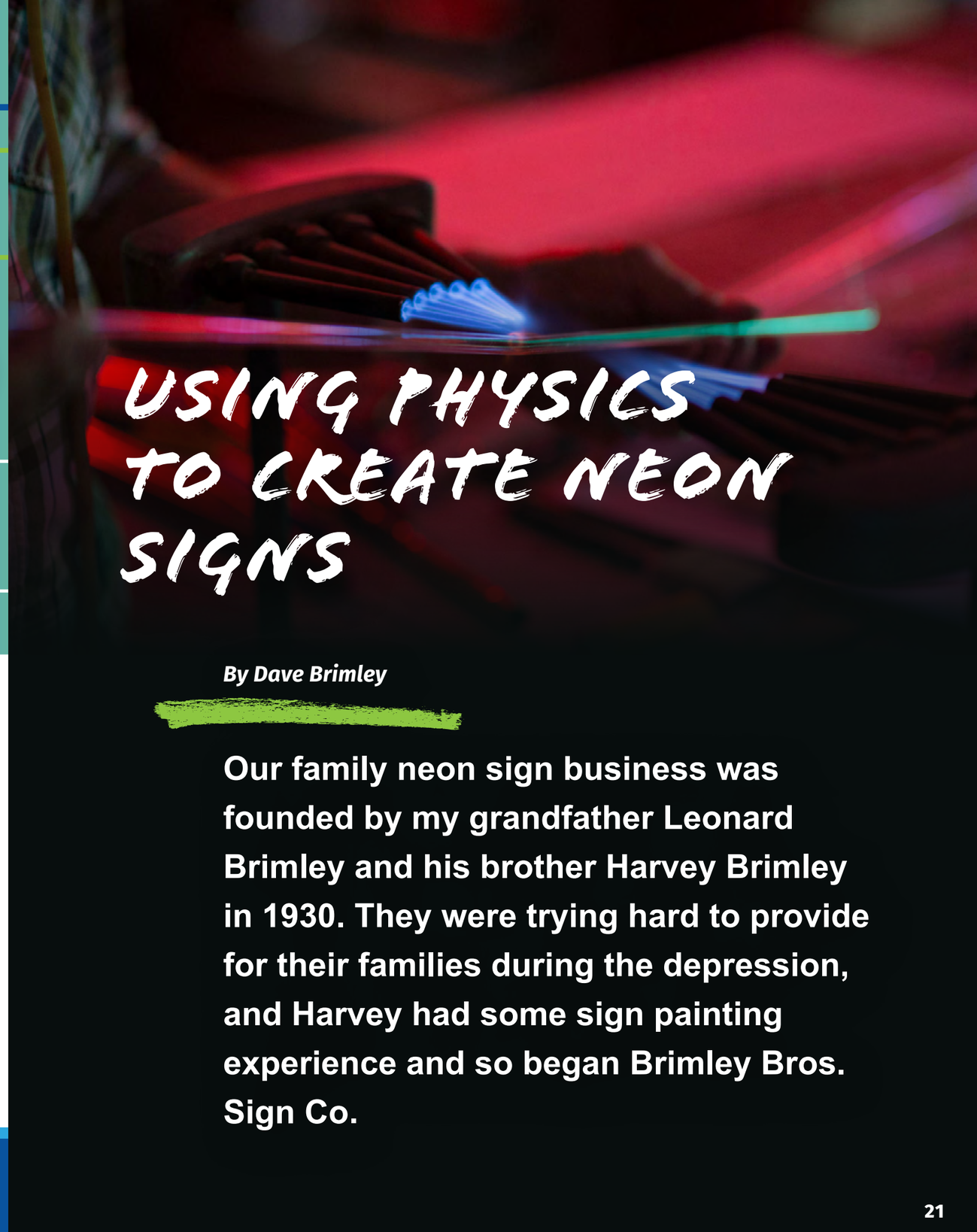
Some people in this publication are writing about how STEM concepts are used in art. My colleagues and I are kind of doing the reverse: using the arts (and dance in particular) to support the development and understanding of mathematics. The arts get people thinking in many ways: moving, building, discussing, drawing pictures, working on their own, as well as writing down symbols on paper. In addition to demanding intense thinking, by its nature the arts include how we feel about a subject. The arts are about expressing.

The funny thing is, math is also about expressing. After all, mathematicians call an equation a mathematical expression.

## AUTHOR BIOS

***ERIK STERN** has always been involved in the arts and STEM, and has degrees in both areas. He began connecting mathematics and movement with Karl Schaffer through their California-based dance company. He and his colleagues have performed original choreography and conducted workshops all over the U.S., as well as in Europe, Asia. and Australia, and have published a book and many articles. Taking two things that most people assume have little in common and revealing how they really can support each other has allowed a wider range of students to interact with and learn mathematics.*

***RACHEL BACHMAN** is a professor of mathematics education at Weber State in the College of Science. Through studying the methodology and efficacy of the math and movement course Erik and Julian Chan created in 2014, Rachel has come to understand how the body and emotions play a critical role in learning. While originally not identifying as a mover, she now enjoys challenging her body to solve new problems.*



# USING PHYSICS TO CREATE NEON SIGNS

***By Dave Brimley***

**Our family neon sign business was founded by my grandfather Leonard Brimley and his brother Harvey Brimley in 1930. They were trying hard to provide for their families during the depression, and Harvey had some sign painting experience and so began Brimley Bros. Sign Co.**

**THE PROBLEM WAS THEY THOUGHT THEY WOULD FREEZE TO DEATH HAND PAINTING UTAH OIL CO. BILLBOARDS IN THE WINTER IN NEVADA.** Neon had just come to the USA from France in 1928 and inspired a huge interest in the new light medium. My grandfather drove his Model A Ford to Chicago, picked up a bunch of neon building equipment, and drove it back to Salt Lake on a flatbed trailer. He then taught himself to make neon, and their business became Brimley Bros. Neon Sign Co.

I was literally born into the trade. One of my earliest memories from around three years old is of a neon Santa Claus face that was outside my bedroom window at Christmas. There was so much magic in watching my dad and grandpa create colored lights from glass, gas, and electricity, that I decided it had to be my life's work, too.

Generally most people have no clue what neon is, or how it works. Very basically, it is the northern lights phenomena captured in a glass tube.

Neon is a natural element of the universe, and as a gas it ionizes or emits light photons when stimulated by electrical energy. It is called ionization. Producing neon tubes is literally hands-on physics put to creative use, with a working knowledge of glass heat forming, creating vacuums, properties of inert gasses, and their color on the light spectrum, electrical current and amperage, transformers, circuitry, chemistry, light output or lumens, and combining it all with artistic knowledge and a wizard's craft.


*PRODUCING NEON TUBES IS LITERALLY HANDS-ON PHYSICS PUT TO CREATIVE USE, WITH A WORKING KNOWLEDGE OF GLASS HEAT FORMING, CREATING VACUUMS, PROPERTIES OF INERT GASSES, AND THEIR COLOR ON THE LIGHT SPECTRUM, ELECTRICAL CURRENT AND AMPERAGE, TRANSFORMERS, CIRCUITRY, CHEMISTRY, LIGHT OUTPUT OR LUMENS*

My favorite school subjects were science, physics, geology, art, music, and physiology. I loved anything that was hands-on skill learning, such as shop classes or building trades classes. By the time I was 16, I had already helped my dad build his entire house completely by hand, from footings and foundations to roof and shingles. We did it all, there was nothing we couldn't figure out how to make it work by thinking it through, and understanding the properties of steel, concrete, wood, glass, and the practical physics that surround us.

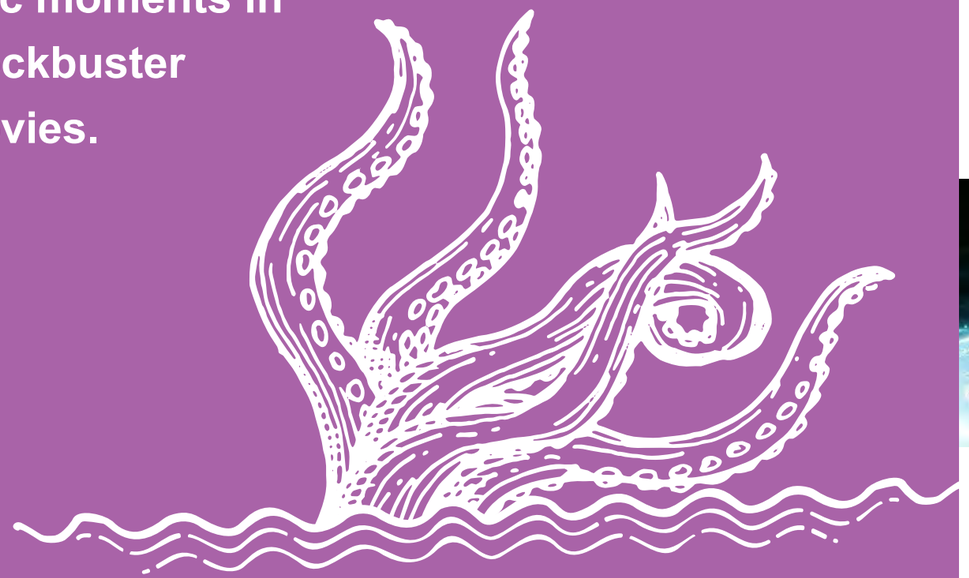

I think that the greatest benefit of hands-on learning is that once you physically manipulate a tangible part of this world and shape it to your will, it leaves a learning impression that will always stay with you, and usually only takes once to form a permanent memory. This way your knowledge compounds daily. Working abilities constantly improve, artistic skill and creativity grow past anything you thought possible, and comprehension of our universe just becomes natural.

STEM studies as we call them today must be connected to physical experiences in order to be useful. Hopefully, creating knowledge in people that is practical allows them to watch the flowing waves of the ocean and the flutter of the leaves on a tree in a breeze and know exactly what is happening, instead of having no clue.

# MONSTERS, ROBOTS, AND ZOMBIES: THE MATH THAT MAKES THE MOVIES

*By Adam Sidwell, Future House Studios*

**While bringing monsters, robots, and zombies to life on screen, I discovered a secret: math and programming are the unsung heroes behind some of the most epic moments in blockbuster movies.**





**STEM IS AT THE HEART OF THE ART OF MOVIES!**
From *Tron: Legacy* to *Pirates of the Caribbean: At World's End* to *King Kong*, math drives the creation of each story and character, making it possible for digital worlds to come alive.

I want to take you behind the curtain to show how math shaped these films — and how it's powering our studio's latest project, the mobile adventure game Swords of Secret. Oh, and we're inviting students to join in by becoming gameplay testers. More on that soon…

**STEM IN TRON: LEGACY, PIRATES OF THE CARIBBEAN, AND KING KONG**
I've worked with some brilliant engineers, programmers, mathematicians and artists over the course of my career. They all knew the same thing: without geometry, programming, and physics, the art of movie visual effects (VFX) would be stuck in the last millenia. I'll use a few examples from a few decades of experience making over a dozen blockbuster VFX movies.

Remember those iconic light walls on the digital grid in *Tron: Legacy*? I used vector math and programming to ensure every glowing barrier formed perfectly as the light cycles sliced through the arena. Some fancy coding made sure those walls lined up just right, giving them that razor-sharp, high-speed feel.

Jump to *King Kong*, and we're suddenly in the middle of a city full of cars trying to escape the wrath of a rampaging gorilla. Instead of building each vehicle by hand, I used modular programming to generate a fleet of cars, each with its own unique body type and dimensions, but all based on the same components. Animators were able to quickly share animation between cars to speed up their workflow. So we flipped, crashed, and drove those cars through the streets, all thanks to the magic of coding. *King Kong* himself? He's a bundle full of matrices! It was matrix math that made each vertex move and his skin deform on top of his virtual skeleton. That math is a key part of computer graphics.

And then there's *Pirates of the Caribbean: At World's End*, where I had the amusing task of using physics simulations to bring pirate zombies to life. These weren't your standard undead — their barnacles, slimy tentacles, and tattered trousers all had to move just right during epic sea battles. Physics simulations ensured every wave, cannon

*I LAUNCHED A NEW STUDIO RIGHT HERE IN THE STATE OF UTAH, AND SHIFTED GEARS TO GAME DEVELOPMENT, BRINGING THOSE SAME STEM PRINCIPLES TO EVERY GAME WE BUILD. OUR LATEST PROJECT, SWORDS OF SECRET, USES MATH AND PROGRAMMING TO TURN THE WORLD AROUND US INTO A VIDEO GAME.*

blast, and pirate stumble felt real, even though we were dealing with a bunch of fishy supernatural creatures.

We could go on and on: without STEM, we'd have neither Avengers nor Jedis.

**FROM MOVIES TO GAMES: SWORDS OF SECRET**

After all the monster-making and zombie-tweaking in Hollywood, I launched a new studio right here in the state of Utah, and shifted gears to game development, bringing those same STEM principles to every game we build. Our latest project, *Swords of Secret*, uses math and programming to turn the world around us into a video game.

It's an epic augmented reality mobile role-playing game (RPG) filled with mythical monsters, daring quests, and more algorithms than a math book. Imagine discovering a wizard's tower down your street, or a foreboding fortress hiding a treasure chest near your school. We use augmented reality (which is a fancy way of saying "algorithms and geometry to put games into the real world") to take you on quests through your neighborhood in search of real world treasures!

**CALLING ALL VIDEO GAME PLAYERS: HELP SHAPE SWORDS OF SECRET!**

Now, here's where you come in: we're looking for gameplay testers. You'll get a sneak peek behind the scenes, play the game before it's released, and provide feedback that will help us fine-tune the experience. I've taught game development sessions in multiple STEM classes and students and teachers are always enthusiastic to join the playtest experience. Whether you're into math, programming, or just love games, this is your chance to see how all the pieces come together.

Go to SwordsOfSecret.com to start your quest and see what's waiting for you in your neighborhood.

**STEM IS THE WAY**

Math and programming may seem like technical skills, but they're the building blocks of creativity in film and game development. From iconic movie characters to epic worlds, math helped create some of the most visually stunning moments in cinema and games.

The future of entertainment is in the hands of the next generation of creators, and we're excited for students to join the adventure. Who knows? Maybe your ideas will shape the next blockbuster — or the next great video game.

*ABOUT ADAM SIDWELL*

***As Head of Studio at Future House Studios, a game development, animation, virtual reality, and creative development studio, Adam directs content for animated projects in multiple mediums and has assembled a world-class team with alumni from ILM, Disney, Microsoft, Epic Games, and more. Adam's roots are in building and directing the art and technology so that teams can bring animated characters to life. A full list of film credits can be found on IMDB.com.***

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# DISCOVER HOW STEM AND ARTISTRY WORK IN THE HOGWARTS LEGACY GAME DEVELOPMENT

**Exploring the enchanting realm of video game development, art and STEM are intricately woven together to create the games we love.**

**IN THE CREATION OF HOGWARTS LEGACY, THE AVALANCHE SOFTWARE TEAM BASED IN SALT LAKE CITY RECOGNIZES THE CRUCIAL ROLES OF NARRATIVE DESIGNER, MISSION IMPLEMENTER, ENGINEER, AND MOTION CAPTURE TECHNICIAN.** Each team member has a critical role in building an immersive and realistic role-playing game. Teamwork is essential as a 21st century classroom skill and a principle of STEM.

## HOW DO STEM AND THE ARTS WORK TOGETHER WHEN DEVELOPING GAMES?

"On a more general level, games often communicate so much more than just 'entertainment' — they showcase the emotion of connecting with characters, the awe of discovery, the beauty of landscapes or architecture, the grandiosity of music, et cetera. And yet they are still, essentially, software. In order to have an excellent game that means something to people, you need to understand how to deliver the art/experience in a way that functions well."

— Jennifer Egan, mission implementer

"Video games are an art form that uses every aspect of STEM. Because video games are an interactive art form, technology, engineering, and math are intertwined to give the player an incredible experience. Our game engines are highly advanced, code bases written, maintained, and manipulated by brilliant programmers. They need to know how to make something feel a certain way while writing lines of code. They must be players as much as developers to allow for it to feel seamless. Art is meant to evoke feelings and STEM is one of the backbones to ensure those feelings are felt."

— Genese Davis, narrative designer

"There's also a good amount of science involved in motion capture, especially when it comes to anatomy. As a motion capture technician, you are responsible for placing sensors on actors that represent their anatomy so we can create a virtual skeleton of them. Knowing the names of bones and how joints work is really important in this process to create realistic, lifelike characters."

— Brady Campbell, motion capture technician

"A video-game is the perfect combination of art and engineering. Games are ultimately running software so engineering knowledge is needed to know how things work and run. This is key to learn so [that] you are ready to fix bugs that may arise and/or issues that need technical resolution. On the other hand, games are highly visual experiences. Games have evolved from black and white 2D games to full photo-realistic 3D games that match or exceed movie-like content. So everyone that works on games is an artist since they are contributing to a visual, interactive medium."

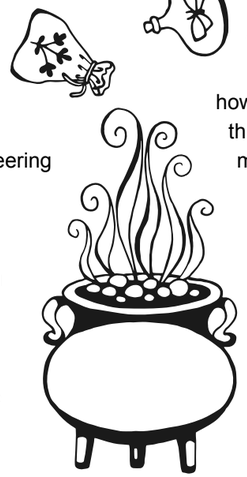
— Jose Villeta, director of software engineering

"Games offer a unique story-avenue that invites audiences to interact directly. It's almost as if we can tell stories in limitless ways. Letting someone explore the world developed by a multi-branching creative team is an incredible experience. It's exciting to offer players amazing visuals from talented artists and directors combined with impactful storylines that offer personal and lasting impressions. Every element of STEM has a place within the arts, and if your strength is in any part of STEM then there is a place for you in video game development."

— Genese Davis, narrative designer

## WHAT SKILLS ARE SHARED BY STEM AND THE ARTS?

“Skills vary per discipline. The main disciplines include art, animation, engineering, audio, visual effects, design, production, and storytelling. Since games take much longer to make with a large team size, it’s important to learn how to work with others. You need both soft and hard skills to design, build, and iterate game content.”
— Jose Villeta, director of software engineering



“Our programmers make sure the code written achieves the feeling of our design team’s goals. If you’re a programmer, you need to know how to write code. And you need to make sure you can write code in the language of the engine, whether it’s C#, C++, JavaScript or Python. The more aware all game developers are of how the technology works the harder you can push that technology to achieve your creative vision.”
— Genese Davis, narrative designer

“Some of the skills required for a job like this is an understanding of anatomy and how the body moves. Having an eye for those things translates to realistic animations and movements. On top of that, being able to communicate well with people is a huge deal since we work so closely with actors in making their mocap (full-body motion tracking) gear work well. Helping people feel comfortable in the mocap gear means they are comfortable in their acting, resulting in better animations.”
— Brady Campbell, motion capture technician

## WHAT ARE SOME SUGGESTIONS YOU HAVE FOR STUDENTS AS THEY LOOK INTO CAREER OPTIONS IN THE FIELD OF GAME DEVELOPMENT? WHAT WERE THE HARDEST SKILLS TO LEARN?

“My suggestion is the same suggestion that was given to me when I first started looking into becoming a game developer: You have to actually make games. Even now, I am still working through being willing to learn something new when I have become comfortable with what I already know. This happens to me continuously — I find myself uncertain about learning a new process or program that might really benefit my ability to contribute to my team. But usually, spending even a little bit of time learning pays off huge dividends in the end.”
— Jennifer Egan, mission implementer

“Whenever I get asked this question, I always ask a follow up: What do you love doing in life? Art, programming, designing, animating, writing, etc. Pinpointing not only something you love about the process, but also something you feel comfortable and have a natural talent in, are large strides in the right direction. If you have no idea, then start anywhere. Download a free game engine, do some tutorials, take a course in any aspect of the game making process and get going. If you have a propensity for 3D art, then learn an art package and use them as quickly and as often as possible, but you must first make sure you’re a good artist. You should understand the general principles of your art.”
— Genese Davis, narrative designer

“Build out a portfolio of your personal or team-based work. A computer-science or engineering- related program can provide a solid foundation for software development. Whereas for art development, learning the industry digital content creation tools like Autodesk Maya, Photoshop, ZBrush, or Houdini among others, is key for a strong skill set. Independent of discipline, the hardest skills to learn are dedication to the craft, eye for quality, and focused efforts to iterate on the game until its completion. Since video game are interactive software applications, the production of them is a never-ending process for fun factor, visual quality and, more importantly, a defect-free experience.”
— Jose Villeta, director of software engineering

EVERY ELEMENT OF STEM HAS A PLACE WITHIN THE ARTS, AND IF YOUR STRENGTH IS IN ANY PART OF STEM THEN THERE IS A PLACE FOR YOU IN VIDEO GAME DEVELOPMENT.

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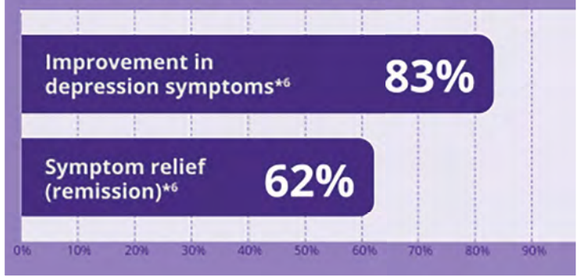


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