



# The Art & Science of Lucasfilm: Working on the StageCraft Set

## STUDY GUIDE

Content written by **Beth Jackson Espinoza**

Designed by **Camille Gwise, Jay Tiong, Soph Schultz**

**Rocha, Keith Zwölfer**

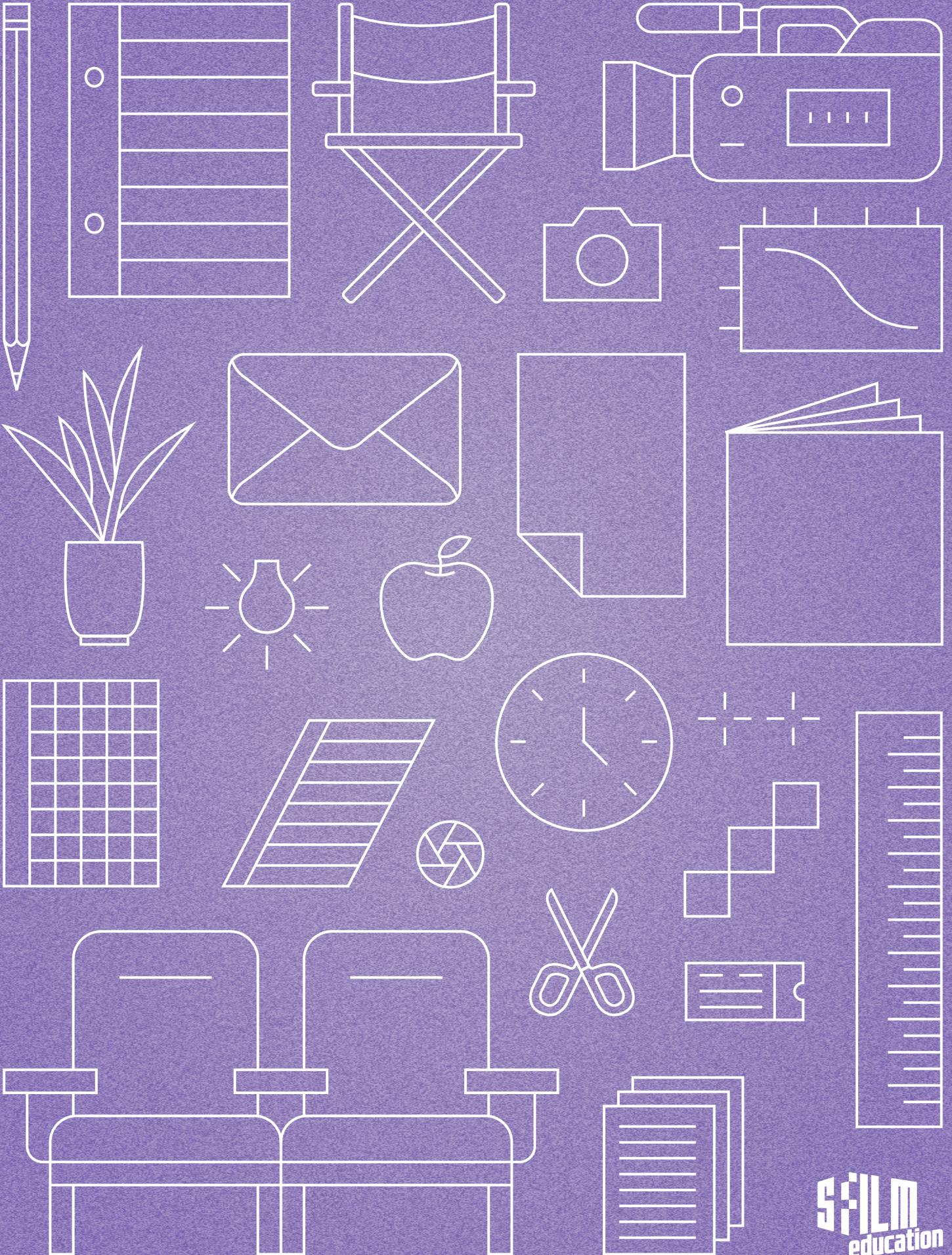
All SFFILM Education materials are developed in alignment with California educational standards for media literacy.

SFFILM Education welcomes feedback and questions on all printed study materials..

More info at [sffilm.org/education](https://sffilm.org/education)



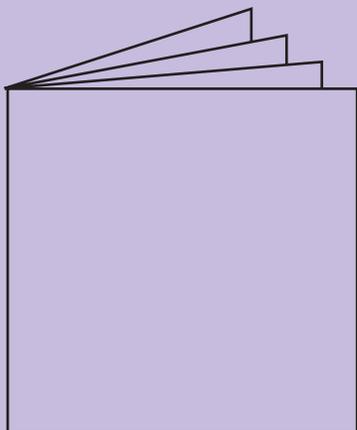
**SFFILM**  
education

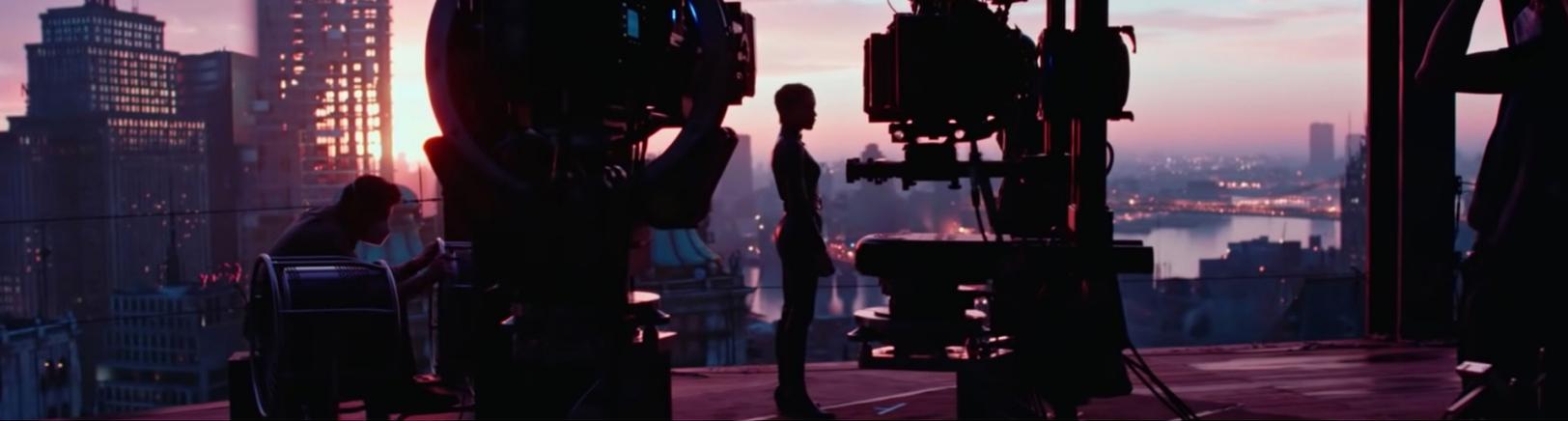




# Index

- 02 Presentation Overview
- 03 Virtual Production Terminology
- 04 Backstage on a StageCraft Set
- 05 Discussion Questions
- 06 Activities
- 09 Lucasfilm Overview
- 10 Media Literacy Resources
- 11 Common Core Standards





# Presentation Overview    Presenter Bio

What is it like to work on one of the most advanced virtual production sets in the world? Sr Virtual Production Technical Director **Emil Chang** will present a behind the scenes look at what a typical day looks like on set with ILM's StageCraft, covering everything from gear and attire to working with different personalities. First used in 2016, the groundbreaking technology provides a continuous pipeline from initial exploration, scouting, and art direction, traditional and technical previsualization, lighting, and of course, real-time production filming itself, with the innovative StageCraft LED volumes. This presentation marks the 15th year of our collaborative educational series with Lucasfilm, demonstrating the intersection of art, science, and technology in the entertainment industry, all while making connections to current STEAM curriculum. Artists and leaders in the field share their expertise in an interactive multimedia presentation and participate in an in-depth discussion and Q&A.

**Recommended Grades:** 6–12

## Subject Areas

- **Art/Media**
- **Career Path Training**
- **Computer Science**
- **Math**
- **Peer/Youth Issues**
- **Science**



## Emil Chang

**Emil Chang** is the Senior Virtual Production Technical Director at Industrial Light and Magic's Stagecraft. Cinematographer, photographer, and writer, Emil is interested in visual storytelling that pushes the limits in technology and entertainment. This includes cinematography in the virtual world, incorporating physical production skills into the growing world of virtual production. He believes in creativity through interdisciplinary connections: the study of storytelling, the art of academia, and the science of cinema. He is also a personal fitness trainer, coach, dragon boater, and overall nerd.



# Virtual Production Terminology

**CHARACTER ANIMATION** - A specialized area of the animation process, which involves bringing animated characters to life. Character Animators must create the illusion of thoughtfulness, emotion and personality by developing every character's appearance, body language and facial expressions from scratch. While an actor generally provides the vocals in an animated film performance, the character animator provides all else.

**COMPOSITING** - The combining of visual elements from separate sources into single images, often to create the illusion that all those elements are parts of the same scene or space.

**CREATURE ANIMATION** - Not unlike character animation, creature animation is the process of bringing animated beasts, aliens and animals to life.

**FACIAL ANIMATION** - The detailed process of animating characters' facial features to convey particular appearances, emotions, reactions, etc.

**GREEN SCREEN** - A special effects film technique involving filming actors against a green screen on which effects such as computerized graphics can be added later and integrated into a single sequence.

**MOTION CAPTURE** - A process by which patterns of movement are captured via a series of sensory nodes applied to various body/face parts of a live actor; these nodes record data about the spatial configuration of these nodes over time; simulation software then processes these data and applies them to a virtual actor on a computer.

**MOTION CONTROL** - A process that generally utilizes robotic camera mounts, enabling identically configured and timed camera movement on every take. This process facilitates digital compositing on shots that involve camera movement, as it eliminates the many variables of human camera operation.

**PHOTOGRAMMETRY** - The age-old practice of determining the geometric properties of objects based on photographic images.

**ROTOSCOPING** - An animation technique in which live-action video is traced and "painted" to create 2-D animation that mimics the live-action.

**UNREAL ENGINE** - The Unreal Engine is a game engine developed by Epic Games, first showcased in the 1998 first-person shooter game Unreal. Today Unreal Engine is the world's most open and advanced real-time 3D creation tool. Continuously evolving to serve not only its original purpose as a state-of-the-art game engine, today it gives creators across industries the freedom and control to deliver cutting-edge content, interactive experiences, and immersive virtual worlds.

**VIRTUAL CINEMATOGRAPHY** - The process of creating the illusion of camera movement by digitally compositing and sequencing background images that change position relative to live action footage.

**VIRTUAL SET** - A 3D software module that collates and arranges a massive series of images according to the spatial organization and geometry of a given scene setting such that live action green screen footage of actors can be dynamically combined with the virtual space. In the case of **The Mandalorian**, the virtual set consisted of an immersive and massive 20' high by 270-degree semicircular LED video wall and ceiling with a 75'-diameter performance space, where the practical set pieces were combined with digital extensions on the screens. Digital 3D environments created by ILM played back interactively on the LED walls, edited in real-time during the shoot, which allowed for pixel-accurate tracking and perspective-correct 3D imagery rendered at high resolution.



# Backstage on a StageCraft

When shooting with StageCraft, filmmakers can design and scout in advance of the shoot, and then capture that vision in-camera during principal photography. The creative intent is clearly communicated to the downstream departments, providing creative confidence and fewer iterations in post. When used in conjunction with LEDs or projection methodologies, filmmakers leveraging StageCraft can film more quickly on the day, and acquire many in-camera finals, which reduces VFX shot costs and is a major benefit considering today's compressed post schedules.

To date StageCraft has been used on feature films such as **Rogue One: A Star Wars Story** (2016), **Solo: A Star Wars Story** (2018), **The Midnight Sky** (2020), **Thor: Love and Thunder** (2022), **Ant-Man and the Wasp: Quantumania** (2023), Emmy Award-winning episodic series such as **The Mandalorian**, **The Book of Boba Fett**, **How I Met Your Father**, **The Old Man**, **Obi-Wan Kenobi**, and **Percy Jackson and the Olympians**, as well as music videos, and a variety of commercials.

[The Virtual Production of The Mandalorian Season Two](#) (7:10) a behind the scenes look at the groundbreaking virtual production technology used on **The Mandalorian**, season 2. What iterations were made in StageCraft 2.0?

Behind the Magic - [The Visual Effects of The Book of Boba Fett](#) (3:51)

[Actors on the StageCraft](#) (1:15) set.

[Why The Mandalorian Uses Virtual Sets over Green Screen](#) (6:38)

If you have seen **The Mandalorian**, did you know it was shot with new LED screen technology instead of traditional green screens? Do you think the show would have looked different if it was shot using mostly green screen technology? What do you think would have been different?



# Discussion Questions

- From the VFX supervisor to technical directors, there are so many crew positions on any given set. What roles mentioned in the presentation sounded interesting to you? What questions would you ask a crew member with this role? How does science, technology, engineering or math play into these jobs?
- Before this presentation, did you know what goes into making a heavily VFX focused show like *The Book of Boba Fett* or *The Mandalorian*? What did you learn about VFX processes that you didn't know before?
- During the presentation, Emil mentions that working on the set can be stressful when so many people are working together at the same time. Write about a time when you were part of a team. Describe the project and your role.

## More about the Technology of StageCraft and Virtual Productions

- Do some research on other new VFX technologies that Lucasfilm has used in its productions over the course of its existence. What other technologies did Lucasfilm and its partners help popularize? How do those past technologies compare to current day VFX technology?
- Why do you think it's important for VFX artists to continuously be trying new things and exploring new technology? Describe a new experience or technology that you have recently challenged yourself to learn and persevere through its challenges.
- Compare and contrast the Unreal Engine and LED Screen technology with Green Screen technology. What are the pros and cons to each kind of technology?
- How do you think the Unreal Engine and LED Screen technology can change the film industry? What are your predictions on how these technologies will be used in the future?
- Unreal Engine technology was created by Epic Games — an American video game and software developer and publisher — to be used in its video games. Now that the technology is being used to improve VFX in filmmaking, do you see a future where video games and film become more intertwined? Why or why not? What do you think that future will look like?
- What aspect of VFX are you curious to learn more about? Why?
- What new skills and competencies will filmmakers of the future need that are different from what they needed in the past?



# Activities

## **VFX Storyboarding**

Watch this [short video titled "Intro to Storyboarding"](#). Pay attention to the explanation of how storyboarding has changed as VFX have evolved over time. How do you think the Unreal Engine and LED Screen Technology will change how filmmakers plan their storytelling?

## **Green Screen Technology**

Try out green screen technology for yourself! Replace the background with any image or video of your choice. You don't need a fancy green screen! Try a green or blue solid tablecloth. Green Screen by [Do Ink](#) (iOS), [iMovie](#) (iOS or macOS) or [Kapwing](#) (Chromebook) are cheap, easy, beginner apps for testing out a green screen story of your own.

## **LED Screen Technology**

Try to re-create the new LED screen technology. You can create a mini version of this technology using a recording device (a camera or smartphone) and a monitor (from a computer, laptop, or TV). Create a miniature character or several characters, and find a video or photo that you want to use as your set background. Pull that photo or video up on your monitor, and set up your characters in front of it. Take your recording device and create a shot where the character seamlessly blends in with your digital background. Play around with the lighting from the monitor and the lighting in your environment and make your own scene with your character(s).

## **Unreal Engine**

Did you know [Unreal Engine](#) is free to use? If you are interested in VFX design or video game design you can give it a try [here](#). There are even [free tutorials](#) created by Epic Games that can help you learn to use the platform.



# Nellie Wong Magic of Movie Essay Contest

This contest is made possible by the generous support of the Nellie Wong Magic of Movie Education Fund, endowed by Tim Kochis and SFFILM board member Penelope Wong to honor the memory of her mother, Nellie Wong (1917- 2007), who was an avid film-goer and cinephile. Developed to support the year-round outreach efforts of SFFILM Education, the Fund aims to cultivate students' imaginations, enhance their critical thinking and creative writing skills and instill a greater appreciation for the magic of movies in young audiences of the Bay Area.

SFFILM Education is pleased to have teachers and their students join us for this year's Schools at the Festival program. We like to encourage freedom in student essay responses across K-12 classrooms. Provided are a series of prompts suitable to give students some guidance, but please let your students know that they can also write about their own experience on their Schools at the Festival field trip without adhering strictly to the prompts. For students who wish to use a prompt, they are not required to answer every prompt listed but should select enough for a thoughtful and complete response.

Winning essays will be determined based on creativity, depth, enthusiasm, clarity, and grammar. Essays must be written in response to any of the in-person or online Schools at the Festival screenings. Students may choose one film program or submit separate essays for more than one program. Students should follow the word count guidelines for their respective grades.

Suggested Word Counts:

Grades 6–8: 300–350 words  
Grades 9–12: 450–500 words

Submissions due no later than May 5, 2023. Submit essays online [here](#).

## Prompts

1. Did this presentation make you think differently about your own career trajectory? Did it make you think differently about how you might use your skills in either math, science, or art in your future career? Think about the experiences that led Emil toward working for Lucasfilm as their Senior Virtual Production Technical Director. Have you had an experience in your own life that inspired you toward a particular kind of work? Imagine and describe a future in which that experience leads you into the career of your dreams.
2. The speakers from Lucasfilm presented about a typical day on a StageCraft set, and how the technology has the ability to shape the future of VFX within the filmmaking industry. Is there a new, emerging technology that you think will redefine an industry or way of life (i.e. new tech in transportation, environmental science, storytelling, sports, medicine, etc)? Write about this new technology and how you think it will reshape our world.
3. Use your imagination to create a new story world of your own. Introduce us to your story world and then explain how you would bring your world to life on screen using new VFX technology. If you had an unlimited budget, would you use LED Screen Technology, Unreal Engine, Green Screens, or something completely different?
4. Watch an episode of **The Mandalorian** through the lens of a film critic. Think back to what you learned about the technical process that went into creating the series. How do these new technological advancements change the viewing experience for the audience? Pay attention to things like lighting, mood, emotion, acting, pacing, and editing, and analyze how new technology made these aspects of the episode different from other Star Wars films.
5. Did this presentation inspire your own creativity or artistry? How do you like to express yourself creatively? How will this presentation impact the ways you will think about the arts or creativity in your everyday life?



# Lucasfilm Overview

## Lucasfilm

Lucasfilm is among the world's leading entertainment service companies, a pioneer in visual effects and sound across multiple mediums, and is home to the legendary Star Wars and Indiana Jones Franchises.

Founded by visionary filmmaker **George Lucas** in 1971, Lucasfilm established itself as a “rebel base” of sorts in San Francisco’s Bay Area, a place the filmmaker chose to “shake up the status quo...of how movies were made and what they were about.” It was a defiant departure from the Hollywood mainstream and a more conducive atmosphere to cultivate his independent spirit of filmmaking.

Basing his Skywalker Sound facility at the Ranch, Lucas moved Industrial Light & Magic, his special effects company based in Los Angeles, to nearby San Rafael, allowing him to keep his production facilities and special effects house in close proximity to each other.

In 2005, Lucas brought Lucasfilm and Industrial Light & Magic together at the Letterman Digital Arts Center at the Presidio in San Francisco. Six years later in 2012, he handed the company reins over to renowned producer **Kathleen Kennedy**, who has since opened up an exciting new era for Lucasfilm by returning it to its production studio roots.

When Lucasfilm was acquired by Disney that same year, Kennedy worked to enhance the company’s collaborative spirit, building a creative community of writers, directors, artists and filmmakers. Lucasfilm draws on the vast pool of skilled, world class talent found in San Francisco and around the world, allowing it to create the top-notch entertainment experiences it has come to be known for.

## Industrial Light and Magic

Founded in 1975 by **George Lucas**, ILM is the leading effects facility in the world, serving the motion picture, commercial production, and attraction industries. ILM has created visual effects for over 325 feature films and has played a key role in seven of the top 10 worldwide box-office hits of all time and has contributed to 25 of the top 50. Some recent films include **Black Panther: Wakanda Forever**, **Thor: Love and Thunder**, **Obi-Wan Kenobi** and **Avatar: The Way of Water**.

ILM has set the standard for visual effects, creating some of the most stunning images in the history of film. At the forefront of the digital revolution, the company continues to break new ground in visual effects, VR, AR, and Immersive Cinema.

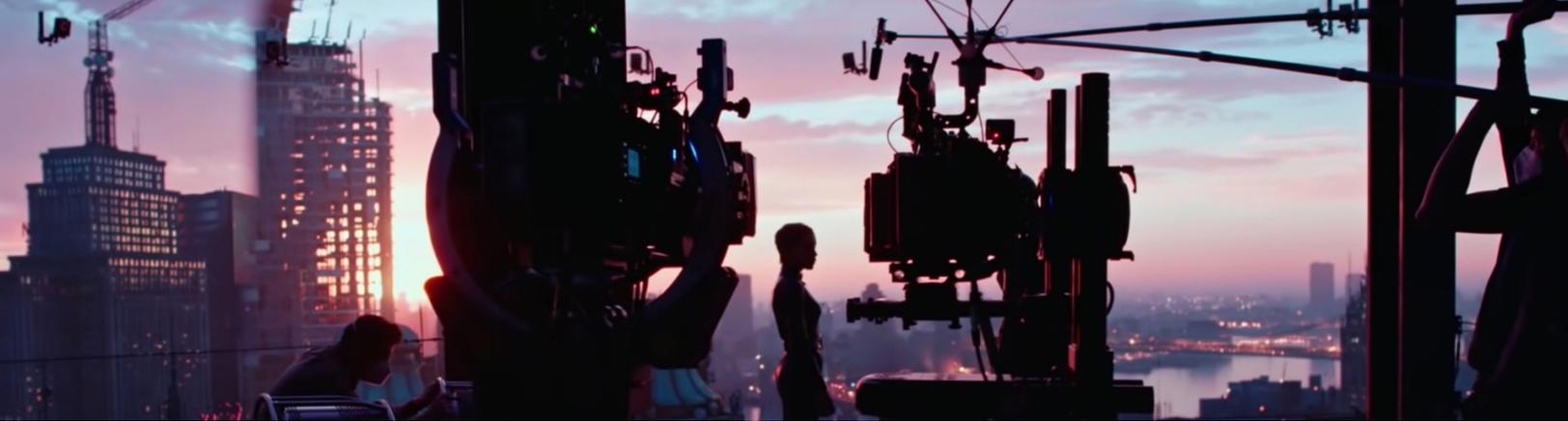
## Skywalker Sound

The pulsating hum of a lightsaber. The thunderous footsteps of a stalking Tyrannosaurus Rex. The awesome roar of Star-Lord’s Milano. For more than a generation, Skywalker Sound has created soundscapes that have redefined aural immersion.

With origins based in **Ben Burtt**’s landmark work on 1977’s **Star Wars**, Skywalker Sound specializes in sound design, mixing, and audio post-production across multiple mediums. From the gathering of real-life, organic sounds to developing new techniques in sound presentation, Skywalker Sound remains one of the world’s most innovative facilities — eager to explore, create, and venture into the unknown.

## ILMxLAB

Lucasfilm’s award-winning immersive entertainment studio, pioneering a new era of interactive storytelling through virtual and mixed reality experiences. Working with acclaimed creators and designers, we create living worlds, inviting you to step inside and become the hero of your own personal adventure.



# Media Literacy Resources: Screening with Meaning

We live in a world where technology mediates a large portion of human interaction and the exchange of information. Every projected image, every word published on a page or a website, and every sound from a speaker reaches its audience through the language of the medium. The ability to parse the vast array of media messages is an essential skill for young people, particularly in a mainstream commercial culture that targets youth as a vulnerable, impressionable segment of the American marketplace. Many students already have a keen understanding of the languages different media use and the techniques they employ to inspire particular emotions or reactions, but they often lack the skill or awareness to fully deconstruct the messages they continuously receive. Analysis of a media message, or any piece of mass media content, can best be accomplished by first identifying its principal characteristics:

1. **Medium:** the physical means by which it is contained and/or delivered
2. **Author:** the person(s) responsible for its creation and dissemination
3. **Content:** the information, emotions, values or ideas it conveys
4. **Audience:** the target audience to whom it is delivered
5. **Purpose:** the objectives of its authors and the effects of its dissemination.

Students who can readily identify these five core characteristics will be equipped to understand the incentives at work behind media messages, as well as their potential consequences. Media literacy education empowers students to become responsible consumers, active citizens and critical thinkers.

## MEDIA LITERACY STANDARDS

### MEDIUM

#### All Media Is Constructed.

- What is the message, how is it delivered and in what format?
- What technologies are used to present the message?
- What visual and auditory elements comprise the media content?
- What expectations do you bring to the content, given its medium and format?

### AUTHOR

#### All Media Is Constructed by Someone.

- Who is delivering the message?
- Who originally constructed the message?
- What expectations do you have of the content, given its author(s)?

### CONTENT

#### Media Is A Language For Information.

- What is the subject of the media message?
- What information, values, emotions or ideas are conveyed by the media content?
- What tools does the author employ to engage the viewer and evoke a response?
- To what extent did the content meet your expectations, given the format/author?

### AUDIENCE

#### All Media Messages Reach an Audience.

- Who receives the message?
- For whom is the message intended?
- What is the public reaction to the media content and/or its message?
- What is your reaction to the media content and/or its message?
- How might others perceive this message differently? Why?

### PURPOSE

#### All Media Messages Are Constructed for a Reason.

- Why was the message constructed?
- Who benefits from dissemination of the message? How?
- To what extent does the message achieve its purpose?
- What effect does the message have on the audience it reaches, if any?



# Common Core Standards

## Science and Technology

CCSS.ELA-LITERACY.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.

CCSS.ELA-LITERACY.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

## Writing

CCSS.ELA-LITERACY.WHST.6-12.1 Write arguments focused on discipline specific content.

CCSS.ELA-LITERACY.WHST.6-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

CCSS.ELA-LITERACY.WHST.6-12.6 Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

CCSS.ELA-LITERACY.WHST.6-12.7 Conduct short research projects to answer a question (including a self generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

CCSS.ELA-LITERACY.WHST.6-12.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

CCSS.ELA-LITERACY.WHST.6-12.9 Draw evidence from informational texts to support analysis, reflection, and research.