A DEEP DIVE INTO ANIMATION

A Hands-on Comparison of Two Techniques

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To view the short animated video created for the project, use the QR code to the left or click this link: http://bit.ly/49yFgZ9

You will see the best quality by downloading the video (MKV file) and playing the downloaded version.

“You must be imaginative, strong-hearted. You must try things that may not work, and you must not let anyone define your limits because of where you come from. Your only limit is your soul.”

— Chef Gusteau, Ratatouille (2007)

1. SUMMARY

ENGLISH:
This project is a study of traditional and 3D digital animation, two widely known animation techniques in storytelling. My goal was to deep dive into the world of design, animation, and motion picture production and expand my knowledge of it. My research was based on the history of the two mediums, the entire production process, and Slovak animation. I applied all of this valuable information to my practical work. The investigation was internet-based and also conducted through expert interviews and consultations with a local professional that knew a lot about the subject. All of my research and previous knowledge have allowed me to develop a pitch bible for planning and preparation and, finally, a short animated video. One half was created by hand, and the other half through the computer software application called Blender. Thanks to my applied practice, I was able to analyze and compare both techniques, highlighting their differences, similarities, advantages, and disadvantages. The results strongly suggest that traditional animation is highly time-consuming and labor-intensive, in contrast to computer animation, which requires more skills and, in my case, was more expensive in terms of cost. Both methods are capable of expressing ideas in distinct ways thanks to their visually unique styles. In conclusion, the ability of animation to communicate in storytelling, whether through timeless charm or realistic visual effects, makes them both fascinating and relevant artistic mediums.

CATALAN:
Aquest projecte és un estudi de l'animació tradicional i digital 3D, dues tècniques d'animació àmpliament conegudes en la narració d'històries. El meu objectiu era submergir-me en el món del disseny, l'animació i la producció cinematogràfica i ampliar els meus coneixements. La meva recerca es va basar en la història dels dos mitjans, tot el procés de producció i l'animació eslovaca. Vaig aplicar tota aquesta valuosa informació al meu treball pràctic. La investigació es va basar en Internet i també es va dur a terme mitjançant entrevistes i consultes amb una professional local que sabia molt sobre el tema. Tota la meva recerca i coneixements previs m'han permès desenvolupar una bíblia d'animació per a la planificació i la preparació i, finalment, un curtmetratge. Una meitat d'aquest va ser creada a mà i l'altra meitat mitjançant l'aplicació informàtica anomenada Blender. Gràcies a la meva pràctica aplicada, vaig poder analitzar i comparar ambdues tècniques, destacant les seves diferències, similituds, avantatges i desavantatges. Els resultats mostren que l'animació tradicional requereix molt de temps i mà d'obra, a diferència de l'animació per ordinador, que requereix més habilitats i, en el meu cas, era més cara en termes de cost. Ambdós mètodes són capaços d'expressar idees de maneres diferents gràcies als seus estils visualment únics. En conclusió, la capacitat de l'animació per comunicar-se a través de la narració, sigui amb un encant atemporal o amb efectes visuals realistes, els converteix en mitjans artístics fascinants i rellevants.

SLOVAK:
Tento projekt je štúdiou tradičnej a 3D digitálnej animácie, dvoch všeobecne známych animačných techník v rozprávaní príbehov. Mojím cieľom bolo hlboko sa ponoriť do sveta

dizajnu, animácie a filmovej produkcie a rozšíriť si v nej vedomosti. Môj výskum bol založený na histórii týchto dvoch médií, celom produkčnom procese a slovenskej animácii. Všetky tieto cenné informácie som aplikovala do svojej praktickej práce. Prieskum bol založený na internete a tiež prostredníctvom rozhovorov a konzultácií s odborníčkou, ktorá o danej téme veľa vedela. Celý môj výskum a predchádzajúce vedomosti mi umožnili vytvoriť bibliu animácii pre plánovanie a prípravu a nakoniec krátke animované video, z ktorého polovica bola vytvorená ručne a druhá polovica pomocou počítačovej softvérovej aplikácie s názvom Blender. Vďaka mojej praktickej praxi som bola schopná analyzovať a porovnať obe techniky a zdôrazniť ich rozdiely, podobnosti, výhody a nevýhody. Výsledky ukazujú, že tradičná animácia je veľmi časovo náročná a prácna, na rozdiel od počítačovej animácie, ktorá vyžaduje viac zručností a v mojom prípade bola drahšia. Obe metódy sú schopné vyjadriť myšlienky odlišným spôsobom vďaka svojim vizuálne jedinečným štýlom. Záverom možno povedať, že schopnosť animácie komunikovať v rozprávaní príbehov, či už prostredníctvom nadčasového šarmu alebo realistických vizuálnych efektov, z nich robí fascinujúce a relevantné umelecké médiá.

KEYWORDS/PARAULES CLAU:

- Animation/Animació/Animácia
- Storytelling/Narració/Rozprávanie príbehov
- Visual world/Món visual/Vizuálny svet
- Movement/Moviment/Pohyb
- Blender/Blender/Blender

2. INDEX

3. INTRODUCTION

3.1 Motivations

I've been surrounded by animation all my life, and I've always been fascinated and captivated by both the stories they tell and the way they were made. They have shaped me into the person that I am today, and for that reason I was eager to learn more about its history in addition to fully experiencing what it takes to create a short animation sequence firsthand. I felt that it was the perfect opportunity for me to learn more about its origins, different techniques, and long process. Inspired by films like *Song of the Sea* and *Finding Nemo,* I wanted to create a serene and magical underwater scene using the resources that I have and the skills that I have acquired throughout the years. Thanks to my interest in both traditional and digital 3D animation, I was able to shape this project into a study of the two contrasting techniques by analyzing and comparing them. This will not only give me an opportunity to get first-hand experience on all the steps of an animation production, but also demonstrate how you can turn a simple idea into a whole world that any viewer can step into.

Figure 1. An inspirational movie poster[1]

3.2 Objectives

1. **Cover the history of animation at an introductory level.** Briefly introduce the origins of animation to understand how it has brought us to the animation we know today. Explore the initial devices that were invented, different techniques that were developed throughout the years, the new and present technology, and major animation studios that arose.

2. **Learn about and go through the entire animation process**. Research the key productive stages that transform static images into motion, which I later apply to my project. Transform a simple idea into a finished animated video with the help of an animation bible, a storyboard, and other tools.

3. **Successfully develop a short animation sequence using both traditional and digital 3D techniques.** Create a short visual sequence putting into practice both methods. This animation should be around two minutes long. Half of it would be produced digitally in a 3D form using an open-source software application called Blender, and the other half would be made traditionally, with a manual frame-by-frame drawing process.

[1] "Song of the Sea." *IMDb*, IMDb, 2014

4. **Analyze and compare the two methods**. Understand the similarities and differences between the two techniques. The process as well as the final result must illustrate each technique's advantages and disadvantages and describe obstacles encountered along the way. Understand why most major animation studios adopted digital methods and how each style visually appeals to viewers.

3.3 Research Hypotheses

1. HYPOTHESIS 1: Cell animation, the traditional animation technique, is more time-consuming and labor-intensive than digital animation.

2. HYPOTHESIS 2: Digital 3D animation, the modern technique, requires more skills and tools and therefore is less accessible.

3. HYPOTHESIS 3: Traditional animation is more expensive than computer animation.

4. HYPOTHESIS 4: Both mediums have their own unique visual qualities and features, which shape the way the audience receives what they communicate.

5. HYPOTHESIS 5: Major animation studios, such as Disney, switched from traditional, frame-by-frame animation to digital 3D animation because it was more efficient.

3.4 Methodologies

- **Investigate**. Conduct research online to understand the history, techniques, and animation process, all necessary to execute the practical part of the project.
- **Interview**. Search out people that have experience in this field in my area and interview them.
- **Inspiration and references**. Search for visual sources that will help me carry out my short sequence.
- **Material search**. Obtain all the material necessary for the production, whether borrowed or purchased.
- **Concept development**. Elaborate on the main idea of the short film and make sketches and storyboards to support it.
- **Visual exploration**. Explore different visual styles and artistic techniques and choose one that would fit best depending on my desired outcome.
- **Animation production**. Use tools that I was introduced to in school (e.g., Blender) and search for online tutorials that will help me develop the digital part of my project. Using all the research and material I previously gathered, I produce the hand-drawn sequence.
- **Analysis and comparison**. Review all the things that I learned throughout the process and the final results, and compare the two methods that were used.

4. CORE OF RESEARCH

4.1 Background Research (Online)

Before diving into the practical part of my project, I did some research on the internet, investigating the key concepts that would support my work.

What is Animation?

Animation is the art of giving inanimate objects, characters, and entire worlds life through the illusion of movement. This is done by displaying a sequence of static images (frames) in rapid succession (usually 24 frames per second, or FPS), which makes our brains perceive motion.[2]

It is based on an optical illusion called ‘persistence of vision,’ where our eyes continue to retain an image for a fraction of a second after it disappears. This principle is taken advantage of in animation, allowing images to blend into a moving picture.[3]

Animation has evolved to one of the most powerful storytelling mediums in entertainment. Over the years a wide range of styles and techniques have been discovered, such as traditional hand-drawn, 3D computer-generated, stop-motion, mixed media, and others. What makes it such a versatile medium is the power to create impossible physics, fantastical creatures, and abstract concepts. It is used not only in entertainment but also in marketing, education, and business.[4]

The Evolution of Animation Techniques: From Traditional to Digital

Archaeological artifacts prove that we’ve been attempting to create motion as long as we’ve been able to draw. Pottery from the Bronze Age city of Shahr-e Sukhteh (3000 BC) includes the world's first example of a goblet, whose images appear to move while spinning it[5].

Another example is Leonardo Da Vinci’s Vitruvian Man drawing, which shows multiple angles of the human body. The desire to create movement continued during the Middle Ages. By the 18th century, with the spread of the Industrial Revolution, innovations began to emerge. One early animation device was the phenakistiscope, which transformed into the zoetrope. They were spinning cylindrical devices with a sequence of images inside. This was perhaps the very first time movement was captured[6].

Émile Reynaud’s Pauvre Pierrot (1892) is one of the first animated films projected to the public. However, Émile Cohl’s Fantasmagorie (1908) is the very first true animated movie

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[2] “Animation.” *Filmmakers Academy*
[3] “Guía sobre la animación de la persistencia de la visión.” *Adobe*
[4] DeGuzman, Kyle. “Types of Animation — Styles, Genres & Techniques 1.” *StudioBinder*
[5] “The History of Animation.” history-of-animation
[6] *Ibid.*

made with traditional animation techniques. That is why he is referred to as “the father of the animated cartoon.”[7]

The development of celluloid by Earl Hurd during the late 1800s marked the era of the golden age of animation. It enabled artists to draw characters separate from their backgrounds and would be the dominant style for the next seven decades.[8]

During this time, Walt Disney became the dominant animation studio in the industry. It all started with the release of Steamboat Willie, the first synchronized sound cartoon. It made history with the very first animated feature film, Snow White and the Seven Dwarfs (1937).[9]

Suddenly, a major transition took place. People began to experiment with computer graphics for science and research purposes. By the 1970s, many people began using it as an art form. John Whitney, often considered the father of computer animation, made significant contributions during this era.[10]

The shift from hand-drawn animation to 3D animation influenced animation styles and made the animation production process simpler and more straightforward.[11]

In 1995, Pixar released Toy Story, the first fully computer-animated feature film. The movie’s success proved that computer animation could be used as a storytelling medium.[12]

By the 2000s, this was the dominant form of animation. This technique turned out to be more versatile and was able to incorporate itself into live-action films such as Jurassic Park.[13]

Today, animation thrives on past styles and new technologies, creating new worlds that the audience can immerse themselves in.

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[7] “The History of Animation.” history-of-animation
[8] “Evolution of Animation Techniques: From Traditional to Digital | RMCAD.” Rocky Mountain College of Art + Design
[9] Lam, Jonathan. “A history of animation: from hand-drawn to digital techniques | Envato Tuts+.” *Video*
[10] Kargman, Bess. “A Guide to the History of Animation - 2026.” *MasterClass*
[11] Lam, Jonathan. “A history of animation: from hand-drawn to digital techniques | Envato Tuts+.” *Video*
[12] *Ibid.*
[13] *Ibid.*

Traditional and Digital Animation

Traditional 2D Animation

Figure 2. Walt Disney at work[14]

Also known as cell animation, this technique consists of drawing each frame by hand on transparent celluloid papers called cells. Using cells was essential, since they freed up the animator from having to draw every element in the film on one single layer of paper. It's a very time-consuming process since each movement must be broken down to achieve smooth and fluid motions. Typically, animators use 24 FPS as a standard frame rate. Traditional animation is one of the oldest techniques, dating back to the 19th century, thanks to the invention of devices such as the phenakistoscope and zoetrope. After the invention of cameras, it began to take shape. This technique creates a charm and authenticity rarely matched by digital methods, evoking a sense of handcrafted artistry, which makes it all the more valued. The Walt Disney Company, Fleischer Studios, and Studio Ghibli are some of the most well-known studios worldwide that use this genre. Some examples of pure cel animation are *Lady and the Tramp*, *Cinderella*, *101 Dalmatians*, and *The Aristocats*.[15]

Digital 3D Animation

Digital 3D animation is known as the process of creating 3-dimensional moving images in a digital environment. Animators use digital software to draw, model, and move objects and characters in their desired way. They do this through keyframing, a technique where animators set "key" poses for a 3D object's position, rotation, and scale at specific points in time on a timeline. This movement often goes by at a rate of 24 FPS, closely mirroring the speed of movement that we perceive in real life. The first fully computer-animated feature-length film was Toy Story in 1995, developed by Pixar and released by Disney. Technology has allowed the genre to rise in popularity, as it can be adapted to its audiences. Today, it is the most widely used and has become dominant in the audiovisual industry. It allows the creation of complex

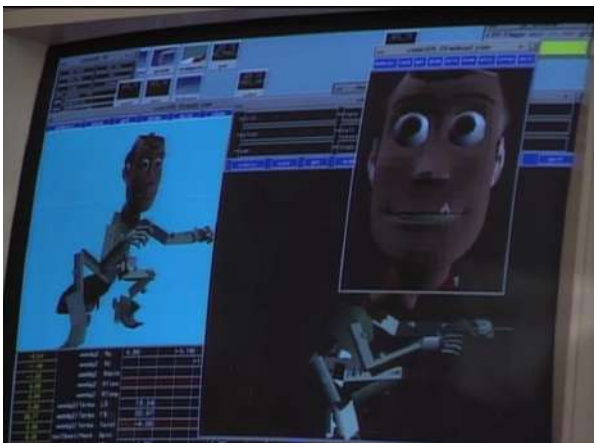

Figure 3. Animating *Toy Story*[16]

[14] "Traditional Animation." *Elite Animation Academy*
[15] "Traditional Animation: The Art of Cel Animation Explained." *GarageFarm*
[16] "You definitely want to see these old-school 'Toy Story' featurettes." *Before and Afters*

three-dimensional worlds, the modification of lighting and physics in real time, and the reuse of models across multiple projects. Some examples are Finding Nemo, The Incredibles, Monsters, Inc., and Kung Fu Panda.[17]

The Animation Process[18]

There are many stages involved in creating an animation, from an initial sketch to the screen. The steps can be categorized into three important phases:

1. **Pre-production:**
   It is the most important part of the entire animation process. Pre-production makes everything in production and post-production possible. This step includes research, planning, designing, writing scripts, and solving problems.

   CONCEPT DEVELOPMENT—Brainstorming through initial ideas of the production. Shaping the story and visual styles.

   CHARACTER AND BACKGROUND DESIGN—It is time to start creating the visual world. Starting with a few sketches, designers construct the personality of each character as well as the universe that they will be positioned in.

   SCRIPT—The detailed document that contains the scene-by-scene action, character emotions, and pacing.

   STORYBOARD—Allows written words to become visual. Artists create a sequence of panels that map out key shots, camera angles, and character movements. It's the first glimpse of your animation.

   ANIMATIC—Considered as a moving storyboard, testing out the timing, rhythm, and flow of the story, the creators time out the panels and pair them with scratch tracks for dialogue, simple sound effects, and music.

   LAYOUT—Composing a scene's visual elements (characters, cameras, props, backgrounds) before full animation.

2. **Production:**
   This step brings to life visual elements decided in pre-production. Finally, the detailed plans, sketches, and storyboards become moving art.

   ROUGH ANIMATION—Start with a rough sketch of all the frames necessary to complete an action of the sequence.

   CLEAN-UP / LINE ART—The final lines of each frame are drawn in pencil with greater precision. Afterward, it is cleaned of all sketch lines and perfected.

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[17] "Computer Animation | An Introduction to Digital Animation." *Adobe*
[18] Nicolini, Lorenzo. "Step-by-Step Guide to the Animation Process." *moonbee*

COLORING—Going over the drawing again with color of a certain technique, depending on the artistic style or aesthetic.

BACKGROUND PAINTING—Consists of painting the scenery and environments that will be used as the background of the animation.

3. **Post-production:**
   The final phase of an animation, where all the separate parts come together through editing and final adjustments into a viewable format.

   COMPOSING—Layering and blending the visual elements (like characters, backgrounds, special effects, and lighting) into a single sequence.

   EDITING—This step assembles the sequences together to refine and polish them and shape the narrative.

   SOUND DESIGN—One of the most powerful tools that influences the final result of the project. It layers the voiceover, custom-recorded sounds, sound effects, and a musical score.

How to Make an Animation Bible

An animation bible (also known as a pitch bible) is a visual guide that is used to gather essential information of any audiovisual project. It helps an artist communicate and present ideas to the rest of the team and potential sponsors. It contains key elements that help introduce the concept, story, characters, and universe of the project.[19]

Elements of an Animation Bible[20]

1. Cover Page. An attractive cover image with the project title and the names of the creators. It must be memorable and eye-catching.

2. Technical Sheet: Specify key technical details of the project:
- Genre
- Format
- Technique
- Duration
- Audience

3. General Project Description: A summary of the theme that the project focuses on and the general concept and appeal.

4. Synopsis: A brief description of the whole narrative of the project. It introduces the main events, the characters that appear, and the plot.

[19] Jonatan. “Cómo hacer una Biblia de Animación.” *notodoanimacion*
[20] *Ibid.*

5. Premise: An explanation of the objectives and intentions of the proposal. It's an explanation of the message that the creator wants to communicate.

6. Character Design: This subpart includes images of the characters that appear, a brief description, and individual traits. It provides insight into their role in the story.

7. Universe Design: Gives examples of the environments and backgrounds used in the project. Includes style references and color schemes.

8. Structure: Define a skeleton of the project with the organized content of the narrative.

9. Audience Strategy: The age range that the project is aimed at. In short, which is the target audience of the production.

10. Planning: A schedule to follow with specific goals and deadlines.

11. Budget: A list of materials and the price range.

12. Team/Who's Behind the Project: Specify the creators and main team members involved in the project.

13. Back Cover: Include contact information of the team and creators.

4.2 Activities Conducted and Results

Reflecting on my interests and capabilities

My first step was to think about which area I would like to learn more about and dedicate my time to, considering my skills and interests. I have always been fascinated by the world of art, especially the fields of design and animation. And since I had little experience in both, I thought that this project would be the perfect opportunity for me to explore the topic further. I have been drawing ever since I was young, and I had just learned how to use Blender in school one year prior. I wanted to take advantage of both of these tools by creating something exciting. With this in mind, I was one step closer to choosing the subject for my project.

Choosing my subject

I brainstormed many ideas that I didn't end up pursuing, some of which were interior design, character design, 3D printing, and architecture. But thanks to these initial proposals, I finally ended up with a short animation. I was deciding between digital, traditional, and stop-motion techniques when I came up with the idea of developing two that I could later analyze and compare. Finally, I selected digital and traditional animation, two contrasting methods that I would subsequently compare, looking for differences and similarities between the two.

Creating my story

My father helped me a lot with this step. He had many great suggestions and ideas, such as using a fish as the focal character and creative transitions between frames. His guidance was essential in shaping my final idea around an ocean theme. Since we live by the Mediterranean Sea, the subject felt especially meaningful. The story revolves around a lost fish that swims through the depths of the ocean searching for its school. Its journey allows viewers to discover the hidden beauty of the sea and its creatures while showcasing the underwater world in all its dimensions. It would be a serene and poetic scene that combines natural tones with magnificent lighting and soothing music and sounds. Therefore, the feeling that the sequence transmits and the visuals have a more important role than the story behind it all.

Looking for inspiration and references

Figure 4. Online inspirations[21]

I continuously looked for inspiration anytime I had the opportunity, entering art shops in Barcelona where the owner and I had a conversation about some art pieces, visiting art museums and galleries, and watching animated films. The two films that were my main focus were The *Song of the Sea* and *Finding Nemo,* which shared the same theme (the ocean) but explored it in different styles. Although Song of the Sea was done digitally in 2D, it inspired my hand-drawn segment, while Finding Nemo gave me a realistic/lifelike version of what I hoped to achieve. In addition to seeking references in my surroundings, I also used the internet as a guide. Pinterest in particular was a very helpful site in this step. I gathered photographs and videos that fueled my creativity, and I placed them into a folder. These let me choose different color schemes, the style, and the overall visual aesthetic.

[21] "Ocean Images." Pinterest

SUMMARY OF INTERVIEWS WITH SEFA PONSATÍ:

AN INSIDE VIEW ON THE CZECHOSLOVAK ANIMATION INDUSTRY

As part of my research, I had the opportunity to consult a resident of La Bisbal d'Empordà who spent 40 years working in the animation and cinema industry, becoming a key figure in the promotion of animated film in Catalonia. Her name is Sefa Ponsatí.

Sefa is one of the founders of Cinètic (1992), located in la Bisbal and dedicated to the diffusion and promotion of cinema among children. This association organizes film education programs for schools based on screenings, exhibitions, and audiovisual workshops.

Sefa Ponsatí studied fine arts in Barcelona and afterward studied design and photography. Later on, she worked with Miquel Porter, with whom she co-founded COCICA (Col·lecció Cinematogràfica Catalana) and Drac Màgic, an audiovisual cooperative in Barcelona.

She organized screenings, exhibitions, and workshops with the goal to showcase international animation from countries such as the Czech Republic, Latvia, Iran, Russia, Japan, and Canada. In our consultation, she informed me that she was always on the lookout for alternatives to DreamWorks and Disney, i.e., non-recognized cinema.

She has served on juries at major international animation festivals, where she met many interesting individuals from the industry. "I fell in love with the people," she told me while talking about her trajectory. Together, she has successfully programmed 26 screenings, the movies of which were donated to the Filmoteca in Barcelona.

What immediately caught my attention was her direct experience with animation from my home country, Slovakia, which at the time was part of Czechoslovakia. I thought that it might be interesting to investigate. She was kind enough to meet with me more than once, including at the La Bisbal city archive. There she provided me with valuable resources, such as old magazines, pamphlets, and catalogs that expanded and enriched my research. She gave me insight into what techniques were used and who were the pioneers of animation at the time, some of whom she had met in person.

The objective of these consultations was to incorporate a more personal perspective into the project. As a result, I became inspired to mix two different techniques, a practice often seen in my home country.

THE GOLDEN ERA OF CZECHOSLOVAK ANIMATION (1945–1989)

A unique perspective[22]

The history of Czechoslovak short films is heavily linked to cinema history in general. Just two and a half years after the Lumière brothers' groundbreaking premiere at the Grand Café in 1895, the first short films by Jan Kříženecký were created.

Animation was considered unimportant in most countries at the time. However, in Czechoslovakia, it became one of the first official and organized types of film. The distinctive national character of the country's cartoon and puppet films spread all over the

[22] Pos, Jean. "Une contribution indispensable: celle du cinéma d'animation tchécoslovaque." *Paris-Prague*

world. Its qualities included originality in theme, artistic presentation, technique, and the use of satire and humor. Its masterly animation demonstrated that films for youth are equally worthy works of art as films for adults.

After World War II, the government took control of the film industry and created a state-run system and a national animation cinema. Political pressure demanded that animation should only entertain children and teach moral lessons, and the socialist state requirements limited the artists creativity. Even with the restrictions, artists like Trinka, Zeman, and Týrlová, the pioneers of that time, invented new animation techniques themselves and developed their own style, which shaped Czechoslovak cinematography forever.

By the 1950s, the country's animation style became world famous and one of the most important contributions to global animation. Rich, imaginative, and expressive films were being developed. Their style came from national artistic traditions and functioned as an original, serious art form, not just children's entertainment.

After a while, new artists emerged, including Pojar, and a new generation took over, shifting from puppets to cartoons. American style was considered a threat to the unique style, so instead they used national tales and collaboration across different disciplines: writing, composing, illustrating, and animating. Animations were inspired by national culture, such as legends and tales.

The golden era of Czechoslovak animation ended with the collapse of Communism in 1989. Animation was an expensive medium, and private finance was reluctant to cover it on the same scale. But outstanding Czech animated films were still being made, moving beyond fairy tales to contemporary everyday life, humor, playfulness, and mockery.

Most used techniques and visual style[23]

The main techniques used during this era were image-by-image animation, stop motion, paper cut-outs, and puppets. Puppet films were especially important and unique. Almost all the excellent puppet animations came from Czechoslovakia or were inspired by them. The pioneers of this style were Hermína Týrlová, Karel Zeman, and Jiří Trnka. Some artists even mixed different kinds of techniques, combining drawings, cut-outs, live actors, and models in a single film.

As for the visual style, Czechoslovakian artists were inspired by folk art, legends, and national culture. They tended to break down Disney's mainstream Western animation style and often used surreal, abstract, and poetic elements. Each artist had their distinct visual style. While Trnka explored lighting and perspective, Pojar used expressive detail and gesture that helps the audience differentiate their films. Although each artist had their style and technique, they were united by the belief that animation was a serious art form, not just a form of entertainment.

Czechoslovak Pioneers and Their Creations[24]

The most outstanding personalities in the sphere of animated children's films were:

[23] Adamec, Oldřich. "Introduction." *Czechoslovak Film Annual Cartoon and Puppet Films*
[24] Adamec, Oldřich. "Twenty Years of Czechoslovak Cartoon and Puppet Films." *Czechoslovak Cartoon and Puppet Films*

Karel Zeman—mostly worked with puppets and created realistic animations where puppets could interact with live actors. He combined techniques (drawings, puppets, cut-out objects, and real actors) in a single film. Zeman believed childhood is a time for learning and observing, the time of life when imagination and fantasy are wide awake. *The Fabulous World of Jules Verne* (1958) reflects that thought.

Jiří Trnka—developed new styles and techniques. His films are not just for children. They are powerful stories that do away with Disney-style graphic clichés. His interest in puppets, depth, space, lighting, and photography achieves expressive effects through epic, lyrical, and dramatic principles. This is seen in his animation *The Hand* (1965).

Hermína Týrlová—she was an animator, model maker, and director. She was a pioneer in puppet and stop-motion animation, often using everyday objects as characters. Týrlová was known for her creative use of materials, such as paper, puppets, or toys, which bring inanimate objects to life. She placed emphasis on childlike imagination and wonder. One of her well-known shorts is *Revolt of the Toys* (1947).

Břetislav Pojar—made inanimate objects come to life on screen. He was the master of the art of puppets and stop-motion animation. The emotional gesture and expressive detail of movement dominate his storytelling. He typically mixed humor, playfulness, and emotion, appealing to both children and adults. He was known as Trnka's closest collaborator. One of his most popular creations is *Come On, Sir, Let's Play* (1965), a playful animated series.

Viktor Kubal—widely regarded as the father of Slovak animated film. He made more than 200 films (some puppetry and some traditional animation) throughout his entire life as both animator and director. Kubal's films have elements of comedy and tragedy, irony, humor, and charm. They displayed expressive gestures and exaggerated movements, which gave his characters a comic yet emotional depth. A great example from his 200 films is *Jurko the Outlaw* (1976).

Figure 5. Well-known Czechoslovak animation "Krtek (Mole)"[25]

[25] Miler, Zdeněk. "Mole." *Films and Film Festival for Children in Czechoslovakia*

Making the Animation Bible (“Pitch Bible”)

After conducting research on the animation process, I came across a tool that is often used to gather all the essential information and elements (concept, genre, character design, etc.) used by creators to “pitch” the project to seek funding. I developed an animation bible as a part of my preparation. This was submitted as a separate document. I included:

- general description
- sinopsis
- technical sheet
- premise
- structure
- visual inspiration
- design of characters
- design of world and backgrounds
- style references
- storyboard
- material necessary
- calendar

See the Annex, section 9.1, for images of the full Animation Bible.

Designing my characters and universe

After deciding the theme and making up a well-structured story, it's time to design its characters. I decided on three different kinds of sea creatures that will be the protagonists of the animation. First I made sketches of my different ideas, then I drew out their official designs and decided on their color scheme, textures, and the different movements they produce.

I did this by studying their movement and body language through 3D models on Sketchfab, a website that allowed me to see them from every angle. I could maintain the creature's movements in a static pose or on loop and even adjust the speed.

Since all of this took place in the ocean, the world would take place underwater. I made the backgrounds simple since adding more elements to each scene would take focus out of the protagonists and wouldn’t be time efficient.

Figure 6. Giant manta ray[26]

Figure 7. Humpback whale[27]

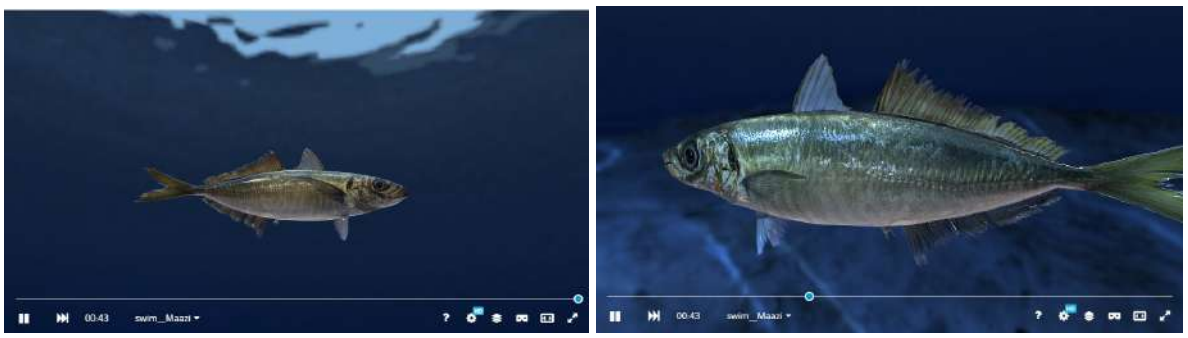

Figure 8. Horse mackerel(Trachurus japonicus)[28]

[26] Nesterov, Mikhail. “Giant Manta Ray.” *Sketchfab*
[27] GoldenZtuff. “Humpback Whale.” *Sketchfab*
[28] AQUA, MEA. “Horse Mackerel(Trachurus japonicus).” *Sketchfab*

Creating the Storyboard

To previsualize my animation and try out different compositions, framing, spacing, and timing, I put together a collection of illustrations. I learned how to create a storyboard in a class last year, so this is a great example of how I took advantage of experiences and tools and used them in my project. I assigned a certain camera movement (traveling, zoom, etc.), camera angles (low view, high angle shot, etc.), transitions (cut, fade, etc.), and duration (in seconds) and a brief description to each shot. This graphic organizer clarified my vision of the final product, and the planning saved me time in the future. At first I just cut out panels that would serve as my frames. I laid them out, drew out my ideas on them, and kept redistributing them until I was satisfied with the arrangement. It served as a great visual representation of my narrative. My shots were simple but cinematic. In some scenes the camera was dynamic and alive, in an attempt to move with the current.

Figure 9. Storyboard. *Source: Author.*

Choosing the style and technique

I had already decided that the digital part of the animation would be done using Blender. It is complex to work with Blender, what with having to create animals that have very particular movements and simulate life-like water, so I knew that it would be a challenge. My goal was to make realistic visuals so that the comparison between the digital and traditional parts would be evident. What was left to decide was the hand-drawn fragment. I ended up testing out a few different techniques, such as watercolor, colored pencil, and oil pastels. After considering and testing the possibilities and benefits of each, I landed on watercolors.

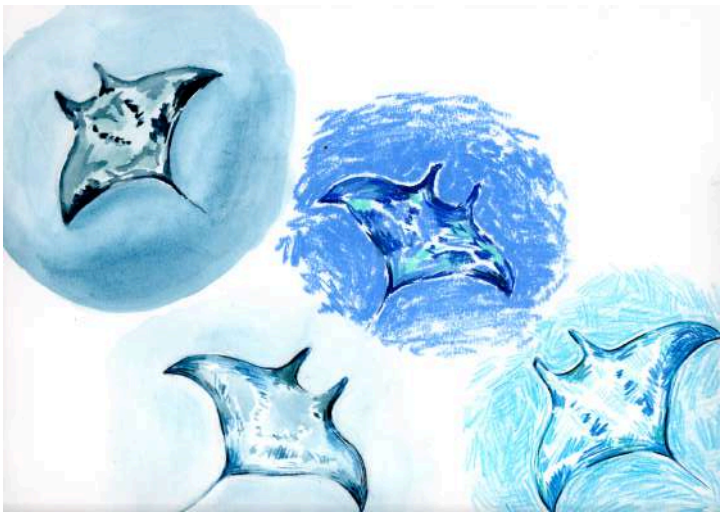

Figure 10. Trying different techniques. *Source: Author.*

Watercolors are not only efficient, straightforward, and fast to work with, but they also fit into the visual design that I imagined, with expressive brushstrokes, pigmented colors, and minimal backgrounds, resulting in a peaceful and captivating sequence. I decided to include cool and neutral colors with different saturation and lightness. These colors symbolize calmness, serenity, and balance, which is what I intended to communicate in my animation. As for the FPS, my intention wasn't to create a perfectly smooth, hand-drawn animation. The deliberately choppy, snappy motions with an artistic feel were precisely what I was aiming for. And of course, using fewer drawings also worked to my advantage and saved production time.

Required Material and Services

MATERIAL/SERVICE	QUANTITY	PURPOSE	NOTES/DETAILS	COST
Blender software	1	to create the digital animation	5.0 version	Free
School Laptop	1	to work with blender	Lenovo	Free (already owned)
Amazon AWS EC2 compute instance (usage cost)	2	for more effective rendering	g6.xlarge	$40
Lightbox/Tracing pad	1	for tracing drawings	LED	Free (provided by the school)
Watercolor papers	60	support for paintings	200 gsm	30 €
Watercolor set	1	for coloring drawings	24 colors	Free (already owned)
Paintbrushes	4	for painting drawings	filbert, liner, and round	Free (already owned)
Notebook	1	for animation bible	bound	12 €
Scanner	1	for scanning drawings	EPSON	Free (already owned)
Editing software	1	for editing the final product	Capcut	Free
			TOTAL	82 €

Testing my ideas

To get familiar with the lightbox device, I illustrated a movement of a swimming fish to test out the tracing of the drawings and illumination. The test was successful, it showed me how many FPS I needed to generate smoothness in my animation.

Figure 11. Simple fish frames. *Source: Author.*

In addition, I made some tests on Blender on water dynamics in all its forms. This let me improve my final file.

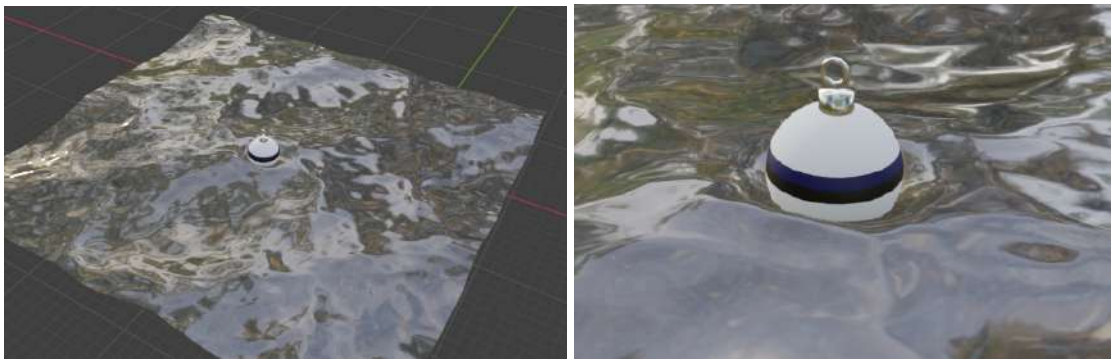

Figure 12. Testing water dynamics in Blender. *Source: Author.*

4.2.1 Blender 3D animation

Digitally I generated six separate objects for my animation. These included the fish, a school of fish, a whale, a close-up of the whale, the ocean, sand, and light rays. The only object that I didn't develop myself was the rocky formations found in the whale scene. Instead, I uploaded them from BlenderKit, an extension that offers countless free materials, brushes, and 3D models in Blender. In total, all of this amounted to three files: the transition scene with the whale, the whale close-up, and the very final scene where the fish is rejoined with its school.

I made a few initial tests and designs during the summer to get familiar with the tools that I will be using.

Figure 13. Blender animations. *Source: Author*

4.2.1.1 General Process

Each Blender project has to go through a process with common foundational steps that collectively bring an idea into a visible reality. Here are the steps for developing each scene:

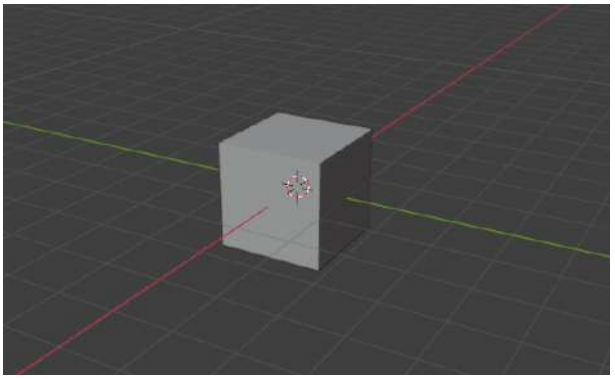

Figure 12. Modeling in Blender - cube. *Source: Author.*

1. Modelling. This is the first step to any Blender project. It consists of shaping the geometry of the mesh (vertices, edges, faces) and transforming it into a rough shape of your object.

I did this by adding a cube in an infinite space made up of three spatial axes (x, y, z). I applied a symmetry modifier so that the changes I made in edit mode are executed on both sides. Afterward, I started loop cutting (Ctrl+R) my mesh and extruding the points of the cube until I reached the shape that I wanted. I also applied a subdivision surface modifier to increase detail in the mesh and create a smoother appearance.

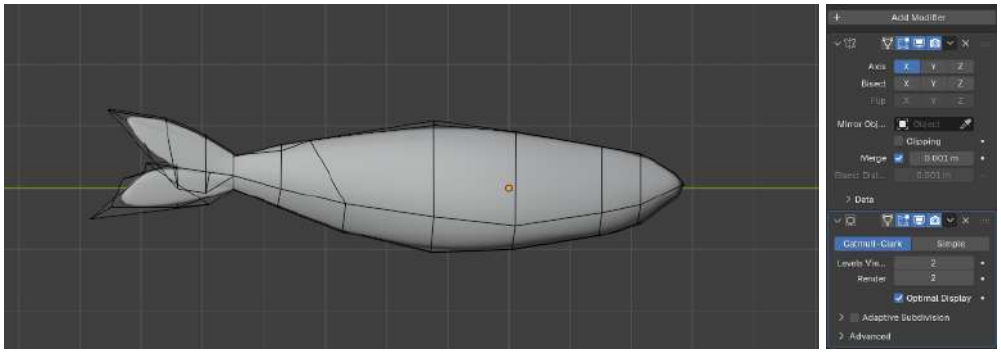

Figure 14. Modeling in Blender - mesh with configurations. *Source: Author.*

2. Adding colors and textures.

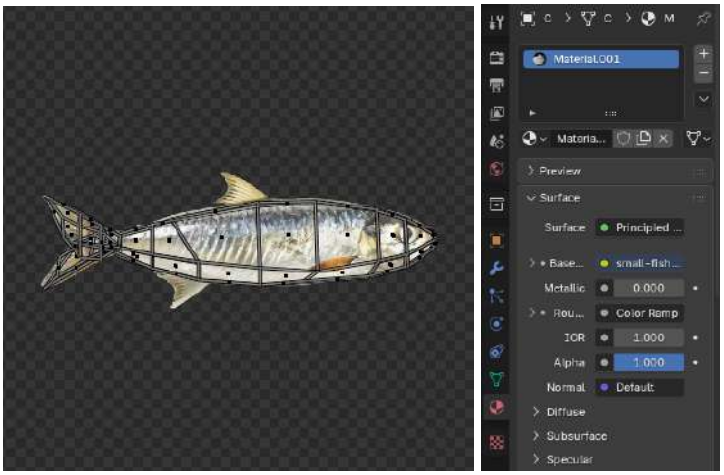

Figure 15. Colors and textures in Blender. *Source: Author.*

After constructing the form of the object, it was time to add some textures. I did this by downloading an image from the internet to make it look as realistic as possible without having to sculpt or texture paint, which my school laptop couldn't handle. In the **Material Properties** configuration, I selected *Principled BSDF* and applied the image as the base material. In **UV Editing,** I made sure that the shape of the mesh overlaid perfectly with the image. This would transmit the texture that I want into the fish on both sides (thanks to the symmetry modifier).

3. Armature. Next I rigged my object so that I could animate its mesh. The purpose of creating a skeleton for any object is to bring its movements to life as precisely as possible. I did this by adding an armature with multiple interconnected bones that I later manipulated in pose mode. By connecting the model's mesh to the armature, I made the mesh follow the bones' movements. This step is called parenting with automatic weights. I also used **Weight Painting** to assign influence to the model's vertices, determining how much each bone controls their movement.

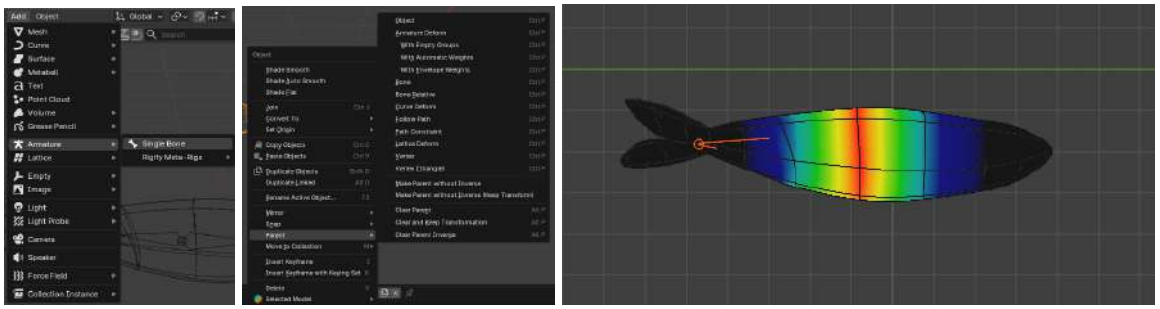

Figure 16. Armature in Blender. *Source: Author*

4. World texture. Now that I had my object created, the next step was to simulate its surroundings. This is selected through **World Properties** in BlenderKit.

5. Lighting. Lighting up the scene is essential. It determines how the colors, textures, and objects are going to show up on screen. It is essential to achieve the right balance, avoiding both overexposure and underexposure.

I decided to create light rays to make the sequence more realistic underwater. I did this by adding a light area to distribute the luminosity evenly. Furthermore, I increased the power to 1500 and used **Shader Editor** to add nodes that I connected with wires to create complex procedural effects. This step let me create strands of light instead of one big area.

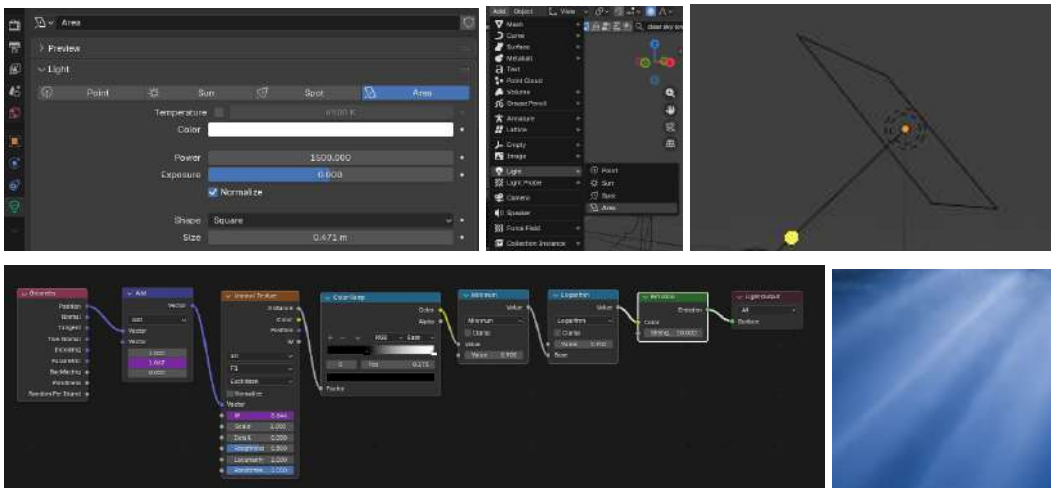

Figure 17. Lighting in Blender. *Source: Author*

6. Camera. The final object necessary to add is the camera. It defines which portion of a scene is visible in the rendered image. In camera properties, I set the lens to perspective and changed the focal length to 30 mm. The placement and angles depended on what object to focus on.

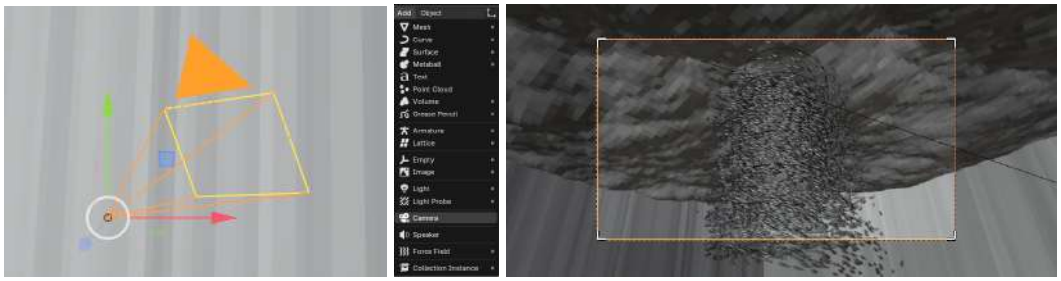

Figure 18. Camera settings in Blender. *Source: Author*

7. Animate all objects. This is one of the most difficult steps. In Blender, animation is done by setting the keyframes that hold each object's values (position, rotation, and scale) that I previously assigned. Blender then automatically generates the motion between keyframes, creating a smooth sequence. In **Timeline Editor,** I configured the position of the keyframes so that I could achieve the desired speed and timing of the motion picture.

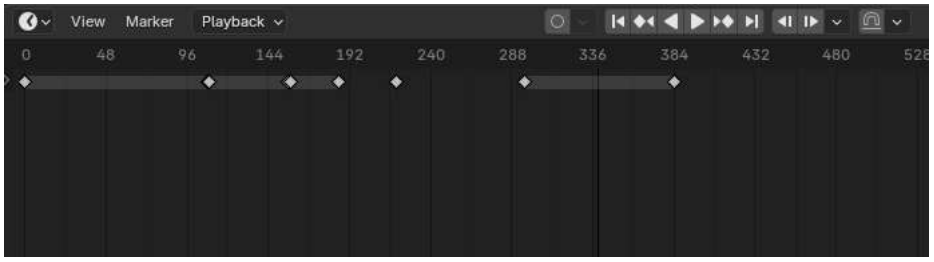

Figure 19: Object animation in Blender. *Source: Author*

9. Render/Output Properties. In **Render Properties,** the render engine that I chose was *Cycles*. Contrary to *EVVE*, this engine gives much more realistic lighting, complex materials, volumetrics, and cinematic realism. I changed the **Device Settings** to *GPU Compute* (see the section **Problems and Solutions**) and checked *Denoise* to make the frames look smooth and clean. Finally, I inserted 400 max render samples per frame.

In output properties, I left the frame rate at 24 FPS and edited the frame range depending on how long my animation was. After changing the file format to PNG and the media type to video, I selected a folder from my laptop into which my file was going to be stored after rendering.

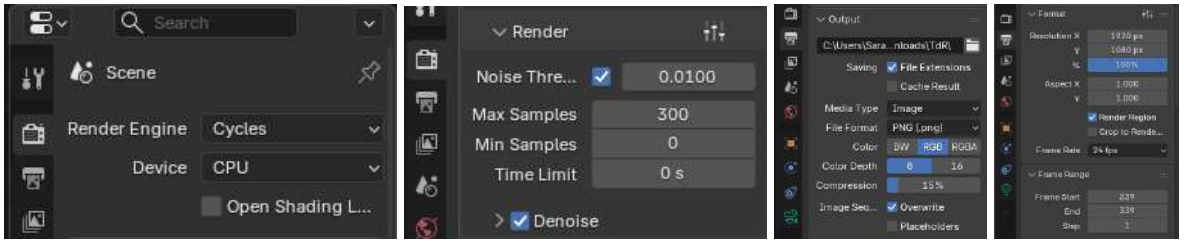

Figure 20. Examples of rendering properties in Blender. *Source: Author.*

10. Render. When all of my work was finished and the properties I needed were configured, I simply clicked on render animation and waited until my final product was revealed. This step can take hours depending on the length of the animation, the complexity, and the number of frames to render. So patience is a virtue.

Figure 21. Rendering a video in Blender. *Source: Author.*

Sources of information and tutorials

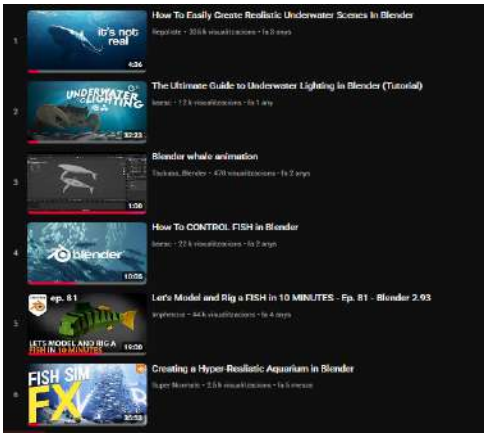

Figure 22: YouTube tutorials[29]

I followed many tutorials that allowed me to create more complex designs[30]. They have provided me with all the necessary information that I needed to generate ocean water, light rays, and sand. Once I had all the tools, instructions, and a more profound understanding of certain functions that Blender offers, I was capable of working independently.

[29] YouTube, *YouTube*
[30] Normals, Super. “Creating a Hyper-Realistic Aquarium in Blender.” *YouTube*; Imphenzia. “Let's Model and Rig a FISH in 10 MINUTES.” *YouTube*; baeac. “How To CONTROL FISH in Blender.” *YouTube*; Tsukasa_Blender. “Blender whale animation.” *YouTube*; CLAYMORE_DEV. “How to Model Any Fish In Blender.” *YouTube*; baeac. “The Ultimate Guide to Underwater Lighting in Blender.” *YouTube*; Regoliste. “How To Easily Create Realistic Underwater Scenes In Blender.” *YouTube*

4.2.1.2 Problems and solutions

Problem #1: Constant glitching on my school laptop. The device couldn't handle the quantity of work done in the program, and I kept having to restart it.

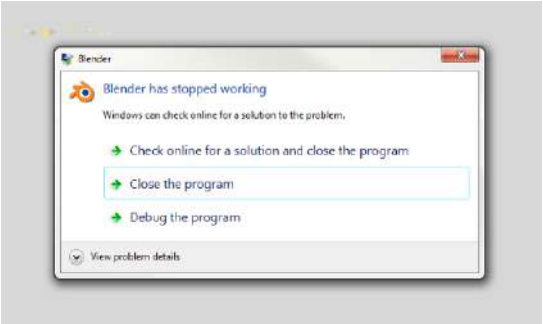

Figure 21. Blender error dialog.*Source: Author.*

Solution #1: Quantity over quality. I had to lower the resolution of my file and assign fewer textures for it to function properly.

Problem #2: The school laptop is inadequate for Blender renderings. Blender renderings on my school laptop take hours, and often result in errors or corrupted output files. For example, rendering 1 frame of one of my videos takes 1.5 hours. And with the amount of keyframes that I had and the quality that I wanted, it would have been impossible to render in time.

Solution #2: Use an Amazon AWS EC2 instance for Blender renderings. Cloud computing services like Amazon AWS offer configurable compute instances for rent, including those with GPUs. Since my father already had an Amazon AWS account for his work, he was able to help me configure an EC2 compute instance. This tool allowed me to make renders at a remarkable pace.

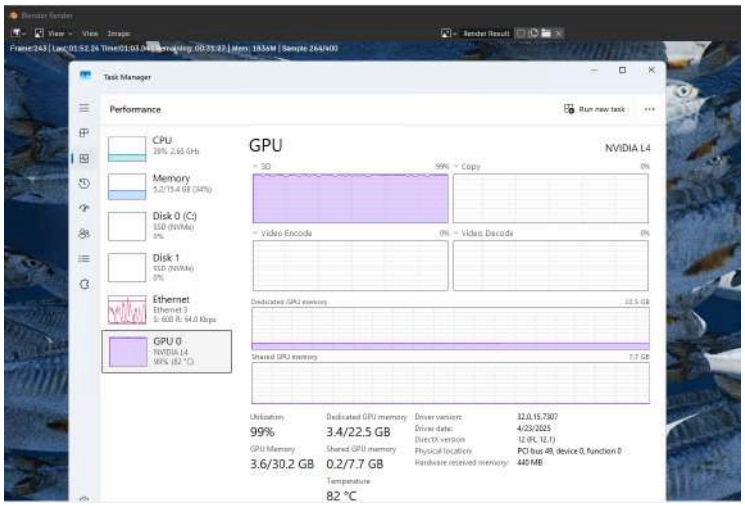

Figure 23. GPU metrics when rendering on Amazon EC2 GPU instance. *Source: Author*

Problem #3: Transferring files. Another issue was transferring all materials, textures, and lighting from the file onto Google Drive and then to the EC2 compute instance on Amazon AWS. When only copying the Blender file, information such as the texture was missing, as seen in the first image below:

Figure 24. Comparing renderings where texture is missing. *Source: Author.*

Solution #3: Pack all Blender files. There are multiple separate Blender files per project. I packed all of them into one large self-contained file before transferring it onto the EC2 compute instance on Amazon AWS.

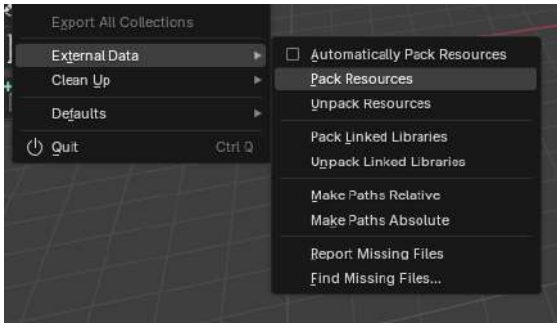

Figure 25. Packing Blender files. *Source: Author.*

Problem #4: Not being able to see the final product when in cycles. **Viewport Render Shader** is just a preview of your work. It's fast but an estimate, and it's difficult to predict how your render will turn out.

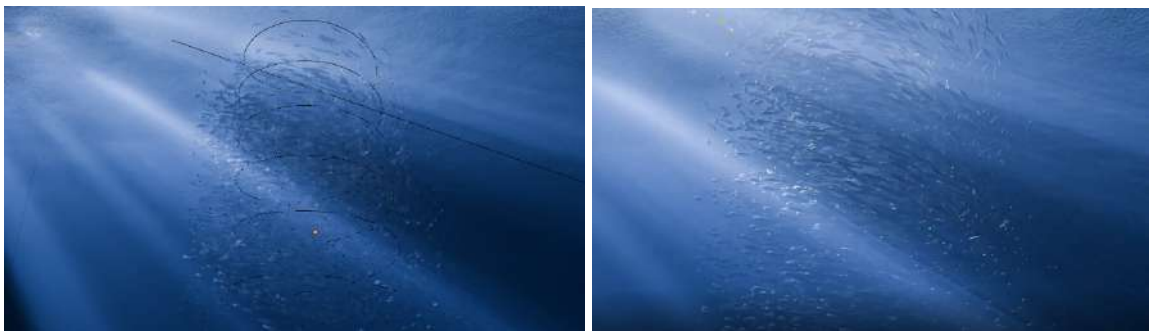

Figure 26. Blender Viewport Render Shader. *Source: Author.*

Solution #4: Testing. I had to do render tests of one single frame to see what the animation would look like. This gave me a much better idea of the ultimate quality.

Problem #5: The properties wouldn't get copied even after packing the file. After transferring my file, the settings would reset, and there would be a slight change that would modify my whole scene.

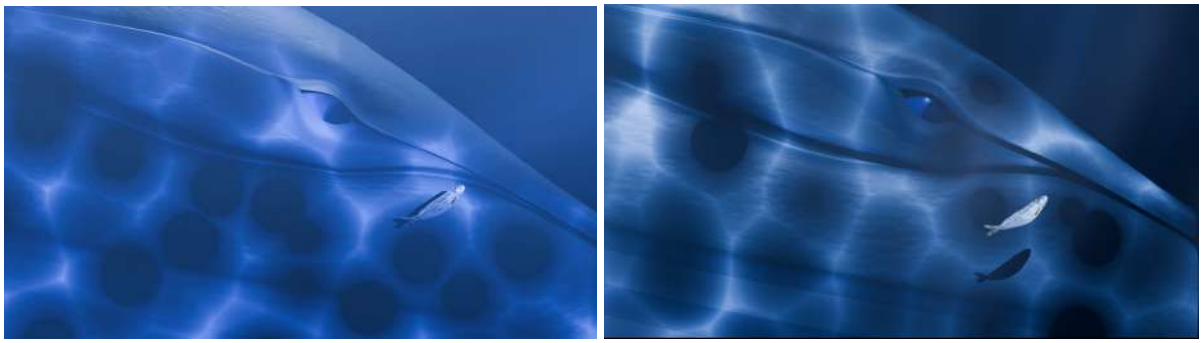

Figure 27. Scene comparison with different settings in Blender. *Source: Author*

Solution #5: Compare settings. After packing everything, I had to compare all render and output settings on my school laptop to the EC2 compute instance. This way there weren't any unwanted changes, as shown in the first image.

Problem #6: The rendering still takes too long. A single, entry-level GPU machine (g4dn.xlarge, which has an older T4 GPU) was still taking too long to render the videos (estimated 40 hours for a 20-second video).

Solution #6: Upgrade the GPU machine on Amazon AWS. We upgraded to a single, newer GPU (g6.xlarge, newer L4 GPU), and it ran more than 2 times faster. We also lowered the sample size and made other rendering configuration optimizations, the tradeoff being slightly lower video quality for faster rendering speeds.

4.2.2 Hand-drawn animation

4.2.2.1 General Process

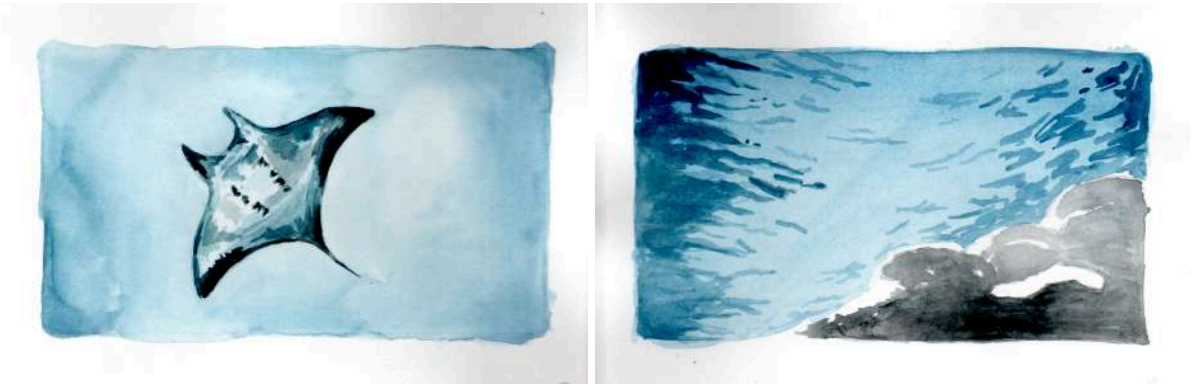

Figure 28. Cels hand-painted with watercolors. *Source: Author.*

1. **Draw grids.** I measured the camera grid from the digital animation to make sure that the hand-drawn would match and added two on each page. I used two frames per paper so that I don't waste too much material or time.

2. **Deciding on frames-per-second.** I used a metronome to envision how many frames would be appropriate and necessary to use. I decided on around four FPS.

3. **Tracing.** I would choose a scene that I wanted to paint and make a quick sketch of the main character. I would overlay the pages and use a lightbox to trace the drawings while making slight changes, thus creating movement. Then I would number the pages consecutively.

4. **Testing**. I took pictures of the frames on my phone to preview what the animation will look like. I checked how fluid the motion was and if there wasn't any inconsistent spacing or timing. I made any necessary changes before painting it.

5. **Painting**. I started with the objects and then moved on to the background. It was important to make sure that all strokes and colors matched the previous frame. I repeated this process until all the scenes were finished.

6. **Scanning.** My brother and father scanned 60 pages worth of drawings. In properties they selected 300 DPI and saved them as PNG files, each about 5 MB.

Sources of information

I watched a fascinating video on how older Walt Disney cartoons were made[31]. Although I used a different technique and my project is more modest, it gave me insight into traditional methods used in the past and what steps I needed to take.

[31] puntadeleste. "How Walt Disney Cartoons are made." *YouTube*

4.2.2.2 Problems and solutions

Problem #1: Having to start all over if I make mistakes. There was no return button. If I made an incorrect movement, I had to repeat a frame or even a whole sequence.

Solution #1: Sketch first, paint later. Using pencil before applying the final coats of paint saved me from making irreversible mistakes.

Problem #2: Too much complexity. This could mean taking away precious time that I was unable to afford at this stage.

Solution #2: Simplify components. It was necessary to simplify many elements (primarily backgrounds) to save time and facilitate production.

Problem #3: Waiting for the paint to dry. Watercolors dry slowly, especially when using the wet-on-wet technique.

Solution #3: Multitask. I would work on multiple frames at a time to avoid having to wait for them to dry.

4.2.3 Editing/Postproduction

I used the CapCut online software application to put together both the hand-drawn individual frames and the rendered scenes. I chose this video editor because I had used it in the past, and I was familiar with how it functions. I had previously planned to use Adobe, but due to time restrictions, I had to play it safe with an application that I had experience with. I cropped the grids and edited the duration of each frame. Finally, I put them in the right order and added some transitions to make the sequence easier to digest.

Creating the transition

The transition between hand-drawn and digital animation was an important step. Inspired by videos online, I had the idea of using an occlusion transition. The shot consists of a 180-degree orbit around a subject with the camera locked onto it. As the camera completes the orbit, it passes through another object using natural occlusion, revealing the other technique on the other side with no visible cuts.

Choosing music and sounds

To make the video more realistic, I uploaded diverse environmental sounds onto CapCut (splashes, whale sounds, ocean sounds, manta ray sounds…) and chose serene background music to accompany my animation.

The final product

After working through all of these steps, I successfully completed my first-ever short animation. See the QR code and link on page 1.

5. CONCLUSIONS

The aim of this project was to deep dive into the world of animation by exploring its history, process, and techniques. I began this project in June of 2025 and finished it in January of 2026. I completed the project in eight months. I produced 120 frames by hand and 640 frames digitally, with a duration of around two minutes. I have completed all of my objectives, including producing a short animation and comparing the techniques that I used. Overall, I found the practical part challenging. I had gone through many difficulties that made the final product far from perfect, but I am proud of the work that I put into it.

5.1 Hypothesis Evaluation

Hypothesis 1: Cell animation, the traditional animation technique, is more time-consuming and labor-intensive than digital animation. The results support this hypothesis because you must draw each individual frame by hand. One simple movement can take hours to create, especially if you want a smooth animation. On the other hand, computer software such as Blender lets you create keyframes in the Timeline and automatically interpolates (fills in) the rest between them to create smooth motion. This step facilitates the production. Instead of spending hours drawing and correcting mistakes, you can shift the object and assign a keyframe.

Hypothesis 2: Digital 3D animation requires more skills and tools and therefore is less accessible. The results support this hypothesis. Blender is a software that needs time and dedication to fully understand its complex functions. It is necessary to understand and have minimal experience in the program if you want to use it properly. On the other hand, traditional animation doesn't depend on advanced digital software or equipment and therefore can be done by anyone. It only requires an understanding of motion and a certain level in drawing.

Hypothesis 3: Cel animation is more expensive than digital 3D animation. The results partially support this hypothesis. Although this is true for most large-scale projects that I investigated in my research, my case was different. My computer-generated scenes ended up costing more than the hand-drawn ones. Even though the software didn't depend on any physical material, I had to pay for the Amazon AWS EC2 compute instance to speed up the rendering of my scenes. This turned out to be the most expensive tool that I paid for throughout the entire project.

Hypothesis 4: Both traditional and 3D digital animation have their own unique visual qualities and features, which shape the way they communicate with audiences. The results support this hypothesis. My final product showcases the visual aspects of both techniques. I found that the traditional style was more expressive and had an artistic quality with human elements that the digital struggled to replicate. However, the 3D computer-generated method created a highly realistic 3-dimensional world with complex visuals. It achieved greater realism through real-world physics and material properties, which create lifelike environments. In summary, while both techniques tell the same story, the medium itself influences how the audience experiences it.

Hypothesis 5: Major animation studios (such as Disney) switched from traditional to digital 3D animation because it was more practical at the time. My research supports this hypothesis. In the past, it took hundreds of artists and crew members to develop billions of frames used in one single production. After technological advancements, studios adapted to computer-generated software, which ended up being less labor-intensive, more efficient, and less expensive to produce and required fewer workers. On top of that, my research proves that the public's interest in new technologies and the unknown helped it rise in popularity.

5.2 Additional Findings

- In Blender, creating many different objects can be difficult, but copying the same design is easy (using CTRL+C). On the other hand, in cel animation, drawing different objects is easier compared to doing it digitally, but making copies of the same design makes it difficult (must be done manually).
- The technical difficulties in Blender that you find along the way took up more time than the rest of the process in the software. Many of these issues are difficult to solve, and consume a lot of time and energy.
- In digital animation, generating camera and light movements is so much easier than it would be in cel animation. Using keyframes, the motions are done for you and don't require manual redrawing for each frame.

5.3 Limitations

My first obstacle was the computer hardware. My school laptop was inadequate for modeling and rendering my scenes. I had to adapt by using less complex textures and rendering my scenes on the Amazon AWS EC2 compute instance.

My biggest limitation was time. Animating is a very time-consuming process, and eventually I ran out of time. I had to adjust and cut off some of my ideas and save them for another project.

5.4 Directions for Future Research

If I had more time or if I were to continue the research, I would have extended the sequence and my research on Slovak animation. I had a lot of fascinating material on the subject, and I was only able to use a tiny part of it. I also would try using stop motion as one of the techniques. Finally, I would have loved to 3D print an object that I created in Blender to have a physical object of my work.

6. ACKNOWLEDGMENTS

I would like to thank the following people for their support and guidance during this project.

- I would like to thank Marta Alsina, my tutor for the project, for her willingness to provide guidance and constant feedback. Her consistent availability helped me mold my project into what it is today.

- I am grateful to Sefa Ponsatí for all the time she dedicated to meeting with me and for providing me with valuable resources. I am sincerely grateful for her interest and continued help and suggestions. (And thanks to my neighbor, Ignasi Corney Oller, who suggested talking to Sefa Ponsatí as part of my investigation).

- I also appreciate my brother's help to scan my drawings one by one. His assistance and time dedicated are greatly appreciated.

- I am grateful for my mother's support and for helping me scan, print, and choose my animation technique.

- Finally, I want to thank my father, without whose interest, patience, and support I would have never gotten this far. He has motivated and encouraged me whenever I needed assistance, and for that I'm truly grateful.

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8. GLOSSARY

Amazon Web Services (AWS): Amazon's massive, on-demand cloud computing platform.

Blender: A powerful, free, and open-source 3D computer graphics software used for creating animated films, visual effects, 3D models, video games, and interactive 3D applications.

BlenderKit: A popular add-on for Blender that provides a vast library of 3D assets such as models, materials, HDRIs, and brushes directly within the software.

Cel Animation: The traditional animation technique, where **"cel"** comes from *celluloid*, the transparent sheets historically used in animation. Each cel is hand-drawn and becomes a frame in the film.

Cycles: Blender's powerful, physically-based rendering engine that creates photorealistic images by simulating how light behaves in the real world.

Digital Animation: The modern animation technique that includes 2-dimensional (2D) and 3-dimensional (3D) imaging, virtual cinematography and lighting, and digital post-production.

DPI (Dots Per Inch): Measurement of image resolution and detail, indicating how many ink dots a printer lays down or how many pixels a scanner captures in one inch.

Edit Mode (Blender): Where you manipulate an object's actual geometry (vertices, edges, faces).

FPS (Frames per Second): Dictates how many still images (frames) are shown each second to create the illusion of motion.

Frame: A single, static image in a sequence.

GPU (Graphics Processing Unit): Graphics card, used to dramatically speed up rendering (especially with the Cycles engine) and improve viewport performance, handling complex shading, lighting, and large geometry much faster than the CPU.

.

HDR (High Dynamic Range Images): Spherical image files used as powerful, realistic environment lighting, backgrounds, and reflections for 3D scenes.

Keyframe: A time-stamped marker that records the value of an object's property (like location, rotation, scale, or color) at a specific frame.

Mesh: The fundamental building block for 3D models, representing a shape as a collection of points (vertices), lines connecting them (edges), and filled surfaces (faces or polygons).

MKV: A video file format that uses the Matroska multimedia container format

Natural Occlusion: It refers to the fundamental visual cue where one object physically blocks part of another.

Nodes: Visual building blocks representing data, settings, or operations (like math or logic) that you connect with “noodles” (wires) to create complex procedural effects for materials (shaders), geometry, textures, and image compositing.

Packing: Embedding external data, like image textures, fonts, or linked libraries, directly into the .blend file, turning it into one large, self-contained file instead of managing separate files and paths for portability, sharing, or rendering on other machines.

PDF (Portable Document Format): A universal file format for presenting documents, including text, fonts, images, and interactive elements like links and forms, consistently across different software, hardware, and operating systems.

PNG (Portable Network Graphics): Popular image file format known for lossless compression and supporting transparent backgrounds.

Render: The process of converting your 3D scene (models, lights, textures, camera) into a final 2D image or animation.

Render Farm: A powerful cluster of interconnected computers (nodes) that work together to rapidly process and generate complex computer-generated imagery (CGI), 3D animations, and visual effects.

Rigging: Creating a digital skeleton (an armature) for a 3D model, allowing animators to pose and move it like a puppet to create realistic motion.

Sample: Refer to the number of light paths calculated per pixel during rendering.

Sculpt Mode: Alters mesh geometry with brushes for shape, while Texture Paint Mode applies color/materials directly onto the mesh's UVs.

Shader editor: Blender's node-based workspace for creating and editing materials, defining how surfaces look by connecting functional blocks (nodes) to control color, roughness, shine, and complex visual effects like displacement or procedural textures.

Subdivision surface modifier: Used to smooth a low-poly mesh by adding geometric detail, splitting faces into smaller ones to create complex, organic, and curved surfaces without manual high-poly modeling.

Symmetry modifier: A collection of tools and features (like the Mirror Modifier, Symmetrize tool, and in-viewport toggles) used to create matching halves of a model.

Texture paint: A powerful feature that lets you paint colors, details, and effects directly onto a 3D model's surface.

Timeline editor: The central interface for controlling animation, showing frames over time (the X-axis), a blue playhead for the current frame, and diamond-shaped keyframes where property changes are set.

Viewport Render Shader: The real-time rendering mode in 3D software that applies shading, lighting, and material effects directly within the 3D viewport.

Wet-on-wet: Painting technique where wet paint is applied to a surface that is already wet, either with water or previous layers of wet paint.

9. ANNEXES

9.1 Animation Bible

Source: Author.

DESCRIPCIÓ GENERAL

Aquesta història segueix un peix perdut que navega per les profunditats de l'oceà a la recerca del seu banc. El seu viatge permet als espectadors descobrir la bellesa amagada i silenciosa de l'oceà i de les seves criatures hipnòtiques. Està construïda tant amb animació tradicional com digital, contrastant entre les dues i mostrant el món submarí en totes les seves dimensions.

FITXA TÈCNICA

- Gènere : animació curta atmosfèrica i poètica
- Format : curtmetratge
- Tècnica : animació tradicional barrejada amb digital (2D i 3D)
- Durada :
- Públic objectiu : general

SINOPSI

El curtmetratge s'obre amb el títol apareixent al fons de l'oceà. Un Un petit peixet bellugadís salta fora de l'aigua i hi torna a entrar, iniciant el seu viatge per trobar el seu banc. El motiu de la separació continua sent un misteri, però el seu objectiu és clar. Es troba enmig d'un banc estrany que no li pertany, però igualment s'hi uneix durant un temps mentre navega més profundament dins l'oceà. Després de separar-se del grup, neda al voltant d'una manta oceànica i, més endavant, es desplaça al costat d'una gran balena gepervda, impassible davant la seva escala imponent. Finalment, el petit peix troba el seu banc i s'hi uneix en una espiral.

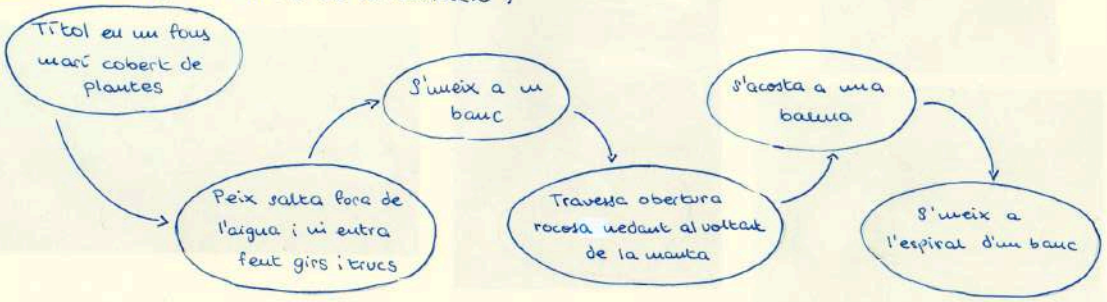
PREMISSA

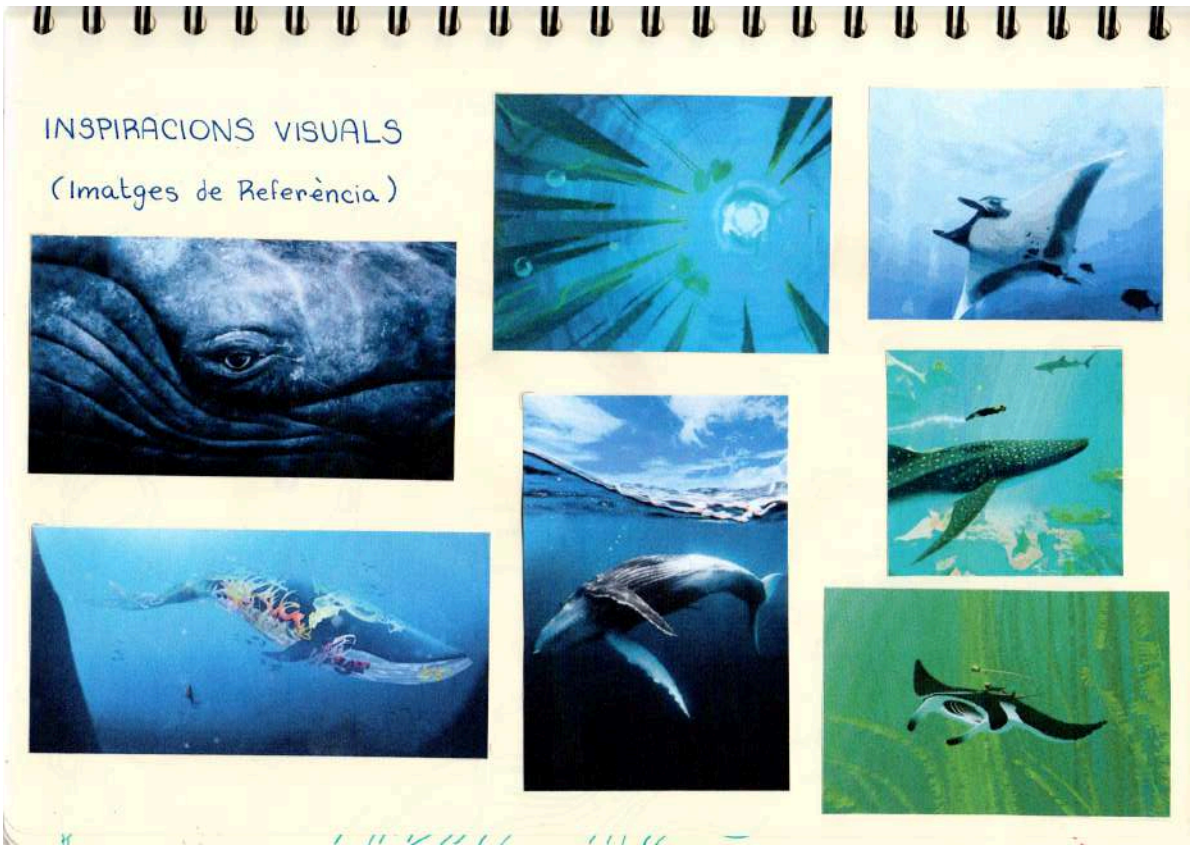
L'objectiu no és comunicar una història, sinó transmetre una sensació. Una sensació de pau, harmonia i serenor. Crear una atmosfera que permeti a l'espectador aturar-se i admirar un silenci durant un instant. Per aquest motiu, aquesta animació s'adreça al públic general. És altament visual i abstracta, amb la intenció de transportar els espectadors a les profunditats de l'oceà i permetre'ls veure sota la superfície com de petits i insignificants som realment els humans. Que hi ha alguna cosa molt més enllà del nostre control que sovint obliden.

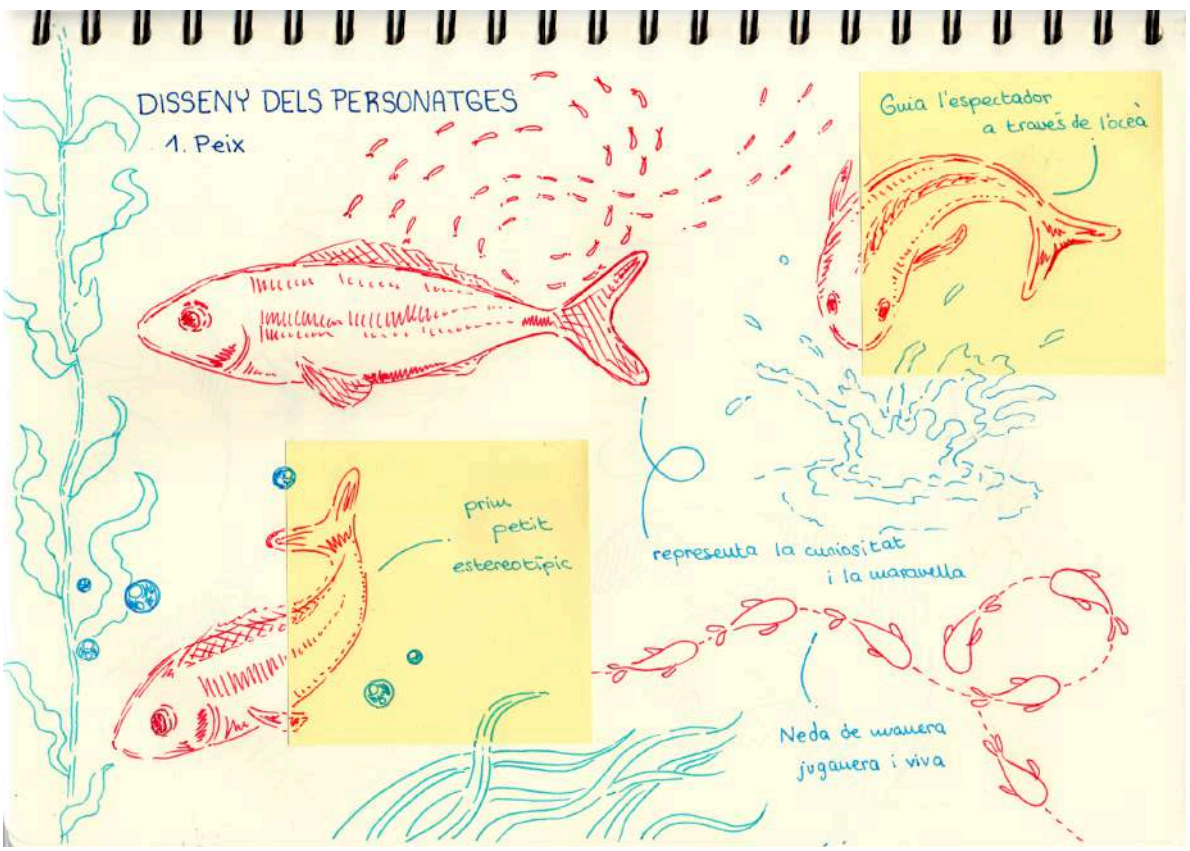
NOVES IDEES !!!

1. Transició d'animació a mà a digital. = molt feina, més interessant
2. Començar l'escena amb full en blanc i anar construint a poc a poc fins arribar a la imatge final.

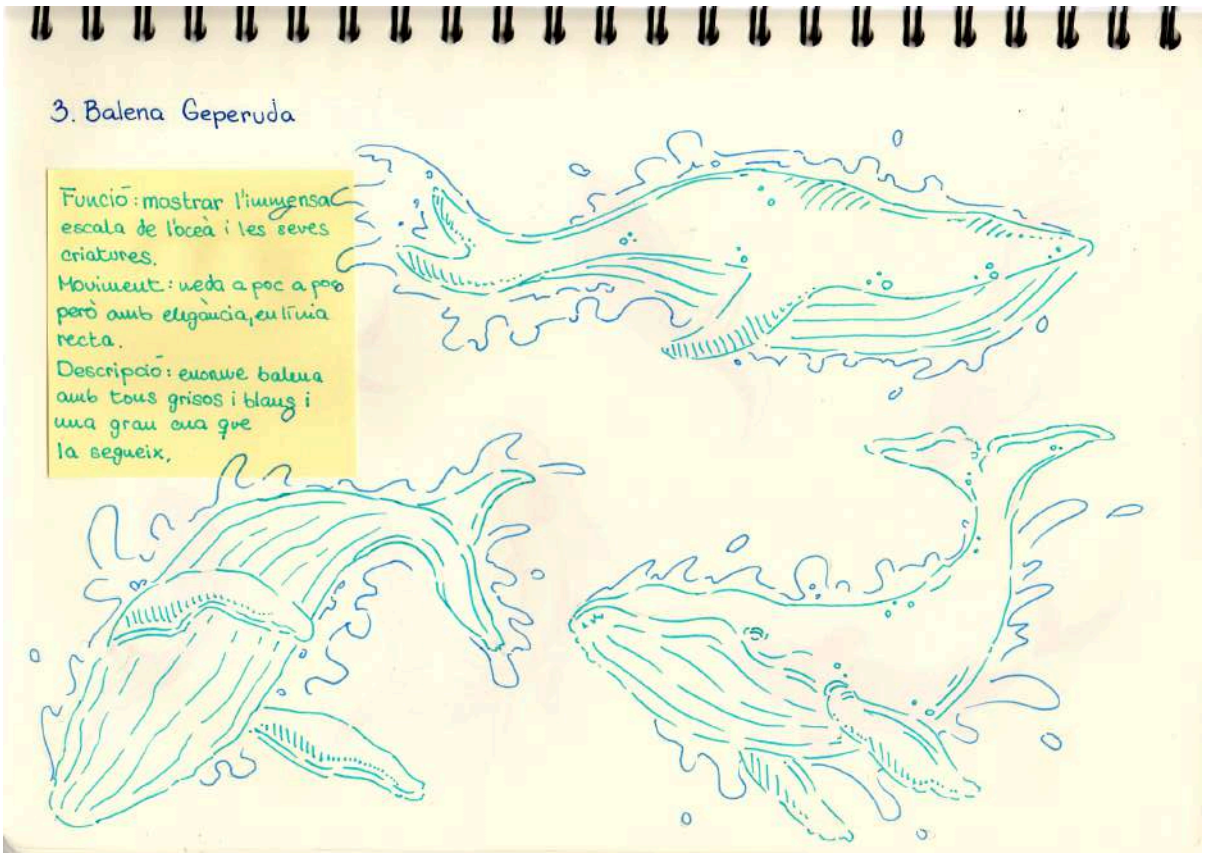
ESTRUCTURA (Evolució de la Narració)



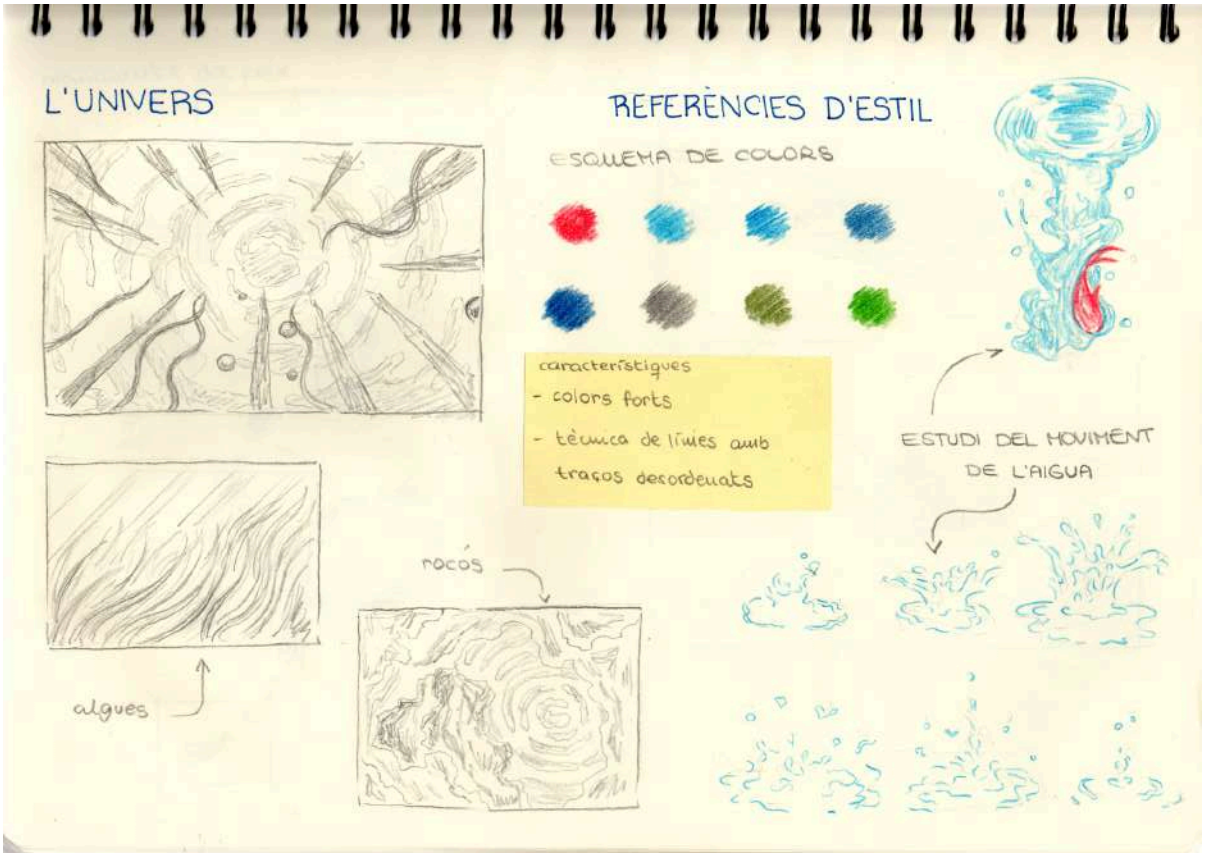

INSPIRACIONS VISUALS
(Imatges de Referència)

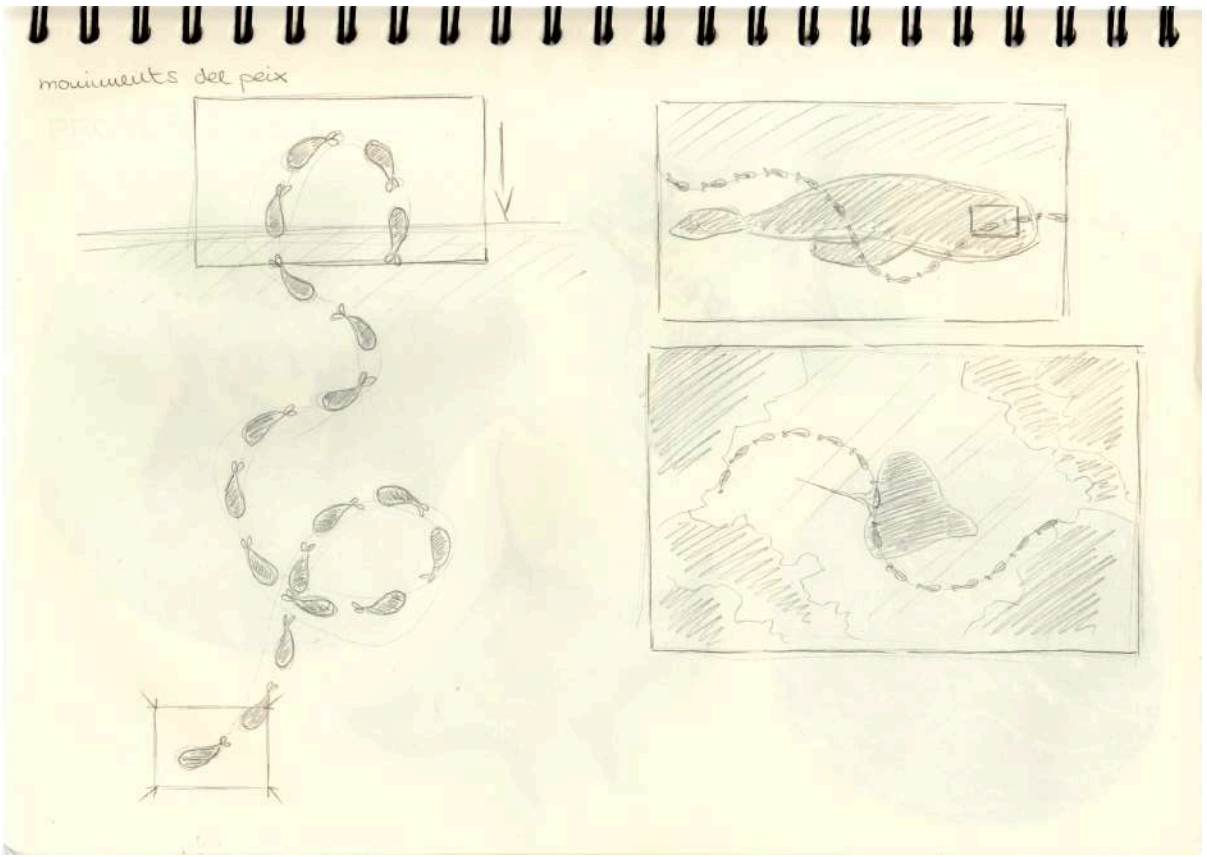

DISSENY DELS PERSONATGES
1. Peix
Guia l'espectador
a través de l'oceà
prim
petit
estereotípic
representa la curiositat
i la meravella
Neda de manera
juganera i viva

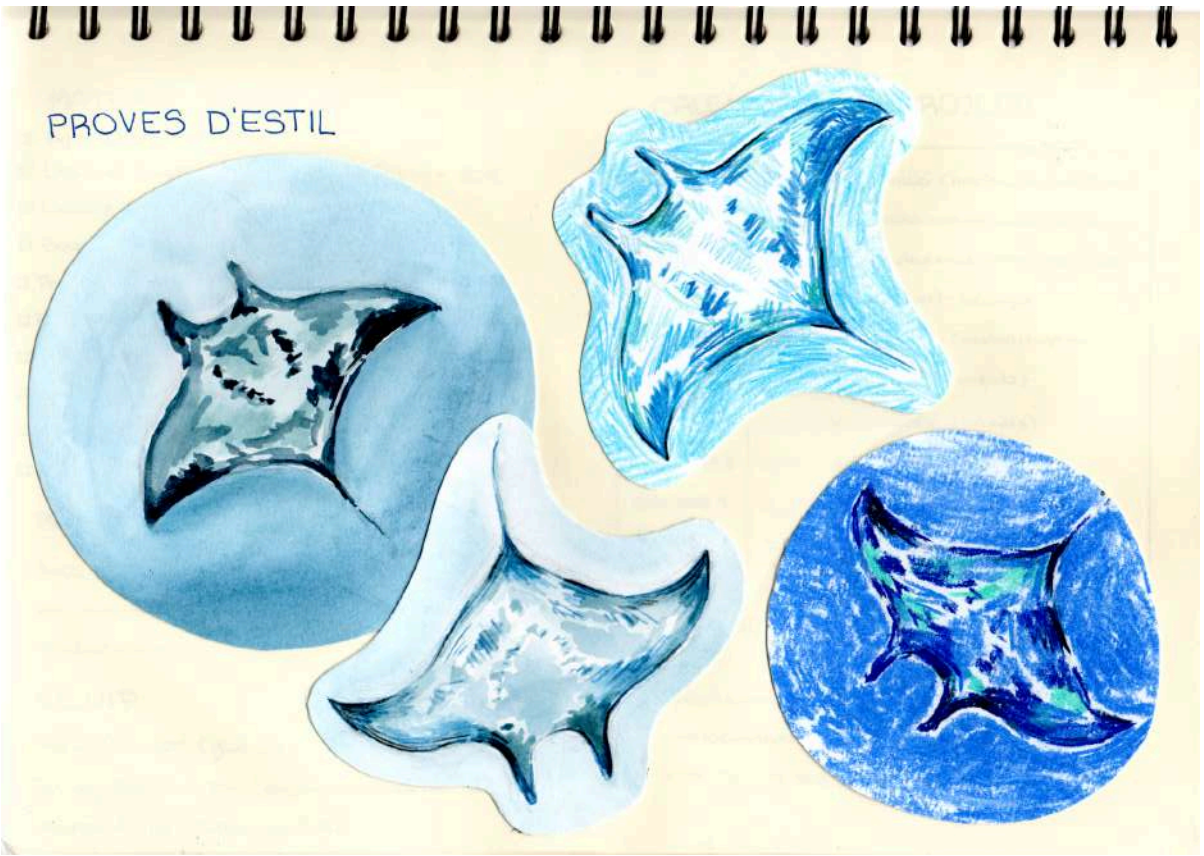

2. Manta Oceànica
Funció: aportar varietat a les criatures marines
Moviment: neda de manera suau i coufiada
Descripció: manta oceànica


3. Balena Geperuda
Funció: mostrar l'immensa escala de l'oceà i les seves criatures.
Moviment: neda a poc a poc però amb elegància, en línia recta.
Descripció: enorme balena amb tons grisos i blaus i una gran cua que la segueix.


MÉS DISSENYS DEL PEIX


L'UNIVERS
REFERÈNCIES D'ESTIL
ESQUEMA DE COLORS
característiques
- colors forts
- tècnica de línies amb traços desordenats
ESTUDI DEL MOVIMENT DE L'AIGUA
algues
rocós


moviments del peix


PROVES D'ESTIL

MATERIAL NECESSARI

- ☐ Aquarel·les → 14 €
- ☑ Llapis de Colors - ZZONEART Set → 30 €
- ☐ Escaire ; cartabó → 6 - 15 €
- ☐ Goma d'Esborrar → 2 €
- ☐ Portaminas → 8 - 10 €
- ☐ Perforadora → 5 - 10 €
- ☐ Taula de llum → 20 - 30 € (Institut)
- ☑ Paper Vegetal → 0,10 - 0,50 € per full
- ☑ Escàner → Institut
- ☐ Animació Aplicació (Software) → Gratis ? (capoot)

PRESSUPOST

Sota 50 € (ja disposo d'alguns materials, alguns els obtindré en préstec i d'altres estan disponibles gratuitament).

EQUIP

Sara Erickson (guionista, dissenyadora, animadora)

Jeffrey Paul Erickson (coguionista, assessor tècnic)

Marta Alsina (tutora del TdR)

CALENDARI DEL PROJECTE

SETMANA 1	Fer bíblia d'animació (història, personatges, etc)
SETMANA 2	Storyboard inicial + prova taula de llum
SETMANA 3	Reunió amb professional + sessió feedback
SETMANA 4	Part teòrica (dossier) - tècniques i pràctes
SETMANA 5	Començar animació (esbossos / keyframes)
SETMANA 6	Animació (polir moviments)
SETMANA 7	Neteja de l'animació (detalls)
SETMANA 8	Color i fons
SETMANA 9	Ss i edició
SETMANA 10	Escanejar i ajuntar frames

CONTACTE

worldanimation.com

worldanimation@gmail.com

+34 931 234 567

STORYBOARD

#1
4"

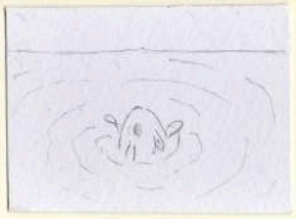
TALL

Paisatge subaquàtic amb una superfície rocosa.
Gran Pla General
Contrapicat Lleuger
Moviment càmera ×
Música / Sons ?
So de l'oceà

moviment de l'aigua

+ TÍTOL

#2
1"



×

Superfície de l'aigua de la qual, de sobre, salta un peix.
Pla Mitjà
Picat Lleuger
Tilt up
Música / Sons ?

#3
1"

Peix sortint de l'aigua, creant un petit esclafit i tornant a saltar dins del mar.
Contrapicat Lleuger
Zoom out
Música / Sons ? - So d'esquitxades
Pla Seucer

#4
1"

Peix entrant dins de l'aigua creant encara més esquitxades.
Plcat llargs
Pla Seucer
Travelling Lateral
Música / Sons ?
So d'esquitxades

X

#5
1"

Càmera que puja sota l'aigua seguint el peix seure inclinar-se.
Neutre
Pla Seuer
Travelling Lateral
Música / Sons ?

X

#6
1"

Peix nedant amb curiositat
Neutre
Pla Seucer
Travelling Lateral
Música / Sons ?

#7
1"

El protagonista comença a fer cercles
Neutre
Pla Seucer
Travelling Lateral
Música / Sons?

X

#8
1"

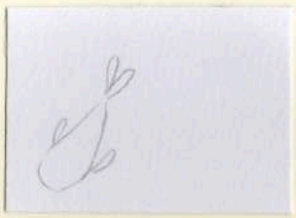
Continua fent cercles.
Neutre
Pla Seucer
Travelling Lateral
Música / Sons?

X

#9
1"

Finalitza, nedant cap a un racó
Neutre
Pa Mitja
Zoom In
Música / Sons?

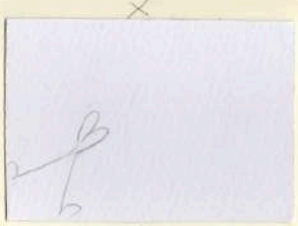
#10
1"



La càmera s'acosta al peix, el qual surt de vista de la càmera.
Zoom In
Neutre
Primer Pla
Música / Sons?

X

#11
1"



"
Zoom In
Neutre
Primer Pla
Música / Sons?

TALL

#12
3"

Algues al fons de l'oceà movent-se amb el corrent.
Pla General
Neutre
Moviment càmera X
Música / Sons ?

TALL

#13
1"

Càmara situada dins de la boca d'una manta.
Zoom Out
Neutre
Primerissim Primer Pla
Música / Sons? Sons de l'oceà

X

#14
1"

Pla de la manta fent zoom enrere per mostrar tot el seu cos
Zoom Out
Neutre
Primer Pla
Música / Sons ? Sons de l'oceà

X

#15
2"

"
Zoom Out
Neutre
Pla mitjà curt
Música / Sons? Sons de l'oceà

#16
2"

TALL

Mostrant la imatge completa de la manta
Neutre
Zoom Out
Pla Seuer
Música / Soul ?

#17
5"

TALL

Mostrant un angle des de baix de la manta passant per mare.
Contrapicat
Moviment càmera x
Pla Seuer
Música / Sons ?

#18
4"

Un altre paisatge subaquà rocós al fons del mar.
Gran Pla General
Contrapicat Llargo
Moviment càmara x
Música / Sons ? De l'oceà

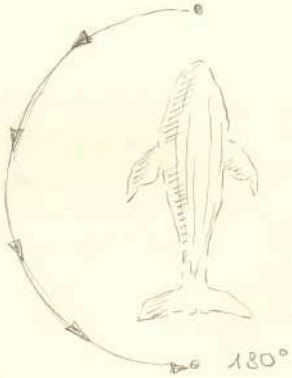
TALL

#19
2"

Vista frontal de la balena blava.
Neutre
Pla Seuer
Gir circular
Música / Sons ? De la balena

#20
2"

Vista de banda de balena
Neutre
Pla Seuer
Gir Circular
Música / Sons ?



#21
2"

Vista de darrere de la balena
Neutre
Pla Seuer
Gir Circular
Música / Sons ?

TRANSICIÓ:
Girant 360° al voltant de la balena, passant entre roques que bloquejen la vista de la camera → transició entre tècniques.

transició animació tradicional a digital

començament animació digital

#22
6"

TALL

Vista lateral de la balena mentre peix neda al seu voltat.
Neutre
Pla Seucer
Moviment càmera x
Música / Soni ?

#23
5"

TALL

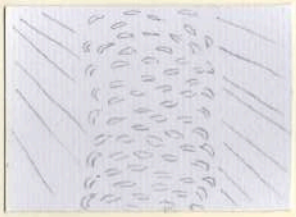
Vista des de sota de la balena
Pla Seucer
Moviment càmera x
Contrapicat extrem
Música / Soni ?

#24
5"

L'ull de la balena observa el peix
Primerissim Primer Pla
Moviment càmera x
Neutre
Música / Soni ?

TALL

#25
5"



TALL

Banc de peixos movent-se en cercles
Contrapicat Lleuger
Moviment càmara x
Pla General
Música / Soni ?

#26
3"

Vista de més a prop
Neutre
Zoom in
Pla Mitjà
Música / soni ?

#27
2"

Observació peixos nedant des d'un costat a l'altre.
Neutre
Tilt Up
Primer Pla
Música / Soni ?

#28
8"

Cercle del banc de peixos
Contrapicat extrem
Zoom out
Pla General
Música / Soni ?