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Shipwrecked Spaceship with Undersea Overgrowth and Dynamic Weather System

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ARTIFACT - SYNOPSIS

This artifact depicts an underwater overgrowth scene featuring coral, barnacles, sea urchins, and various sea-life enveloping the iconic Slave-1 ship from Star Wars. The ship exhibits visible damage to its hull and substructures, resulting from missile impacts and prolonged decay subsequent to a crash landing in the ocean. Consequently, remnants of destroyed substructures are interspersed with coral growth, transforming the ship into an artificial reef.

The artifact comprises four distinct scenes: an initial pristine underwater environment teeming with flourishing kelp, vibrant sea life, and animated corals; a subsequent chaotic scene depicting a vortex that evacuates the water from the environment; a scene where a sandstorm desiccates and buries the reef under sand; and a final tempestuous scene featuring a towering fire tornado that casts an illuminating glow over the surroundings.
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MASTERY PILLAR 1 - OVERGROWTH

DESCRIPTION

Researching types of undersea overgrowth, researching how coral and barnacles grows both in reefs and on manmade environments such as ships, and researching how metal materials corrode and transform when abandoned in nature. Implementing overgrowth along and around the ship to create a vibrant scene.

RESEARCH

Researching types of coral and overgrowth that grows on ships underwater.

Testing out methods to implement overgrowth.

PROOF OF CONCEPT

Overgrowth Research:

When looking into overgrowth for underwater life, I looked into both what grows on ships that sink, what types of metal are best for plants to grow on, and how does coral grow in order to maintain accuracy. A research paper that aided me in the latter as far as finding good sources for how coral grows and develops was from the Living Ocean’s Foundation titled “Coral Growth.” It gave me a basic breakdown of how coral develops and reproduces, along with the different growth patterns of coral. Typically most coral reproduces sexually or asexually by releasing polyps that can then slowly calcify or “grow”, typically upwards. However, there are multiple patterns of growth for coral, including branching, columnar, and foliose growth. All of these different growth patterns are what give coral distinctive looks that differentiate them from one another, and in order to create a vibrant underwater scene, I felt it necessary to pick examples of coral that went under the various
types of growth pattern for my asset development list, in order to create a diverse scene. Images of each coral and explanations of how they grow are listed below, with citations towards the research article. For cohesiveness sake, and to keep the scene accurate to real life, I narrowed down my choice of coral to coral that is native to the Caribbean. As a result, certain coral like bubble and fungal coral that are only found in the Pacific Ocean, would be absent from the scene.

In Unit 6: Coral Reproduction, we learned that corals are able to create more coral polyps by reproducing sexually and asexually, but this doesn’t explain how their skeletons are built. Stony corals increase the size of their skeletons by gradually depositing layers of calcium carbonate (CaCO₃). This process is known as calcification. Calcification is the rate at which corals create their hard skeletons by absorbing calcium from seawater. In this unit, we will learn how corals grow and the shapes that they form.

How do corals grow? In colonial corals, each polyp contributes to the growth of the coral (figure 9-1). The polyp lifts itself up out of the cup-like skeleton, called the coralite. Then it deposits calcium carbonate in the space below. The polyp secretes this mineral from the basal plate. This layer of calcium carbonate allows the coral skeleton to grow upward. For more information about the structures of a coral polyp see Unit 3: Coral Anatomy.

![Figure 9-1. Cross section of a coral polyp - the polyp is lifting out of the coralite and depositing calcium carbonate in the space below.](https://www.livingoceansfoundation.org/wp-content/uploads/2015/04/U9-Coral-Growth-Background.pdf)

Coral typically grows in a variety of numbers, with hard coral growing in pairs of six tentacles, while soft coral has eight. There will often be multiple of these arms which house said tentacles, creating massive structures for them.

Contrarily, barnacles and urchins tend not to be as organized with growth, though barnacles tend to grow very closely on ships, as they provide a hull for them to burrow in.

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Coral like Elkhorn Coral undergoes branching as its method of growth. Branching involves each coral limb growing extra segments in a more fractal pattern similar to trees, with smaller branches further splitting off into smaller ones. Branching corals are typically fragile and keen to break off, and by fragmenting, can often asexually grow on more surfaces. Other examples are lace coral and staghorn coral, pictured below. ⁴

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⁴ (Spatial, Temporal and Taxonomic Variation in Coral Growth—Implications for the Structure and Function of Coral Reef Ecosystems - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Major-growth-forms-of-scleractinian-corals-arranged-according-to-their-major-growth-axis_fig1_292400830 [accessed 19 Jul, 2023])
Figure 5 – Lace Coral

Figure 6 – Elkhorn Coral

Figure 7 – Staghorn Coral

5 https://reefs.com/delicate-rose-lace-coral/

Fire coral, while not technically coral, grows in a similar branching pattern to branching coral.

Columnar coral like pillar coral grow upwards without branching out, similar in growing to branching coral but far sturdier. Examples include pillar coral.

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7 (Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Superposition-of-schematic-and-actual-branching-patterns-in-an-a-Acropora-formosa_fig12_269762411 [accessed 19 Jul, 2023])

8 (https://www.inaturalist.org/guide_taxa/239555)
Encrusting coral like Cyphastrea and Brain coral grow in an outward pattern, often attached to rocks that allow them to grow and root themselves out.

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9 (https://reefguide.org/carib/pixhtml/pillarcoral2.html)

Foliose coral will grow in a floral pattern like flower petals, growing upwards in a more spiral/petal fashion.

Additionally there is coral such as orange cup coral, invasive species that particularly enjoy settling on things such as reefs, as they do not build their own reefs.

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Additionally, I have found references of numerous underwater crash sites and have saved them below to study material breakdowns and how reefs scatter along airplanes.

13 [https://reefguide.org/carib/orangecupcoral.html](https://reefguide.org/carib/orangecupcoral.html)

For implementation in Unreal, I have found a few tutorials on how to implement clutter or overgrowth and will test them myself.  

This tutorial teaches how to procedurally generate overgrowth in Unreal Engine, which could be potentially used for implementing barnacles and sea urchins. There are multiple ways to procedurally generate clutter with the PCG system in Unreal, using a built in plugin made by the developers of Unreal. There are some risks to it as it is not yet fully polished, yet for what I intend to do I think it will definitely suffice in making quick

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16 Evans, S. (2018, May 17). *Turning aircraft into artificial reefs -- could this be a way to save the oceans*?. Verdict. https://www.verdict.co.uk/turning-aircraft-artificial-reefs/

17 Easy Procedural Overgrowth Tutorial with PCG in Unreal Engine [https://www.youtube.com/watch?v=8sejPMc_by sappydev](https://www.youtube.com/watch?v=8sejPMc_by sappydev)
overgrowth in set-dressing my scene. Below is a screenshot of my test with the program, where I was simulating if barnacles or sea urchins would stick to a mesh.

Added are a few more links on procedural content generation:¹⁸

![Figure 19 – PCG Barnacles](image)

(Credit to myself for above photo)

Additionally, I have been looking at ways to give the scene more life, such as types of fish I can implement in the scene, as well as starfish and other creatures that can stay stagnant or move along a fixed path. Certain fish such as rays or sharks would require a larger attention to detail to create, so they would either be a lesser priority asset or omitted entirely in favor of simpler reef fish.

Essentially, keeping a simpler silhouette for the fish that would populate the scene would make creating instances of them with textures and materials far easier.

**MASTERY PILLAR 2 - DESTRUCTION**

**DESCRIPTION**

Researching what the substructures of real-life ships, engines, and other parts look like to create convincing destruction. Researching how metal bends and destroys through blunt force or through decay, along with how other materials destroy both normally and in crash landings. Modeling destruction through multiple layers and material changes.

**RESEARCH**

Research ships, shipwrecks, and crashes of airplanes both on land and underwater.

Find a ship to destroy and collect references for where it will be destroyed.

¹⁸Spawn Vines on Any Mesh Procedurally! Unreal 5.2 PCG – Part 2 [https://www.youtube.com/watch?v=Xp1YoTxC6Ww by HullaBulla](https://www.youtube.com/watch?v=Xp1YoTxC6Ww by HullaBulla)
PROOF OF CONCEPT

Destruction Breakdowns:

To properly look into my destruction mastery, I began doing material breakdowns of how real life machines like airplanes are destroyed, what is underneath various substructures, and how are they built. With this came numerous material breakdowns, finding similar objects to the parts of the *Slave-1* I want to destroy, and doing blockouts and breakdowns of them to get a better understanding of what I will be modeling.

To first get an understanding of what real life objects I would be looking into for destruction, I had to find blueprints and sources on the substructures of the *Slave-1*, where I was lucky to find cross-sections on the ship and then figure out which areas I was going to destroy. These drawovers of the *Slave-1* cross-section show areas I will look to destroy and show inner destruction for my artifact.

![Figure 20 – Slave-1 Destroyed Areas](image)

Above is a breakdown of the cross-section, with color blocked areas being where I will destroy the ship. Areas marked in red will highlight destruction of the ship, while areas marked in teal would be destruction with overgrowth occurring over it. Some areas like the cockpit would try to balance both, where the wings would lean more into overgrowth and the hull would solely be showing destruction.

Below are objects similar in appearance or materials to the *Slave-1* to serve as reference for how I will destroy the ship.

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19 (David Reynolds, Hans Jenssen, etc, *Star Wars Incredible Cross Sections*, Lucasfilm, 1998)
Figure 21 – Destroyed Plane

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The last four images are serving as references for breaking apart a hull to a ship, as well as the various piping, wiring, and machines that lay under things like engines, generators, and so on. Using these as a database will help me return to them and properly model in destruction to the ship.


23 [https://www.istockphoto.com/search/2/image?phrase=airplane+engine]
These two images are serving as inspiration for the part of the Slave-1 that will be burned, looking at how burns affect aircrafts and the material transformation that they undergo when burning occurs.

24 (Aircraft Accident Investigation Central Directorate - Egyptian Ministry of Civil Aviation -29 July 2011)

These three images are taken from a submarine explosion, looking into the metal guts and sludge that corroded from a submarine after bursting at a low depth. Again, these serve to look at different materials I can use when destroying the substructures and frames of the ship.

Figure 29 – Sunken Plane

Figure 30 – Sunken Plane 2

27 (https://www.istockphoto.com/photo/underwater-airplane-wreck-gm484471987-37735782)

28 https://blog.padi.com/incredible-plane-wrecks-to-dive-around-the-world/
These images will serve as a database for me to go back to in order to look at how to make convincing and realistic destruction for the ship. The last two serve as inspiration for setting the scene underwater, and taking a closer look at the corrosion and rusting that occurs underwater.

The following are a few breakdowns and cross-sections I have found of the Slave 1 from Star Wars, looking at the various substructures that will be broken down from the ship. In order to tell a story about the crash landing, part of the ship will show an indication of being blown up by some sort of missile or blast, and the rest will be debris from the crash into the ocean.

![Slave 1 from Star Wars](https://starwars.fandom.com/wiki/Slave_I?file=Slave_I_DICE.png)
Lastly, I have the size and dimensions of the ship listed: 21.5 meters in length, and 21.3 meters in wingspan, making the ship a bit longer in size, along with the rather round dimensions to it.

**MASTERY PILLAR 3 – DYNAMIC WEATHER**

**DESCRIPTION**

Researching Niagara and other particle systems in Unreal Engine to create weather effects and learning how to trigger them dynamically. Learning how to create convincing and unique weather systems to show a strong technical art/VFX showcase.

**RESEARCH**

Research three weather events and collect references.

Proxy out an underwater environment.

**PROOF OF CONCEPT**

*Dynamic Weather*

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30 (David Reynolds, Hans Jenssen, etc, Star Wars Incredible Cross Sections, Lucasfilm, 1998)
The weather of the underwater environment would be normal at first, showing caustics, bubbles, and a generic day event. With this I am trying to create a very vibrant reef scene to showcase the contrast of colors of the reef environment, and the dark, corroded feel of the ship.

The second weather event would be an underwater storm, with a maelstrom effect being the focal point of the scene. I would take real world inspiration from tornados and hurricanes, as well as fiction like the maelstrom in *Pirates of the Caribbean* to create a convincing underwater effect.

![Undersea Storm](image31)

**Figure 34 – Undersea Storm**

Above is a photograph of a storm from an underwater perspective, giving some inspiration for the scene.

![Maelstrom reference](image32)

**Figure 35 – Maelstrom reference**

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31 (Storm Below, Ocean Waves, George Karbus Photography)

Considering that both the wet and dry scenes will both have tornados or tornado-like effects, I will be looking extensively at tornado blueprints for Unreal Engine.

Figure 36 – Tornado Tutorial

Figure 37 – Proxy whirlpool

Fluid Tornado in UES Niagara Tutorial (https://www.youtube.com/watch?v=woKpGp10gOs&list=PLwMi8tF6Wzso5nAnyHb9NFFpmQ5rv0o8&index=2) by CGHOW
I went into Niagara and experimented briefly, creating a basic whirlpool effect and underwater lighting with caustics and a PostProcessVolume. Below I have linked a few tutorials I used to get re-acquainted with Niagara particle systems and the underwater scene, which I overall found rather intuitive and helpful to use.

34UE4 Tutorial: Caustics  https://www.youtube.com/watch?v=DvG1O6zwBP8&t=320s by Jack Beven
For the dry variant scene, I have taken a lot of inspiration from the skeleton coast of Namibia, known for a lot of shipwrecks dried out on the desert sands.

35 Unreal 5 Niagara Particles: A Beginner Tutorial for Motion Designers https://www.youtube.com/watch?v=pzlORuULNfo by Jon Jags Nee
Additionally, I will have harsh sandstorms and fire tornados to populate the dried-out scene, gathering references and tutorials below.

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37 Unreal Engine Fire Tornado Tutorial [https://www.youtube.com/watch?v=MDS6TXVIdaQ] by CGHOW
Figure 44 – Fire Tornado

Figure 45 – Fire Tornado


Gathering references of these weather events in addition to technical application will help me in breaking them down and refining on the inaccuracies that may be left behind by the tutorials. Additionally, finding good tutorials will assist in making myself able to stand on my own as a technical artist afterwards.

The third weather event would be a sandstorm, filling the ship’s hull with sand and dust. I have attached some images of sandstorms and references to them as well.

![Figure 46 and 47 – Sandstorm Refs](image)

THE ARTIFACT

DESCRIPTION

The artifact would take the Slave-1 from Star Wars and sink it under the ocean, subjecting it to undersea overgrowth such as coral, barnacles, and sea urchins to create a manmade reef on top and around the ship. The ship would be destroyed, part of the ship shot by a blast or missile, and the other part damaged and destroyed by the crash, opening parts like the hull and wings of the ship to show destroyed substructures, and to have things like overgrowth in the interior cockpit of the ship. The ship would sit in three states, crashed and with overgrowth in a calm, flourishing environment underwater, a scene where it is surrounded by an underwater storm and maelstrom, and a scene where the ocean has dried out into a desert, subjecting it to sandstorms and fiery tornados in a barren environment.

PRODUCTION

PROTOTYPE

DESCRIPTION

The entirety of the Slave-1 proxied out, as well as coral assets and pristine substructures under the destroyed parts of the ship. Proxy overgrowth will be implemented procedurally in Unreal, having set up the basic blueprint. The entirety of the ship and the reef would be proxied, as well as basic proxies for the weather events. The overall floor, lighting, and scene should be set up and in a solid state before continuing, to not have to backtrack if lighting conflicts with textures.

SCHEDULING / PLANNING
<table>
<thead>
<tr>
<th>WEEK</th>
<th>TASKS / HOURS / JOURNAL</th>
</tr>
</thead>
</table>
| 1    | **Begin proxy of Slave-1: 8 hours**  
Create photobash of the three weather events – 2 hours  
Experiment with Substance Designer and created barnacle and coral materials – 2 hours  
- Begin modeling pillar and elkhorn coral pieces – 4 hours |
| 2    | **-Pivot from modeling individual coral pieces into modeling fleshed out rock formation pieces containing the various coral I modeled, with this begin modeling rock formation piece – 6 hours**  
- Researched ways to create a weather transition, and begin proxies of the vortex weather event in Niagara Fluids and Particles – 4 hours  
- Created basic underwater environment – 1 hour  
- Continue modeling Slave-1 and begin proxying the destruction substructures underneath – 2 hours  
- Create new coral material – 1 hour |
| 3    | **Create custom clouds, as well as proxy VFX of each weather event – 5 hours**  
- Create basic blueprint to key input weather events – 3 hours  
- Continue modeling rock formation – 2 hours  
- Continue modeling Slave-1 hull – 3 hours  
- Test coral materials on coral – 1 hour (I ran into issues after this that I went into detail on above) |
| 4    | **-Pivoted from Niagara fluids to a mesh for my vortex, as Niagara fluids are incredibly costly and difficult in engine, also created water material for mesh – 8 hours**  
- Tested modeling the ship in Zbrush, but went back to Max and continued modeling (will use Zbrush for destruction) – 4 hours  
- Proxy model new coral – 2 hours  
- Create barnacle decal and fix Designer materials – 2 hours  
- Reach out to previous graduates Nathan Chen C30 and Yiou Gao C31 for advice on weather – 1 hour |
| 5    | **-Create fire tornado and sandstorm proxies in Embergen – 4 hours**  
- Create basic flame and test import into Unreal to ensure Embergen will work – 2 hours  
- Model additional substructures of ship – 3 hours  
- Model supplemental environment pieces like extra rocks and sea grass – 2 hours  
- Create variants of rock formation – 4 hours |
| 6    | **-Create supplementary particles for the weather sequence – 3 hours** |
- Create sequencer in Unreal that causes the wet to dry weather event – 6 hours
- Work on journal and presentation – 2 hours
- Bring everything into Unreal and set scene – 2 hours

| 7 | Prototype - MIDTERM PRESENTATION – Proxy of scene with parts of the ship where destruction will take place almost done in terms of modeling, ideally most priority 1 and 2 models in proxy Refined based on advisor feedback (Changed scene setup, tested exporting as geo from Substance Designer, tested scatter) – 6 hours |
| -Refined Slave-1 Hull – 4 hours |

METHODOLOGIES

Overgrowth

For Overgrowth, I used Substance Designer to create some new materials based on the feedback from my advisor on the first day. Rather than individually modeling overgrowth elements like barnacles, it would be better to look into Substance Designer or cheaper ways to create materials that can easily be called on to texture the ship with. I created barnacle material in Designer, and additionally created numerous coral materials. The barnacle material is a bit flat due to reasons listed below in my coral research, but given that they will be very small in size and far away from the camera, adding displacement in Unreal does the trick to fix them. I used a video to take reference on how another artist used noise to create barnacles, but I ultimately did a separate method with tile sampling and getting opacity and height without using scale and tessellation.

For modeling my coral, the first week I decided to try it two ways, in Max or by sculpting in Zbrush. Ultimately it proved more time efficient to just make the coral in Zbrush, and additionally focus on creating rock “hero

Figure 49 and 50– Barnacle Decal

42 Quick Shapes-Substance Designer Tutorial-Barnacle Sea Shells https://www.youtube.com/watch?v=3mYQkayqZUQ&t=1s By: Zman
pieces” that contain multitudes of different coral that can give me an idea of how to stage each piece in the scene.

While I use ZBrush for the bulk of my sculpting, Max is still very useful in nailing the basic shapes and proxies of coral and other organic matter, rather than starting from a sphere or primitive in Zbrush. When modeling my coral, I often place a reference image into Max, get the basic silhouette of the coral with either spline, soft selection, path deforming, or basic primitives, and after attaching and subdividing, throw it into Zbrush for better refinement to give it more texture and character.

![Coral](image1)

**Figure 51 – Coral**

![Additional Coral Proxies](image2)

**Figure 52 – Additional Coral Proxies**

Lower priority or background items like rocks and sea grass that support the scene can be kept in Max, as they will not be the focal point of the scene and Max can get a good-looking shape and silhouette for those objects. It will also save time on retopology if not everything is sculpted out further in Zbrush. A quick way to get a decent looking rock in Max is a technique I learned from Professor Fisher, where you add a cellular material on a Displacement modifier which can create slices along a subdivided or spherical mesh to get a smooth, “rocky” look.
One issue I ran into with my coral materials is that I was using high amounts of tessellation in Designer, and tessellation is no longer supported in Unreal 5. As a result, I am looking into tutorials on creating displacement maps or similar blueprints that can replicate the depth I had created with my coral material in Designer.

After looking into it, something I would recommend to anyone looking to use materials from Substance Designer would be to not use heavy amounts of tessellation, as even with displacement solutions in Unreal, the smoothness of tessellation cannot be exported from Designer. Quite a few video tutorials utilize tessellation as it makes materials “pop” and give a more three-dimensional effect, but these tutorials are not good for exporting out into Unreal 5. The images below should better illustrate what I mean. The former is in Designer, and the second is implemented in Painter.

While the latter is technically still fine for getting color variation of coral, as well as the rough texture of it, it lacks the depth and porousness of the former. In order to get height and displacement detail, I highly recommend creating a good normal and height map with the ability to be displaced as opposed to shortcuts in Designer which while looking very impressive and nice, are too expensive and most engines are not able to run them cheaply.
After fleshing out my main rock formation piece and importing all my coral pieces into my Zbrush file, I used them to create multiple variations, allowing me to place various rock pieces around my scene instead of individual coral pieces, shortening the time needed to set dress my scene. Additionally, quickly remeshing the rock formations allows me to go back and sculpt out areas to help better suit the scene. For anyone doing a similar environment piece that requires lots of overgrowth or foliage, I would say it heavily depends on the goal of the individual project, but considering the hours spent placing objects around the scene and shortening that time if you are able to is a great help.

![Rock formation in Zbrush](image)

**Figure 56 – Rock formation in Zbrush**

One other concern for my artifact is that aside from the weather the scene will be very static as just a coral reef and sunken ship. While things like fish will be implemented to the scene later on, something I talked about with Professor McDowell was possibly giving parts of the reef slight, breathing animations, something I tested out with a sponge asset in Unreal. Given that the scene is not technically tethered to being realistic, we felt this could be something that adds more life and vibrancy to the scene.

**Destruction:**

Beginning with destruction, I found dimensions to the *Slave-1* and set up a scene in 3DS Max with a proper scale box, and reference images that matched the height and width of the ship, before creating the majority of the ship in Spline. I found a spline tool called the Arc, which allows you to measure the width of a distance and create an arc between it, which I used to build a smooth spline model over my initial one which developed lumps after playing with the width too much.
To model destruction, I made an instance of the ship, made it transparent, and modeled destruction to fit the scale underneath the ship, mostly creating proxies to pay attention to where things will go and how they will fit into place. All destruction will be made pristine before being destroyed. While most of the substructures are modeled in Max when pristine, Zbrush will be used to create quick destruction with lots of character and texture. The Bend modifier is useful for sliding objects to fit perfectly inside the ship and align with one another for a crowded, mechanical look to the ship’s parts.
Additionally, I attempted modeling my ship in Zbrush to test if the hard surface pipeline is worth looking into in Zbrush. While Zbrush is powerful and capable of hard surface with Booleans, hPolish and other brushes, it is very hard to keep control of it, and it is better used for my organic pieces like coral, rocks, and for more textured things like destruction. I will consider returning to Zbrush to create quick panel cuts but given that 3DS Max has been easy enough with modeling my ship, that is more of something to test out than a given. Below is a test sculpt of destruction, using the hull of my ship as an example. TrimDynamic, move and Booleans were used to achieve the torn-up look of metal, as well as alphas to give it texture. Given how quick it is to achieve decent results in Zbrush, I will return to it with more important pieces that I want to be destroyed.
As all of my destroyed models must be made pristine first, I did not model much destruction other than proxying out a hole in the ship for the scene, opting to spend the remainder researching realistic destruction on ships, airplanes, and other objects that would be destroyed in a similar fashion to my ship, expounding more on the research done over the summer. A lot of this research serves as reference for when I begin destroying and texturing the ship, having references and guidelines to work upon.

![Figure 61 – Destruction Pureref](image)

**Dynamic Weather**

For dynamic weather, I made the mistake of not realizing what it fully entailed by the end of the summer. At the end of the summer, I envisioned that the dynamic weather would take place in three separate scenes, as opposed to one continuous one, which added a significant amount of work to this mastery. In class I explained that my three weather events were an underwater maelstrom or vortex, a sandstorm in a dried-out scene, and flaming tornados following the storm. I created three photobashings to illustrate these ideas and convey the overall look to them.

First, I created an underwater environment, by making a mesh and placing a water material I made over it, creating a sand material in Designer, and creating a light caustic effect to give the illusion of an underwater scene. With the scene set, I began to research ways on how to create a maelstrom or vortex. Initially I ran into a lack of resources, with most tutorials set in Houdini, but given my lack of experience with that software I figured using Houdini would be more trouble than its worth.

Thankfully, I found the following tutorial on Niagara Fluids which gave me a quick “vortex” like result and enough information for me to take and refine for my own use, allowing me to get a basic proxy of the vortex weather effect. I have noticed that there may be some rendering issues with Niagara Fluids, but so far I have not run into such issues yet with them not running in my scene. For creating the sandstorm, I initially used Niagara fluids which has smoke and gas effects that can create a similar pattern to a sandstorm, and Niagara
particles for the flaming tornado. I followed a tutorial for Niagara Fluids that gave quick results for getting a whirlpool.

However, the more I played with Niagara Fluids, the more I realized they are quite unstable, expensive, and not at a point where one can confidently use them for complex weather events. A big issue occurred when I realized I could not enlarge the fluid past the size of roughly a swimming pool when I needed an entire ocean displaced, and if I attempted to enlarge it further it often led to my computer chugging or Unreal crashing. Additionally, the fluids can barely be edited in terms of appearance, the most I could do being altering the

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43 UE 5 Tutorial Niagara Fluids and Intro To FLIP Fluids/3D Water and Foam [https://www.youtube.com/watch?v=1p5IAPDS4&t=435s](https://www.youtube.com/watch?v=1p5IAPDS4&t=435s) By Render-Bucket
color of the water. Additionally, while Niagara particles can certainly be used to create good looking particles, I felt that there had to be better looking methods to look into or at least experiment before settling on them. 

This led to me going down a rabbit hole in search of alternate methods, a crucial period as I needed to settle on a method that I could use to get a proper vortex and other weather events quick. After talking to C30 Artist Nathan Chen and C31 Artist Yiou Gao, they both encouraged me to look at other methods as opposed to Niagara Fluids, namely Houdini, Embergen, or using a mesh to “fake” the vortex. Given that my technical art skills are still in training for a software like Houdini and the stories told by both Professor Fisher and McDowell that led to many students having to start from scratch, I opted to look into Embergen and creating a mesh for my vortex and weather effects.

Creating a high poly mesh and faking it with a translucent water texture proved to be better, as I can create a convincing looking water material while also allowing it to ripple, move and displace at various speeds. All I have to do is place the mesh in a spinning emitter and it creates an easy spin, and it’s a matter of looking into ways to creating a way for it to dissipate naturally. Additionally, the mesh can be animated on its own to expand outwards or inwards to suit my scene, giving me a lot more hands on control to get it exactly how I want it. Since my weather is dynamic however, it is important that my vortex storm creates supporting particle effects to change the physics of the scene, as well as colliding with the scene itself. For this, I created dust particles in Embergen that will trigger when the storm first touches down, and when it expands.

![Vortex mesh and material](image)

Figure 64 – Vortex mesh and material

I created a key input blueprint that allows the weather events to spawn, having one key trigger the vortex and subsequent drying out of the sea, and other buttons to trigger the sandstorm and tornados. I followed a YouTube tutorial in order to learn how to blueprint specific events into a keyed function. ^44 I also followed a

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^44 UE 4 Tutorial – Dynamic Weather! [https://www.youtube.com/watch?v=uFjmiLpfoEg&list=LL&index=17&t=581s](https://www.youtube.com/watch?v=uFjmiLpfoEg&list=LL&index=17&t=581s) by Dean Ashford
tutorial that also showed me how to edit the look and thickness of the volumetric clouds in Unreal Engine, and allow them to be changed in thickness and speed like a material instance. 45

In Embergen I was able to proxy out some very quick weather effects after following a few tutorials, such as the fire tornado shown below. 46 In addition to the tutorial shared, the YouTube channel run by Jonathan Winbush is a great source for anyone looking to use Embergen and bring Embergen particles into Unreal. 47

There will be some subsequent testing to see what export format works best with Embergen, between VDB, alembic particles, or flipbooks. It should be noted that VDB is now supported on the newest versions of Unreal, but 5.2 users have to use an Unreal supported plugin created by OpenVDB order for it to work. I have currently tested both VDB and flipbooks, VDB being the most expensive but having a great look and customizability in engine, and flipbooks being the cheapest but losing a bit of their quality. I think “Hero” weather pieces like the tornado or weather that will be up close to the camera of the scene will be prioritized as VDBs, while other supplemental particles can easily be implemented as flipbooks materials.

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46 Quick Embergen Tutorial: Creating a Tornado Effect. [https://www.youtube.com/watch?v=AYrhW0Wg-A&t=350s](https://www.youtube.com/watch?v=AYrhW0Wg-A&t=350s) Janga FX VFX Software and Tutorials

47 Jonathan Winbush. [https://www.youtube.com/@JonathanWinbush](https://www.youtube.com/@JonathanWinbush) By Jonathan Winbush
The final issue that needed to be resolved with my weather mastery this milestone was the matter of how the scene was going to transition from wet to dry, as when I initially pitched this artifact, I had thought I was going to create two separate scenes, wet and dry. After learning that that was not dynamic it led to creating photobash mockups and storyboards to better illustrate how the scene would transition out, settling on the water vortex taking out all of the water in the scene. The vortex would fade outwards, but supplemental effects were needed to sell the overall transition. Talking to Professor McDowell led us to agreeing that we could attempt to have dust kick up in the scene when the storm touches down on the ground and allow for a transition to the vortex, which subsequently kicks up more dust and particles and then expands out of the scene, leaving the ship and coral all wrecked in its wake. This meant creating a proxy sequence that can illustrate that the transition can work.

I used level sequencers and a simple keystroke blueprint to achieve my results. There is some concern to cost with multiple large VDB files, but I believe I can work around that with some of the weather being turned into flipbooks, as well as creating simpler particle systems for things like dust being kicked up to reserve cost for the weather that is more deserving of higher cost such as the whirlpool and tornados. Additionally, I created a keystroke event to switch on my Fire Tornado, still in proxy as well as it does not move from its origin, but the import was a success.

Moving forward, I created a proper flipbook material and emitter in Niagara with my Embergen dust/sand effect. This was completed by exporting my Embergen effect as a flipbook, which allows it to also be exported as an emissive, normal map, and with several various other ways to increase the overall quality. The reason for doing this is that the flipbook material created in the material editor is unwieldy in a sequence, not repeating at the same time each time the sequence is keyed. Creating an emitter allows it to key once and exactly when needed. Creating a flipbook emitter is simple, just create a basic material with the sprite sheet baked from Embergen, and then create a Sub UV Animation in the emitter settings by counting the number of rows and
columns the animation has. I followed a simple tutorial to learn this. I also focused on making the Embergen effect look more like a burst of sand, as opposed to smoke. While some tweaking can still be made, the overall resolution and look improved.

Learning how to create flipbook materials will help in case any future VFX needs to be converted over, as VDBs can be expensive to work with.

Additionally for weather, I also looked into adding debris that gets pulled off the ship to help make the weather more dynamic. I cloned a piece of the hull and duplicated two substructures to be picked off the ship, animating them in Max and then adding it to the weather sequence. Additionally, I plan to add more animations to the ship slowly getting dragged by the vortex to better sell the gravity of the scene.

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48 UE4 – Niagara Flipbook [https://www.youtube.com/watch?v=nZDW3GyOxwk](https://www.youtube.com/watch?v=nZDW3GyOxwk) by gameDev Outpost
VERTICAL SLICE

DESCRIPTION
Finished pristine front hull of the Slave-1 (without wings, cockpit not opened, no cannons) with one part blown off to show destruction underneath. Underwater storm weather implemented in the scene. Additionally, finished coral, and sea urchins are implemented on top of the ship.
Highlighted in green would be part of the ship that would be presented in VS, with the little red indication showing the destruction that will be showcased. While parts of the ship like the wings, engine, and cockpit would also be destroyed, they will either not be included in this milestone or will be modeled pristine.

**SCHEDULING / PLANNING**

<table>
<thead>
<tr>
<th>WEEK</th>
<th>TASKS / HOURS / JOURNAL</th>
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<tbody>
<tr>
<td>8</td>
<td>-Updated flipbook material – 3 hours</td>
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<tr>
<td></td>
<td>-Updated coral rock piece – 5 hours</td>
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<tr>
<td></td>
<td>-Gathered more coral references – 2 hours</td>
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<tr>
<td>9</td>
<td>-Changed the look of dust/sand material to appear more like sand and dust – 3 hours</td>
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<tr>
<td></td>
<td>-Retopologized coral pieces – 6 hours</td>
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<tr>
<td></td>
<td>-Refined Slave-1 Hull and Substructures – 5 hours</td>
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<tr>
<td></td>
<td>-Tested exporting substance designer material as Geo – 1 hour</td>
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<tr>
<td>10</td>
<td>-Finished refining Slave-1 Hull – 3 hours</td>
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<tr>
<td></td>
<td>-Finished pristine substructures for Vertical Slice – 5 hours</td>
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<tr>
<td></td>
<td>-Continued retopology on Coral pieces – 7 hours</td>
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<tr>
<td>Day</td>
<td>Task Description</td>
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| 11  | - Used scatter on sea urchin mesh – 1 hour  
     | - Fixed dust flipbook material – 3 hours  
     | - Created debris animation – 1 hour  
     | - Textured and baked brain coral – 1 hour  
     | - Test destroy substructures – 4 hours  
     | - Create bakes and textures of various coral pieces – 4 hours  
     | - Refine ship – 3 hours  
     | - Refine weather VFX – 4 hours  |
| 12  | - Continue destroying substructures – 8 hours  
     | - Continue texturing coral – 4 hours  
     | - Refine tail of storm and eye of storm – 4 hours  
     | - Create grass cards – 1 hour  |
| 13  | - Unwrapped all destroyed substructures – 6 hours  
     | - Created tail of the storm material – 2 hours  
     | - Created more texture variants for coral – 2 hours  
     | - Began dressing the scene in Unreal – 2 hours  
     | - Refined based on feedback – 4 hours  |
| 14  | - Textured Slave-1 Front Hull and Substructures – 8 hours  
     | - Created new dust storm – 3 hours  
     | - Began dressing more coral in the scene – 2 hours  
     | - Created landscape material – 4 hours  |
| 15  | - Updated vortex and created seafoam VFX - 6 hours  
     | - Continued refining Slave-1 Hull and destruction – 4 hours  
     | - Desaturated Coral Textures – 2 hours  
     | - Created new sequence for vortex scene – 5 hours  |
| 16  | - Refine and take feedback based on VS presentation – 10 hours  |

**METHODOLOGIES**

**Overgrowth**
Following the prototype presentation, I looked at the feedback given to me by my advisors. Overgrowth was considered the one area of concern regarding my artifact, so I took the time until the next due date to really hone in this mastery specifically and bolster it as best I could, looking into a number of ways. Two ideas were suggested by Professor Fisher, one to try exporting my Substance Designer material as geo to circumnavigate the issue of tessellation not working properly in Unreal, and also to research techniques such as scatter and foliage paint. Ultimately, exporting as a geo did get me the height I was looking for, but was too dense and too expensive of a mesh. While there are workarounds that could be explored, I ultimately decided to focus on making coral materials that are easier to export without needing lots of height and displacement. A good workaround that I saw when texturing my first coral piece is creating alphas in Zbrush to create grooves and patterns, and then using a curvature map to texture that area.

With that explored, a method that proved very useful to me was Scatter in 3DS Max, which allows you to place a single mesh along a surface and duplicate it multiple times. To test this out, I created a basic alpha card sea urchin, and used it to place it along the ship’s hull.
The other big concern was the polycount on my coral, as well as that I had only remeshed my coral pieces and exported them into the scene. For Vertical Slice, I want my main rock piece and the coral pieces on it to be polished and textured, so I spent quite a bit of time over the past few weeks retopologizing them, and also testing ways to make the scene less expensive. Some coral pieces are rounder, larger, and closer to the camera, such as my Pillar and Elkhorn Coral Pieces which I felt justified them having tri counts up to 6 to 8000, but smaller pieces like Orange Cup Coral or simpler shapes like the large rocks only needed around 2000 to 4000 tris, while simple shapes like brain coral only needed 800 tris at most. Retopology was completed in Maya, and Autodesk has a function that allows you to send meshes to scenes in Maya or 3DS Max, allowing me to quickly send my meshes back and forth to be retopologized and then unwrapped in Max.
Figure 74,75,76 – Retopologized Coral Pieces
For pieces that would be difficult to hand place topology on such as the small grooves inside the pillar coral, ZRemesher was used and then I went through the mesh in Max and Maya and removed edge loops while conforming it to the highpoly sculpt.

While I am justifying a decent number of tris on some coral pieces, I am also looking towards workarounds for background pieces, one method that worked well in particular was baking coral onto a plane that could be placed far away from the scene. I used a plane to bake this lace coral piece in Marmoset and got a very clean result, allowing for a useful workaround to help make the scene cheaper.
Additionally, I made more materials, some for coral and some for rocks in the scene. With these made, I plan on creating more variants of them as well. Below are materials for coral, potential sea scum/algae, and rocks.

Figure 79-83 – New Materials
For State of VS, I wanted to test bake and texture one coral piece, so I opted for the brain coral to test out various coral materials I made, as well as playing with different color schemes as well. I want to have a mix of bright and complimenting colors for the scene, and playing with curvature maps as well as materials allows for vibrant colors to come through.

Figure 84-85 – Brain Coral Texture and Bake Experiments
After receiving feedback on the first texture test being preferred, I went forward with experimenting with similar looking textures, heightening the glossiness for the underwater look, as well as vibrant colors and textures. Additionally, I played with emissives as well.
Figures 86-89 – New textures on corals placed in Unreal
Additionally, to give the scene more life, I created simple grass alpha cards and placed them in the scene using foliage paint, better filling up the scene and keeping it from getting too barren looking in some areas.

I created a simple card of one grass blade in Photoshop, as well as variations, and then plugged in the three card materials into plane meshes and put them in foliage paint, which randomly scatters them around with varying density or space depending on the brush settings.

Moving forward, I was asked to further desaturate the coral in my scene, as well as create grass card variants. I completed those tasks and showed them below.

Additionally, to create a variance of coral on the ship, I made alternate textures of each coral piece, making dead texture variants of the coral as not all coral that latches onto ships survives.
Figure 93-95 – Dead Coral Textures
Additionally, the sand dunes in my scene clashed with the setup of my rocks and coral, so I was tasked with making a new landscape material. I learned to make a landscape material, and using the LandscapeLayerBlend node in the material editor, was able to create a landscape texture that allows 3 different textures to overlap one another and be painted into the scene, as seen below.

![Landscape Material](image)

**Figure 96 – Landscape Material**

Lastly, I had to continue implementing more coral into my scene for the Vertical Slice. I did this with a combination of Foliage Paint, Scatter, and hand-placing assets in the scene on my own. Foliage Paint works well in Unreal to paint on clutter in the backdrop of the scene, and it allows you to edit the foliage placed in the scene very easily, making it a viable option for set-dressing both in the foreground and background of the scene.

**Destruction**

Moving forward, I continued to attach and airtight more parts of the ship, as well as cleaning up the topology and the edge flow of the hull. Most of this was done by hand, using edge constraints when aligning verts, and then adding geo when needed to weld together more parts of the ship. The front hull of the ship is going to be the focal point of the destruction and also for the Vertical Slice deliverable so ideally, I wanted to finish modeling the pristine hull of the ship as soon as possible.
Additionally, I wanted to continue modeling the VS substructures, creating midpoly meshes with weighted normals. Professor McDowell pointed out to give the substructures more of a sense of being packed in and cluttered, which was my main goal in addition to finishing modeling them out.
Using bend, FFD, and autogrid to model off of other substructures was crucial to keep the scene looking like it could make sense and also prevent meshes from crashing with one another. The vast majority of the substructures were created by studying the aforementioned Star Wars cross-section book.

I also test-destroyed two pieces as well in Max, using simple soft selection and cut on one, and modeling more substructures underneath another piece to better create a layered effect. I have listed references I was studying next to each one as well to better understand how I was choosing to destroy the two pieces.

In order to create better looking destruction, I had to sell the story of how the ship got destroyed, making sure that the destruction would then make sense in regard to how the ship crashed. For the front hull, I punched

\[\text{(https://www.istockphoto.com/search/2/image?phrase=airplane+engine)}\]
and warped the panels, and tore panels off to indicate that a crash occurred onto the rocks in the ocean below, with a cut through part of the hull. As a result, wires along that cut are frayed and split in half as is a metal grate. Other substructures behind are destroyed by impact with panels falling or breaking off, as well as wires hanging from the friction. I studied plane crash references to better nail the appearance of a more convincing crash than what I had before.

Figures 104-105 – Destroyed substructures
Figures 106-107 – Destroyed Hull
Figures 108-111 – Destruction References


Texturing the destroyed substructures was mostly straightforward in that I found references of abandoned undersea wrecks and sought to imitate them, adding heavy layers of rust, scum, algae, and burn marks from the crashing of the ship. Since the ship had no high-res to bake onto, I used the lowpoly to bake in an AO map, curvature map, and other texture maps to better place the rust and dirt on the models. Following feedback from my advisor, I added on more grunge, as well as heightening the AO maps on the clutter to give more of a sense of depth, in addition to also darkening colors on the pieces.

To prevent the destroyed hull from looking empty, I added extra substructures underneath the broken hull, to clutter the scene more in addition to the implemented overgrowth in the scene.
Figures 114 – Textures in Unreal

Figure 115-116 – Implemented Coral in the scene.
Dynamic Weather

Additionally, another criticism from prototype was that the scene was too far from the ship and overgrowth, so I pulled it closer, allowing me to better see the ship, the coral, and the substructures underneath. Some rock pieces will be moved as well to get a better view of the destruction underneath the ship as well.

For Critical Review, I worked on refining the VFX of the initial “tail” of the storm that touches to the ground and creates the vortex that gets rid of all the water from the scene. Initially, I had a very thick tail that touched the ground which while dynamic looking, did not properly resemble the look of actual tails of underwater vortexes. It looked more similar to a tornado or column as opposed to the thin tail often seen in underwater vortexes, shown below.
As a result, I created a couple of various tail VFX to show in order to better figure out which one gets a more convincing feeling of an underwater “tail” that will touch the ground and cause the ensuing vortex that takes the water out of the scene. I have them as screenshots below to show the various iterations and tests.

While Embergen was successful in creating easy tail animations, it was less successful at making the tails look like water, given that it’s meant mostly for smoke and fire effects. To rectify that, I went into the material

https://www.123rf.com/photo_19075788_vortex-underwater-view.html
editor and implemented the same material settings I had on my water VFX over the spritesheet of my tail, as the alpha channel would mask out any crossing over, and then help better emulate a water effect.

Additionally, I made a new dust storm VFX, as we agreed when the tail of the storm hit the ground, the dust storm needed to be larger and more encompassing of the scene, along with moving outwards with the vortex. The new dust also looks less hyper-realistic like the former Embergen dust, which was a bit jarring and out of place in the old scene.
Along with the new dust storm, I updated the whirlpool mesh by adding some Fresnel to give it a cresting wave effect with slight white streaks along the currents, and also made a circling foam/breaking wave effect in the Niagara Particle System.

A minor addition that was added as well was a god-ray light material, as well as doing a complete overhaul of my lighting in the scene, adding Volumetric Fog, god-ray spotlights, updating the caustics, and removing any unnecessary lights. The result can be seen below.
After all the new components were made, I created a brand-new sequence to simulate the storm of the water leaving the scene, as my weather deliverable was to further refine the water leaving the scene. Some issues arose with the sequence, namely figuring out how to key in the PostProcessVolume, lighting and fog without making them spawnable, as I’d like the initial scene to contain all of them. Thankfully, making them a component and keying the visibility or the intensity of the lights worked. Additionally, I had issues with keying entire groups, as the ship holds numerous pieces of coral on it to where I would not want to keyframe one by one to follow the ship. While you cannot key a GroupActor to transform along the scene, you can parent the meshes under one mesh and use that in the Sequence.

![Figure 127 – New Sequence](image)

**ALPHA**

**DESCRIPTION**

Everything in engine, all ship, coral, and destroyed assets ready. Both weather systems ready and in engine, as well as the overgrowth set dressed in important areas. Possibly some room for improvement to fix textures, the look and feel of the weather, and some other elements of destruction needing more refinement.

**SCHEDULING / PLANNING**

**THESIS III PRODUCTION - SCHEDULE**

<table>
<thead>
<tr>
<th>WEEK</th>
<th>TASKS / HOURS / JOURNAL</th>
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</table>
| 1    | - Finish modeling secondary destruction parts of the Slave-1 (cockpit, blaster cannon, etc) – 6 hours  
      | - Continue modeling secondary and tertiary parts of the reef (Kelp, additional coral, etc) – 6 hours  
      | - Refine sandstorm and fire tornado VFX – 6 hours |
| 2 | -Destroy any additional substructures and parts of the ship – 6 hours  
  | | -Place Sandstorm and Tornado in Unreal and adjust as necessary – 4 hours  
  | | - Unwrap and texture additional overgrowth elements and parts of the reef – 8 hours  |
| 3 | -Unwrap and texture secondary destruction parts of the Slave-1 – 10 hours  
  | | -Create additional VFX for Sandstorm and Tornado – 5 hours  |
| 4 | -Texture main hull of the ship – 8 hours  
  | | Make simple animations for coral pieces and other overgrowth – 6 hours  
  | | -Refine desert scene and sandstorm sequence – 5 hours  |
| 5 | -Create fire tornado Sequence – 5 hours  
  | | -Add animated elements to the overgrowth and coral in the scene – 6 hours  
  | | -Implement additional overgrowth and new destruction pieces in the scene – 4 hours  |
| 6 | -Refine all three sequences, add any additional VFX and materials for either of the three scenes – 14 hours  
  | | -Polish textures for the ship – 4 hours  |
| 7 | Refine models, destruction, and effects – 15 hours  
  | | Refine overgrowth in scene – 8 hours  |
| 8 | ALPHA - MIDTERM PRESENTATION – Everything in engine, some textures possibly needing polish, as well as some effects and destruction needing any refinement  
  | | -Refine based on feedback – 15 hours  |
| 9 | -Polish textures – 10 hours  
  | | -Polish VFX – 10 hours  |
| 10 | -Continue to adjust the scene according to advisor feedback – 20 hours  |
| 11 | -Continue to optimize and refine – 20 hours  |
| 12 | -Organize all documentation and RTMs -3 hours  
  | | -Continue to refine and polish – 10 hours  |
| 13 | Evaluation for Defense  
  | | Optimize and polish any last-minute feedback – 13 hours  
  | | Organize all RTM’s – 3 hours  |
| 14 | *RTM - PRESENTATION  |
| 15 | DEFENSES CAN BEGIN  |
METHODOLOGIES

Overgrowth:

For Overgrowth, I first fixed some coral textures that I had created that were too shiny looking underneath the water. This was a relatively quick and easy fix but was one of the main feedback areas I was given from Vertical Slice.

Afterwards, I began modeling additional coral pieces, namely more sponges, vase coral, and cyphastrea, and in order to better optimize my scene, flatter coral pieces were baked onto planes and placed farther away in the scene in order to continue to clutter the scene with more coral and also save the scene from getting too expensive.

The images below are coral that I baked onto alpha cards and textured, using them in the inner parts of the ship or further back in the scene to help keep things optimized.
Figure 131-133 – Baked and optimized coral
Lastly, I created numerous alternate coral textures of every coral asset to better randomize the scene. Given that I had only a set number of coral in my ADL, and only so much time to model new coral pieces for the scene, I felt alternate textures would be good to help break up the monotony of the scene and prevent the feeling of sameness in coral throughout the scene.
Another major area that needed adjusting was my lighting. My scene was far too dark at first and looked foggier than conveying an underwater look. I used a mix of underwater animated films like *Finding Nemo*, along with underwater games to look at reference and brighten up my scene a lot more with warmer colors, as realistically underwater reefs are closer to the shallows and are a lot brighter as well.
I also created grass, kelp, and other foliage to help clutter the scene better, allowing me to easily close the gaps from the coral I was set dressing in the scene. I began to add more living creatures as well, such as fish, starfish, and rays in the scene, again helping better clutter the scene and add more life to it as well, given that the scene would be very static without them. The fish were implemented with basic particle systems that allow them to swim across the screen. I additionally made sure that the fish I placed in scene corresponded to fish that would be found in the same oceanic environments that I was using as reference for my coral. For example, the coral I have modeled is found in Gulf and Atlantic waters, while fish like clownfish are found in the Pacific. The ray moves with a basic spline path.
I continued to set dress more overgrowth along the seafloor and the ship, adding more coral along the open cockpit, the missile blasts, and the new hulls of the ship, along with more sea urchins.

Figure 139-141 – Fish, Ray and Starfish

Figure 142 – Sea Urchins
When deciding where to implement overgrowth on the ship and how to do it, areas such as the wings and cockpit were mainly done through hand placement, as assets such as the ship’s seats provided various nuances and opportunities to get more creative with implementing the overgrowth, while also leaving certain areas of destruction open. Other areas like the ship’s hull used a mix of Scatter in 3DS Max, and foliage paint in Unreal.

An area I had to decide on were my barnacles, as I had initially made a barnacle material in Substance Designer, but the barnacles when placed on cards to be put on the ship or placed on a mesh in Substance Painter did not pop out enough. While it was frustrating to have to give up a material, I spent so much time making, using height and displacement is simply too expensive compared to using a very low res mesh instead, so I opted to make a mesh of barnacles that I scattered along my ship hull, and then used the values from my Barnacle Material to texture them.
Additionally, I added wires and substructures into various cavities of the ship, as well as around the ship to better simulate clutter and overgrowth. I felt it would be beneficial to have more than just organic overgrowth in the scene, and adding in extra tech as overgrowth would help simulate a cluttered and chaotic scene of the crash.
Going forward towards beta I wanted to have the vast majority of overgrowth done, that being most of the coral I wanted placed on the ship and other scattered ship areas to be fully implemented. In beta, I plan to mostly tweak what I have placed, and continue to dress more coral and overgrowth assets along the ship if more is needed.

**Destruction:**

Over the break I decided to model all of the remaining pristine parts of my ship, as I felt it would make my workload when the semester began a lot less stressful as I would have more time to destroy and texture my ship and focus on other areas of my other masteries that worried me a bit more. I modeled the wings, cannons, and the pristine cockpit substructures.
Figure 151 – Cockpit
With the remainder of the ship modeled, I was able to begin placing it out and destroying the final parts of the ship, that being the cockpit, the wings, and parts of the ship where a missile would have blasted it out of the sky. I was met with a difficult choice to make, as I could have kept the front hull of the ship the way it was in my Vertical Slice presentation, where the front panel was popped off of the ship, mimicking how panels fall clean off of underwater wrecks due to the impact met from hitting the water, or I could better sell the front being destroyed by making an additional missile blast above the front hull.

After some thinking, I felt it would better showcase my mastery of destruction if I created an additional missile blast in front of the ship, also allowing me to showcase more destroyed substructures and textures on the
ship. I also made the decision to get rid of the glass from the ship’s cockpit entirely, as the windowpanes of sunken ships seem to hollow out entirely over time, likely due to a combination of the crash impact and the deterioration of glass over time underwater. Given this ship is not freshly crashed but rather long been an artificial reef, it felt better to eliminate it entirely.

While I was solving my issue of the main body of the ship, I went ahead and textured the cannon, wings, backing, and support of the ship, using a mix of rust generators, sea-scum, and algae materials that I made in Substance Designer, and discoloring in Substance Painter to give the ship a weathered look, using multiple references and trying to match them. Something I was given feedback on last semester was the roughness of my ship parts (and coral) was too shiny, and the ship underwater would not appear that way, so it was tricky to make the ship parts and substructures both look like metal while also keeping the roughness low.
Going into beta, I feel my destruction is the most complete and one of my stronger masteries, really only needing texture polish at this point and possibly some more substructures implemented in some areas. As far as the destruction I modeled, I believe it is on me to justify my decisions and defend my choices made.

**Dynamic Weather:**
Following the water vortex sequence, I worked on finishing the sandstorm and tornado sequences. The sandstorm sequence was made with a combination of flipbooks from Embergen and Niagara particles that simulated blowing sand to create a mixture of dust and sand. The sandstorm was relatively easy to implement, as I had become well accustomed to a pipeline of bringing in flipbook animations either made in Photoshop or Embergen, making them into Niagara systems and then further refining them in engine. The sand system was again made with some exploring in Unreal Engine, creating a blowing particle system.
When creating my fire tornado sequence, I ran into some issues, namely due to how expensive VDBs are. Initially, I wanted to have multiple tornados in scene, but having multiple VDBs in Unreal is incredibly costly. I initially tried to export more tornados as flipbooks, but felt the quality of them greatly reduced when doing so, and after talking to my advisor, we agreed it would be better to have one well made, polished and animated tornado to show off in the scene, and I could create supplemental VFX in Niagara and with flipbooks around the scene, plus tornados in real life only appear as one and not multiple, it would both save the cost and look more realistic.
When creating my tornado in Embergen, I found it is very easy to create animations and to keyframe VFX in the system, as you can easily right click on any setting in engine and key it from there. This allowed me to let my tornado shift, billow, spread and dissipate for a fluid looking animation. I also reduced the cost of my VDB by reducing the smoke from my tornado. While flames tend to be more expensive from VDBs, the smoke in my tornado was initially billowing very heavily and reducing it allowed my sequence to run more smoothly in engine.

Following my experience using Embergen and VDBs, I feel it is necessary to leave a fair bit of warning to anyone reading this in the future, who may be interested in using Embergen for smoke/fire/fluid simulation. Embergen is very powerful and can give quick results that look good, but VDBs are incredibly expensive and can tank framerate. VDB support is brand new to Unreal Engine, and while plug-ins have been built in the past, it is still a new territory as far as being implemented into game art. I recommend saving VDBs only for “hero
pieces” so to speak, and to use flipbooks for effects that are secondary, such as small bursts, smoke clouds and so on, as flipbooks in Embergen don’t render out as well when blending smoke and fire.

I also created some supplemental smoke, flames, and embers to sell the scene and make the tornado more dynamic.
With the tornado and sandstorm sequence created, I felt it necessary to return to my Vortex sequence and further refine it. I created variants of my water material, some with more foam, and others with more discoloration, though I felt the foam was too large in the former and the discoloration did not look as natural as what I initially had. I also slowed down the dust burst from my Vortex Sequence, so it dissipates slower and looks more natural, and added additional animations to the scene to make it more chaotic.
Additionally, I felt the jump between the tail touching the ground and the vortex was too sudden, so I added a bubble shockwave or burst before the dust kicks up, to better sell the dust clouding the scene and leading to the tornado.

I adjusted the water material by lerping a foam alpha texture I created with my water material and panning it at a different speed from the water to create more chaos. As a result, my water material has two materials housed inside, the water itself which can be tiled and panned, and the new foam material on top which helps prevent the water from looking too calm and clean.
Figure 170-171 – Water Material

Figure 172 – Water Reference 1

Figure 173 – Water Reference


With the water, and dust adjusted, new animations added for flying debris, and a new VFX for a shockwave, I have the finished sequence below.

![Vortex Sequence](image)

**Figure 174 – Vortex Sequence**

Something that was implemented to all of my sequences was creating a sky color and cloud change, using the Volumetric Cloud material I made during prototype, as well as the atmosphere color to give each scene its own uniqueness. For the vortex, I kept it simple with gray and blue. For the sandstorm, my advisor felt a deep purple could possibly play off the sand very well, so I implemented a purple to complement the yellow sand. For the tornado, I used orange and then a light gray, looking at references from the California Wildfires in 2019-2020.

![Sandstorm Sky](image)

**Figure 175 – Sandstorm Sky**
Figure 176 – Tornado Sky

Figure 177-178 – Tornado Sky Refs

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Going into beta, I feel my weather sequences are in a good state as far as being finished and all the VFX being implemented, and I am quite happy with how the fire tornado looks, though I think there is still room for polish in regard to the supplemental VFX such as my flames, waves, and so on, and smoothing out the transitions between the sky changes. That being said, I think I overcame a major hurdle with my weather mastery for beta.

BETA

*Slave-1* ship finished, textured, and destroyed. Three weather events of an underwater scene that is pristine with sea life, one that is being hit by an underwater maelstrom and storm, one that is overtaken by a sandstorm in a dried-out world and one with a flaming tornado.

POLISH

For polish, I began to fix some of the feedback given during my Alpha presentation, namely better warping and softening some of my destruction to look more like a missile blasted through it, adding panels popping in and out, and fixing the ship textures. I also adjusted some of the VFX, namely adding lights behind the fire tornado, and adding more chaos to the Vortex Sequence.

Something that was raised during my Alpha presentation was what was the difference between an Overgrowth Artist and a Clutter Artist, and I did some research and also looked into what a clutter artist entails, namely that Clutter Artists are tasked with making additional environment assets that are then decorated and dressed into the scene, similar to that of a level artist. However, for my mastery of Overgrowth, it is not so simple. This mastery does involve the job of a clutter artist, given that I’m making numerous assets such as coral, kelp, urchins, and other sea-life and placing them in the scene, however this required a large amount of research, including researching unique coral reefs, keeping each asset in the scene accurate to the reef, and then modeling coral to accuracy. As such, Overgrowth includes a healthy amount of research and understanding how something like coral works. While additional clutter is implemented in the scene such as tech and wires, I feel Overgrowth combines similar pipelines of that of a foliage artist with a clutter artist, creating a combination of the two. Following this project, I feel like I could both successfully model and implement clutter into a scene, while also having pipelines for researching and modeling natural environments like a coral reef and taking this knowledge if I needed to make say, a forest or desert scene. While an overgrowth artist is to an extent a clutter artist, a clutter artist would not necessarily be an overgrowth artist.

Some questions that were asked about coral were if coral could grow on top of coral, and to that the answer is no, as coral are living creatures despite being sedentary. Most coral contain plantlike species called zooxanthellae on top of them, and house other small living organisms. Coral can however potentially grow

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on dead coral. New polyps and coral will grow on the deceased coral and create a sort of rocky substrate from the dead coral’s calcium carbonate. 61

Some other information I’ve compiled is the difference between dead and bleached coral. Bleached coral is not necessarily dead, and can be brought back to life, while dead coral cannot. I’m using bleached coral throughout the scene, as bleached coral can occur for a number of reasons, though bleached coral is usually an indication that an environment the coral is growing in is not ideal, hence why I created dead coral patches using bleached coral. While too much light can cause coral bleaching as well, I felt for better conveyance, it would be better to make the sacrifice to showcase more bleached corals off to harder to reach areas or dark areas to create a “dead” feeling. 63

Brain coral prefers to grow mostly on sand and low rocks, which is why it’s primarily in the foreground of the scene, and not as common on the ship.

All the assets created are native to or can be found in the Caribbean Sea, to keep everything consistent.

Coral, especially the ones I chose for this project, thrive best typically in more shallow waters, and with plenty of light, hence why I added quite a few coral pieces on top of the ship.

To help sell my understanding of overgrowth, I added more hand-placed examples of it along the ship’s hull. Where light shines more brightly on the ship, I added coral along the top of it that was alive and thriving.

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I used this reference to go off.

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64 Rains, T. (n.d.). *Countries around the world have sunk aircraft like the Boeing 747 to boost diving tourism – here are 6 intentionally submerged planes*. Business Insider. https://www.businessinsider.com/photos-show-sunken-aircraft-to-promote-diving-tourism-2021-12
Where light traveled to less along the back of the ship, and under the ship, I added dead and bleached coral, as coral polyps that would attach to less optimal parts of the ship would not receive as much light and would as a result slowly bleach or die.

Figure 181-182 – Coral References

For Overgrowth, I also added some more grass, kelp, and fish around the scene, to give it some more life and to help fill out any bald patches on the ground or areas where assets may be repeating a bit too much.
I also adjusted the destruction of my ship’s hull. I felt the ship looked too “cut out” in my initial destruction pass, so I broke off pieces of it, increased the geo, and warped it so it would create a more “melted” look to simulate a blast from a missile or laser, trying to get an understanding of corrosion or melted metal.

I used a mixture of real life and fictional references to try to better nail the softened edges of the burned ship. Based on advisor feedback, I was told to look at the destruction done in a past artifact by Qiwei Zhang. His destruction was entirely simulated and dynamic, so I could not take much from his methodologies, but he used references from the Enterprise from Star Trek, which I found useful to study for that “melted effect”.

I also popped out panels along the side of the ship, as one piece of feedback I got from my advisor was to add more panels popping from the ship to intensify the feeling of a crash, water-pressure, and being fired at by missiles.

![Panel Destruction](image1.png)

**Figure 194 – Panel Destruction**

Lastly, some feedback I received was that the ship textures looked too low-res, so I increased the tiling on rusted textures, and given how large the ship is, increased the overall density of the textures I laid on it so it would look more high resolution in regard to its size.

![High Resolution Textures](image2.png)
One other thing I added for destruction was broken coral, to help sell the effect of the underwater vortex. The destroyed pillar coral was taken from this reference, which was a pillar coral that was affected by a hurricane. I used that as reference and destroyed a coral piece that would appear in the aftermath of the storm.

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For my weather, I mostly worked on fixing the skies during each weather event. For the vortex scene, I made the scene slightly brighter and removed the underwater PostProcessVolume so we could better see the shine of the water effect.

Additionally, I added more flying and torn coral from the scene, to sell the overall chaos and destruction of the underwater vortex. I also made the movement of the ship during the sequence a lot more violent to sell the weather more.

I also changed up the underwater dust cloud, to better differentiate it from the dust clouds in the sandstorm. I lightened up the sand color, while also adding sand particles blowing along the direction of the vortex to better convey the coming storm.
For the sandstorm, I added higher clouds and decreased the saturation of the purple color I had created prior, to make the scene a bit more realistic while still keeping the complimentary color palette of the purple and yellow that the sandstorm previously had.
Similar changes were made to the tornado scene, as I added clouds higher up and slightly reduced the orange color of the sky. Additionally, I added a bright light to the tornado, given that the fire would cast a light around it.

![Tornado Sky and Light being cast.](image)

**OPTIMIZATIONS**

Quite a bit of my optimizations were done in engine, for starters, removing unnecessary assets from the scene, and from the Unreal file, greatly speeding up the time required to deliver an executable. Before my alpha turn-in, I ran into a problem where my Unreal file was failing to cook an executable that could be submitted, a problem that gave me a great amount of stress prior to my turn-in. Attempting to create an executable resulted in numerous unknown failures, but thankfully I was able to solve the issue. The culprit was...
the Unreal file was far too large, given that many VDB files that were now unused or irrelevant to the project were still in the content browser, and deleted assets were still attempting to be referenced. As a result, I cleaned up the Unreal file, deleted any remaining sequencers that were no longer being used in my project, and was able to execute it.

In addition to cleaning the file itself, I also deleted coral pieces in the scene that were unable to be seen, and replaced more faraway coral pieces with cards as alternative to whole meshes. There were numerous brain coral pieces scattered around the scene from VS for example, that due to various additions to the scene and changes to the camera angle were now unable to be seen at all, so I deleted all of them to help increase the overall performance.

![Figure 207-208 – Cleaned up landscape.](image)

Additionally, I reduced the tri-count of certain objects in the scene.

Certain objects that were reduced were the overgrowth wires I created, along with parts of the main hull, namely the underside that never gets seen in the Artifact at all and wouldn’t be intended to be seen. I additionally reduced the count of some substructures that aren’t seen very close, such as the substructures inside the missile blast. The missile blast substructure was reduced from 13,396 to 8,954 tris, the ship’s body was reduced from 6,559 to 5,057, and the wires were collectively reduced from 9,596 to 5,792.
Figure 209-210 – Optimized Destruction

Figure 211-212 – Optimized Destruction

Figure 213-214 – Wire Optimizations
The fish were additionally reduced to just being flat cards.

![Figure 215 – Reduced Fish](image)

Going forward to RTM, I intend to mainly continue reducing tris on meshes that are a bit too expensive or unnecessary, but otherwise I have had no issues actually running the executable, as the scene seems to be performing quite well.

## CONCLUSION

### RTM

**DESCRIPTION**

RTM includes the final polishes I can add to the scene, the final scene being the *Slave-1* ship finished, the overgrowth in the scene fully pushed, intensified, and reworked. Three weather events of an underwater scene that is pristine with sea life, one that is being hit by an underwater maelstrom and storm, one that is overtaken by a sandstorm in a dried-out world and one with a flaming tornado, with as much polish as I can add to them.

### METHODOLOGIES

Following my Beta presentation, I was given a number of fixes to adjust my scene, many of which however could be done rather quickly and would add to the overall polish of my scene.
Based on feedback, I decided to push the overgrowth further, covering an entire portion of the ship, while still making sure that the silhouette of the Slave-1 would not be lost. Much of this overgrowth was hand-placed, due to the fact that I have only so many coral assets, I had to be strategic in where and how these meshes were being placed in the scene.

![Increased Ship Overgrowth](image1)

> Figure 216-217 – Increased Ship Overgrowth

Regarding my coral, I added a color AO to my orange cup coral piece and my lettuce leaf coral to make them pop a bit more. I also tweaked the color of some other pieces as well, such as my starfish, desaturating it a bit. I found this was a useful way to give coral a certain “living” texture to it, similar to that of subsurface scattering for skin.
Additionally, I felt my scene looked too clean for a coral reef, with not enough coral, rocks, and other assets to fully nail that “overgrowth” effect for my mastery. I added more coral to the foreground of the scene as well, to better create a “reef” feeling, as the artifact looked barren in hindsight. I created more of a barrier or sense of height, using kelp and rocks to help cut the scene and compose it better.
For my grasses and kelp, I added some lighter greens/browns to the kelp to create more of a color variation to fix the textures, as well as creating variation with the length to help break the silhouette of it more. I lowered the roughness to keep them from looking rubbery and used the new variation to break up the scene more and make it more chaotic.
I had a lot of corrections to make for my weather mastery in very little time. I had to first create a Material Parameter Collection, or a Global Parameter for my Vortex Sequence, as the scene needs to look wet when the water leaves the scene. I created a material function that would allow for the roughness of every texture in the scene to become overridden by a new roughness value. This was a bit of a time-consuming process, as you have to apply it to every material you've made, and in my case, every asset I created was individually textured with Material instances, meaning that I could not add additional drips or puddles in the time allotted. If I had the chance to begin this material in Prototype, that could have been possible.
While that was a big fix, it was something I’m glad I took the time to implement. I learned a bit about Material Parameters and Material Functions, and for future projects, I’ll be able to implement it with even more success with more time.

I also tweaked much of the animations in the vortex scene. After talking with my advisor, we determined that the ship would likely be thrown while the storm expands, rather than in the sort of “eye” it creates. I also adjusted so the ship moves more violently from its original position, turning it on its side completely. The coral, which flew out from the scene through the sequence, has now been moved to the initial part of the sequence, as it would be unrealistic for coral to fly off in an otherwise calm “eye” of a hurricane or funnel of water as it expands away. While I could have removed the coral flying out of the scene entirely, I still felt it was good for selling the chaos of the vortex, so I chose to keep them in, just in the beginning of the vortex only.
A part of the artifact that had been bothering me for quite some time was my storm tail flipbook, that starts off the vortex sequence. I felt it looked too flat, too slow, and smoky, and the roughness textures I was trying to implement simply were not appearing or conveying. After messing with my flipbook, I realized it would take longer to try to make an asset I was unhappy with work, when I had all the assets I needed in game to make a better looking tail. I repurposed my vortex mesh and made a material instance of my water material to create a new and improved tail. I know it’s a risk to add a new asset this late, but I felt any improvement I could make to that tail would be miniscule.
Lastly for the vortex, I shortened the duration of the dust that gets kicked up. It felt like a waste of time watching the dust take so long to clear.

Initially, I also added a light that follows my vortex to properly illustrate the glossiness of the water. However, after tweaking my material and my vortex mesh, namely adding a color over the Fresnel and adding displacement to the vortex mesh, I was able to achieve a more glossy, realistic looking water, without needing a large and occasionally jarring looking light.
Figure 229 – Initial water light and new water material
For my sandstorm, I increased the speed of the blowing sand, as well as adding more sand particles from my reworked wave VFX. I also shortened the overall duration of the sand/dust blowing.

![Figure 230 – Faster and quicker sandstorm](image)

To heighten the dynamic aspect of the sandstorm, I created sand meshes that raise up following the dust storm, covering, and obscuring parts of the reef, and also drying the scene once more with my global roughness parameter.

![Figure 231 – Sand Mesh](image)

For my tornado, I moved the tornado off to the side of the scene, as well as added embers flying off it and increasing the amount of fire in the tornado itself.
I moved the light being cast onto the ship and corals as well, using both a spotlight that grows with the tornado, the light cast off the fire itself, and my directional light to sell the illusion.

I also increased the overall intensity and size of the fire, by playing with the blackbody intensity of the VDB. I still wanted the overall silhouette of my tornado to stay the same, simply changing the amount of fire and smoke on it.
I continued to optimize my tri-count on all of the destruction assets, as they were the highest out of most of my meshes.

I optimized my ship’s wings, from about 12000 to 7000 tris.

I optimized the main cockpit area, from over 21000 tris to under 15000.
Additionally, I greatly optimized the big chunk of substructures under the main hull of the ship, which was by far the most highpoly and dense out of all of my meshes.
Figure 238-239 – Optimized Substructures
Almost each destruction asset is below 1500 tris individually, with none above 2.5k. The Whole chunk is reduced from 100000+ to 70k.

To help on both overdraw and my shader complexity, I changed my sea urchin material from translucent to masked and unlit, making it look identical to the translucent version. My scene has had no issues with performance at all, but replacing this material both made the majority of my shader viewport green, while also fixing an annoying issue I was experiencing where the sea urchin meshes were clipping in front of various VFX.
Additionally, I optimized any VFX that needed optimization. In my Vortex scene, my wave VFX and my dust vfx needed lots of optimizing, and to do so I reduced the spawn rate of my wave vfx, and created a mix of dithered and translucent materials for my dust clouds. Faraway clouds could be dithered, which is a masked material with some translucency, while the dust clouds that obscure the camera during the vortex were a mix of masked and translucent dust, as they needed to cover the scene successfully, despite optimization. The dust scene briefly shows white, though for no more than a second, and it’s necessary to cover the scene up.

I used the aforementioned methods for both of my expensive sandstorm VFX as well, decreasing the spawn rate and shortening the lifespan of the dust that rises before the storm, and dithering the crashing sandstorm that removes the debris. The sand particles were already green, thankfully.
Figure 242-243 – Optimized Shader Complexity Sandstorm
Lastly, for the tornado scene, my embers were green, and my following smoke VFX was red, so all I had to do was try to optimize the VDB. I found the solution in the blackbody intensity of the VDB. Lowering it made the flames go from white to red, and the framerate increase was definitely an improvement, however it comes at a cost. The result is the flames lose some of their aesthetic, glowing quality. While I still optimized the flames, keeping the initial of the tornado bright for aesthetics and the rest optimized, I found this interesting, and I considered that this VDB could have two uses. In game, it could be optimized to red for a better shader complexity, but in a cinematic sequence, the white would be perfectly fine. In general, I do believe it is not advisable to use VDBs in games. From my research in past cohorts, I may be the first to implement them into an Artifact as an Art Creation student, and I hope my research can prove useful for future cohorts.
Lastly, I fixed the texture sizes in my scene. I had a lot of unnecessary 4k textures, and I lowered every single one to 2k except for the normal map of my ship’s main hull, as it is such a large asset. To make up for this, all of my coral was reduced to 1k, as no difference was seen when I changed the resolution down, and my fish and smaller overgrowth assets like sea urchins and barnacles were brought down to 512.
Figure 242-243 – Texture Before and After
CONCLUSION

OVERGROWTH – RETROSPECTIVE

What Went Well:

-I was given comprehensive experience of organic modeling, material making, and foliage modeling. Overgrowth allowed me to learn multiple art pipelines and strengthen my skills as a level artist and environment artist.

-I gained a lot of knowledge and understanding of underwater environments and coral reefs, and my abilities as a researcher and artist greatly improved.

-I am quite happy with the result of my coral pieces

- I had a clear plan of what coral assets I wanted to make by priority, allowing me to begin my pipeline almost immediately into Prototype

What Went Wrong:

-Many of my first materials were a bit too expensive to be implemented, or did not convey as nicely in Unreal Engine

-Methods like scatter and foliage paint are good for initially dressing a scene, but still require a lot of hand-placement and further adjustment. The procedural methods I looked into during POCT were still a bit too prototypical for my project, leaving much of my implementation done by hand.

What Was Learned:

-I gained experience with multiple modeling pipelines, and I got a good understanding of Substance Designer, as making coral and underwater materials is something that does not have a whole lot of tutorials and coverage for, leaving me to teach myself. My abilities in setting a scene also greatly improved as I continued to build the reef.

Even Better If:

I was able to use more procedural methods for Overgrowth. While level art and hand-placing environments is a good skill, I think a combination of both would have better pushed this mastery into a more technical realm.

I was able to get more coral and more rock variations to prevent too much asset-reuse.

PRACTICAL DESTRUCTION - RETROSPECTIVE

What Went Well:

My destruction pipeline was very efficient, as I was able to develop a wide array of destroyed substructures throughout my scene, and easily developed lots of ways to emulate the feeling of a ship corroded underwater.
I successfully recreated the Slave-1 and its substructures from studying numerous concepts and cross-sections.

I feel I was able to successfully use my destruction to tell a story of crash-landing and sinking underwater to become home to an artificial reef.

What Went Wrong:

I think I could have destroyed the burned and corroded parts of my ship better, as by the time I had destroyed those parts, I did not have enough time to fully implement my feedback to make it look more polished.

What Was Learned:

I learned the pipeline for modeling and texturing destruction.

I learned that I genuinely dislike modeling destruction. Destruction is a discipline that necessitates a lot of fine-tuning, and a lot of reasoning and justification to make sense, which is absolutely justified for game development which necessitates good conveyance and consistency, but I dislike working on art in that way. However, I’m glad I learned this now, and not later. While I may not want to work on destruction in the future, it is a skill I know, and something I respect.

Even Better If:

I think I should have used Zbrush or some other methods of simulating destruction in Max on the burned and corroded parts of my ship to better nail that melted, “missile-blasted” look. I experimented with Zbrush early in prototype but felt it would be wasteful to use it as the deadlines for Alpha and later milestones drew near. I used Max to the best of my abilities, but I should have been better about experimenting with these sorts of effects earlier in prototype.

DYNAMIC WEATHER - RETROSPECTIVE

What Went Well:

I successfully created blueprints to key a dynamic weather sequence, and successfully took the water out of an underwater scene, something I genuinely did not think I’d be able to do when I began this project.

I gained a lot of hands-on experience using VDBs, something that is brand new to Unreal Engine, and got to learn a lot about using Embergen for other effect making. Embergen is a powerful software and I’m glad I was able to get experience with it.

I became very comfortable with working with Level Sequencers, and really developed a love for creating wild looking weather events that drastically change a scene.

What Went Wrong:

I did not get certain global parameters in until after Beta. Had I begun working on Global Parameters and Material Functions in prototype, my scene could have looked more detailed, with dripping puddles after the vortex and sand coating the scene.
VDBs are horribly expensive, so much so that I couldn’t have more than one in my scene without absolutely nuking my framerate. I took on wanting to use VDBs to experiment, as I am the first Art Creation student to do so from my research.

What Was Learned:

I learned quite a bit about Embergen and VDBs and hope my research and the sources I’ve put together can help future students and cohorts. While I do not regret working with VDBs, it’s dishonest to say that they do not come without numerous drawbacks, and I do not advise future cohorts to use them for a thesis project, though they could be great to play with in a DFS or personal project. Considering this project will be part of a larger database of research and work in this graduate program, I believe my research can help future cohorts looking for different types of VFX.

I learned that a lot of VFX pipelines are daunting from far away, but once you get the hang of the language used, are actually a great way to bridge my knowledge in game art with previous knowledge in 2D art and technical art.

Even Better If:

I had done more research on the differences between Dynamic VFX, Dynamic Weather Systems and so on earlier on. While I enjoyed making VFX, I did not realize just how blueprint heavy Dynamic Weather was going to be.

ARTIFACT - RETROSPECTIVE

What Went Well:

Overall I am satisfied with the scene, I got to experiment and try out multiple art pipelines and methods. Following pre-production in the summer I was seriously worried that I was not going to be able to achieve this project, but I’m glad I persevered and didn’t let myself get intimidated by the work I had ahead. I feel I’ve grown tremendously as an artist especially in the final semester where a lot of things game-art related finally started to click for me.

What Went Wrong:

I feel my artifact as a whole did not start to finally come together until maybe the last few milestones. A lot of my fundamentals and my skills really developed during this last semester, so I grew very unsatisfied with older assets but did not have the time to go back and fix things as I’d see fit. As a result, while I’m happy with the result, there is a lot I would do differently.

I experienced heavy amounts of burnout and stress related to this project. As a result, I needed to start taking days away from my project in order to finish it. I feel not listening to warning signs that my body was giving me contributed to this stress, and some time away often produces better results. I can guarantee that anyone can achieve a lot more productive work after a day of no screen-time than forcing themselves to have sleepless nights. I wish I realized this earlier.

What Was Learned:
For people who want to tackle and try multiple disciplines like I did, scope is everything for these projects. I was very meticulous about the assets I would need and use for this project, the subject matter I wanted to go for, and the VFX I wanted to try, but even with good planning and responsibility you can still get overwhelmed.

Something my advisor created for my section was a weekly schedule and breaking down my tasks through the week both helped in keeping the project from getting too daunting and kept myself from getting stuck on one thing. If you’re someone who can get stuck on one thing, I highly recommend keeping a good schedule, with tasks sorted by priority. Keep yourself accountable and get as much as you can done. You can always polish but there will come a point where you cannot and should not add new things to this project.

Even Better If:

While I had a clear idea of what I wanted to create and what I wanted to work on for this project, there were key things I did not consider until later. The scene layout was a big one, the framing of my ship and coral was something that I did not fix until later milestones, and I should have concepted out my weather transitions earlier on to keep the project cohesive on an aesthetic level.

WHY IS THIS MASTERY

I think this project really helped me demonstrate my three masteries. Overgrowth as a mastery lends itself to working as a clutter, biome, or foliage artist, and choosing a coral reef as my subject allowed me to work with all three of those concepts, as well as organic modeling and strengthening my abilities as an environment artist. My coral reef shows that I can study an environment in the wilderness and make a large array of assets for it that all fit the theme, are realistic to their environment, and are not expensive to place in a scene. This could help both in the sense that I now have a niche for myself built as someone who can create coral reefs, and also as someone who can potentially work with other biomes and ecosystems as well.

Destruction is a common thing seen in most games, and destroying the Slave-1 demonstrates my ability to both recreate a piece of art from just a few concepts and dimensions, while also being able to do my own research to accurately destroy it and make it fit the environment it has been destroyed in. I was able to improve my hard-surface modeling ability, my midpoly modeling ability, and my understanding of how to follow a concept and destroy it.

Dynamic Weather Systems are another thing very common in games, and I chose to challenge myself by picking three bold and chaotic weather events. I was able to get experience in not just blueprinting and keying weather systems, but also with making effects out of meshes, flipbooks, and voxels. I got experience making water VFX, sand effects, and fire effects, three diverse yet common elements in most games. I now have experience with blueprints, level sequences, and a wide array of VFX.

For artists looking to work in an Overgrowth and Destruction mastery, I have some advice. First for overgrowth. Research is everything. Having a clear understanding of what environment you want to make, what lives in the environment and grows in it, how things in the environment change if something disrupts it, like say, a shipwreck in my specific scenario, or how things grow in the environment will inform how you create your assets and make your own environment out of them. Poor research will make things appear odd or uncanny. If you want to make a forest, understanding how that forest grows or having a large amount of references will help it appear more natural. For modeling, try to be conservative with your tri counts when
applicable, things like foliage or grass should be baked onto cards and optimized to prevent overdraw, and assets like some of my larger coral for example can be a bit denser, but you should be mindful of how you implement them in the scene. I would model all of your overgrowth assets in a way where they can easily be placed together to keep things looking cohesive. If you’re going to sculpt overgrowth assets, I think that is good for detailed pieces, but sculpted pieces often require a lot more work to tweak if you have to adjust the overall look of it. Additionally, proxying them in Max beforehand will let you have a ready lowpoly without the headache of retopology.

For destruction, model everything pristine before destroying anything. If you are creating substructures for a ship, ideally model them fitting together so pieces will not crash into each other in an odd way. Additionally, try to concept where the destruction will take place, and try not to destroy assets for the sake of destroying them. I would keep assets optimized in the order of how they’ll appear, lower priority and further assets can be lower while assets closer to the viewer can be more dense or detailed. There are lots of modifiers in 3DS Max that can get you a quick “destroyed” and warped look, like ripple, Boolean, or relax, but you should then use your own eye to adjust the assets to fit your storytelling.

With the knowledge I have now, there are a few things I would do differently, namely creating more variation with my ship’s destruction, making more coral and supplementary overgrowth assets, and while I am glad I experimented with VDBs, I think the other methods I used were far less of a headache to work with. They are great for cinematics, but not for optimized game art.

PERSONAL GROWTH

Over the course of this project, I feel I improved a lot as an artist, both my hard and soft skills. I am a far more organized person than before, with regards to keeping schedules, following plans, and being self-disciplined. Those are skills I am glad to take away from this.

Additionally, my understanding of modeling, texturing, technical art, and putting together an environment has come a long way. I feel far more confident in my abilities to model what I see, to create new materials, and to put together more environments in the future. There were plenty of days where I was burned out, but overall, I feel this project provided me with a unique challenge I tackled to the best of my abilities.
## Thesis "Sunken Spaceship" - Asset Development List

### Priority One Assets

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Date</th>
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<tbody>
<tr>
<td>Overgrowth Assets</td>
<td></td>
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<tr>
<td>Lace Coral</td>
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<tr>
<td>Elkhorn Coral</td>
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| Slave 1                          |                                                       |            |
| Slave 1 Main Hull                |                                                       | 6/24/2023  |
| Slave 1 Window (Pristine/Destroyed) |                                                      | 8/22/2023  |
| Slave 1 Blaster Cannon           |                                                       | 8/22/2023  |
| Slave 1 Wing                     |                                                       | 8/22/2023  |
| Slave 1 Hull Substructures (Pristine/Destroyed) |                               | 9/12/2023  |

| High Priority Effects            |                                                       |            |
| Maelstrom VFX                    |                                                       | 8/22/2023  |
| Storm Tail                       |                                                       | 6/24/2023  |
| Sandstorm VFX                    |                                                       | 1/22/2024  |
| Flaming Tornado VFX              |                                                       | 1/22/2024  |
| Dust VFX                         |                                                       | 8/26/2023  |

| Textures                        |                                                       |            |
| Saw-1 Textures                  |                                                       | 10/10/2023 |
| Corroded hull texture           |                                                       | 10/10/2023 |
| Substructure texture            |                                                       | 10/10/2023 |
| Coral Textures (Underwater)     |                                                       | 10/10/2023 |

### Priority Two Assets

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>Date</th>
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<tr>
<td>Secondary Coral/Barnacles</td>
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<td>Fire Coral</td>
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| Secondary Underwater Assets     |                                                       |            |
| Rock Formations                 |                                                       | 10/9/2023  | 2          |
| Base Fish                       |                                                       | 10/9/2023  | 2          |
| Manta Ray                       |                                                       | 10/9/2023  | 2          |
| Starfish                        |                                                       | 10/9/2023  | 2          |
| Sea Anemone                     |                                                       | 10/9/2023  | 2          |
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