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ATCM 4399.010 Honors in Arts, Technology, and Emerging Communication - S18
04/06/2018

The Lost City of Atlantis
Virtual Environment of an Underwater Scene

Index

Style Overview

Tagline: Virtual Environment of diving underwater at a beautiful, calm, and peaceful reef.

Description: The Red Sea is considered to have one of the most beautiful coral reefs in the world. Therefore, I would like to mimic the realistic feel of the underwater aquatic life of the sea. My project consists of screenshots and a video

Figure 1: Reference picture:
https://wallup.net/preview/?wallpaper=artwork-shipwreck-underwater

flythrough viewing the coral and the caustic effects in the underwater scene. The coral reef has a realistic art style utilizing the models of the coral, seaweed, fish, etc. To beautify the scene, there are animated light and shadow effects (costal shadows) to give the illusion of moving water.

As the player sinks to the bottom of the reef, he/she is able to walk around and look at the rocks, corals, seaweed and a shipwreck. The contrast of the lights casting on the models brings a feeling of calmness and peace. The flythrough is simple. There are pathways between the coral reefs with a shipwreck on one side and a cave on the other. The camera flythrough is focused on 4-6 locations. The first camera is focused on the pathway between the coral and the reefs, the second on the shipwreck, the third on the cave and treasure chest, and the 4th to 6th on the corals and the silhouette of the rocks from a distance, along with turtle, sharks, fish, etc.

Research

The reference images I used are the reefs of the Red Sea and the Mayan underwater ruins. After mapping the area of the reef and making a whitebox, I used different programs to model a variety of underwater wildlife such as fish, seaweed, coral, sharks, etc. Textures and particle systems played an important role in making the environment feel alive. Furthermore, I embedded audio of bubbles, underwater ambience, and calm music.

To promote a sense of awe and wonder, variation in scale is utilized heavily, and the key focal points are the statues of Neptune and the mermaid. The entire ocean is not explorable, but rather a fog effect and the blue fade towards the horizon.

a. Visual Research & Concept Art:

My choice of underwater scenery for a game is based on the uniqueness of the subject of a game. There are not many underwater games because it's expensive to use real lights and multiple particle systems to accomplish the theme of the lights coming through the water to cause the costal effect on the ground of the sea, in addition to the fog and the animated shaders and wildlife. Therefore, exploring the lighting effects and making them achieve the objective with the least cost. Also, it is important to study the LOD (Level of Details) which deals with how much details of the textures and meshes the system will load depending on the distance of the camera from the objects.

Figure 2 Reference picture: Assassin's Creed (Black Flag)

Figure 3 Reference picture by: Andreas Rocha

Figure 4 Reference picture: Free Resource

Figure 5 Reference picture: Assassin's Creed (Black Flag)

b. Color Palette:

A color palette of the environment consists of green, red, orange, purple, pink, and mainly blue. The ground is orange sand and some smooth rocks with moss. However, the lights casted on the ground with the shades change the color to blue or green. The beautiful colors of the coral complement the environment.

Implementation

- **Software Packages**

3D Assets -   AutoDesk Maya 2016 Extension 2
                    AutoDesk Mudbox
Rigging -   AutoDesk Maya 2016 Extension 2
Animation -   AutoDesk Maya 2016 Extension 2
                    Unreal Engine 4
Textures -   Adobe Photoshop
                    xNormal
                    Substance Designer
                    Substance Painter
Engine -   Unreal Engine 4
Video Production (Reel-Demo) - Adobe After Effects

- **File Formats for Engine**

3D Assets -   Filmbox (FBX)
Image Assets - Portable Network Graphics (PNG)

- **Technical Specifications**

2D Layers - 16:9 aspect ratio, Max Texture Resolution - 2048x2048

Guidelines

a.   Whitebox

I mapped the layout of the scene by placing boxes and meshes in different positions and then tested the silhouette of the scene. At the beginning, I put two statues in the back, trying to mimic the gate statues of the city from the movie *Lord of the Ring.*
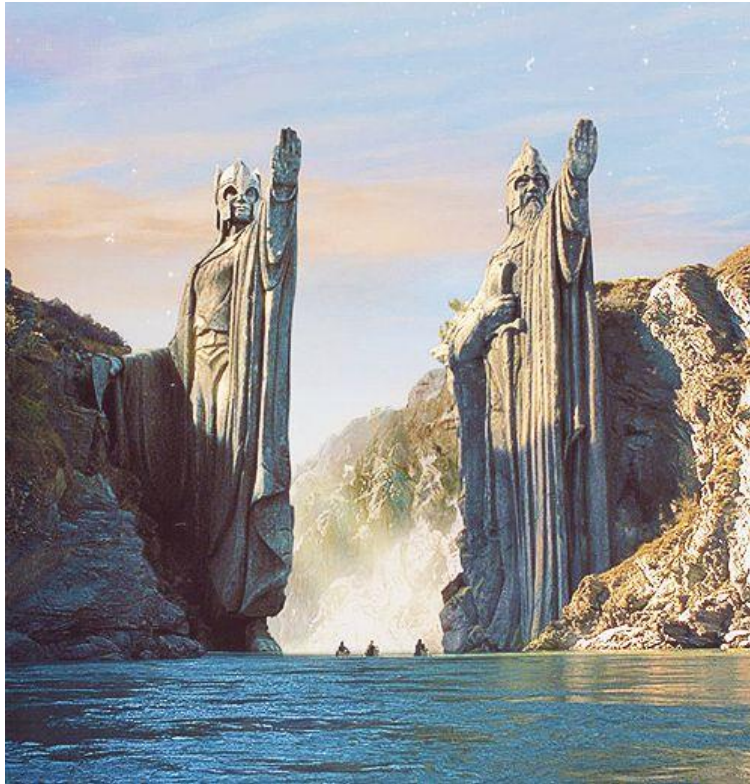

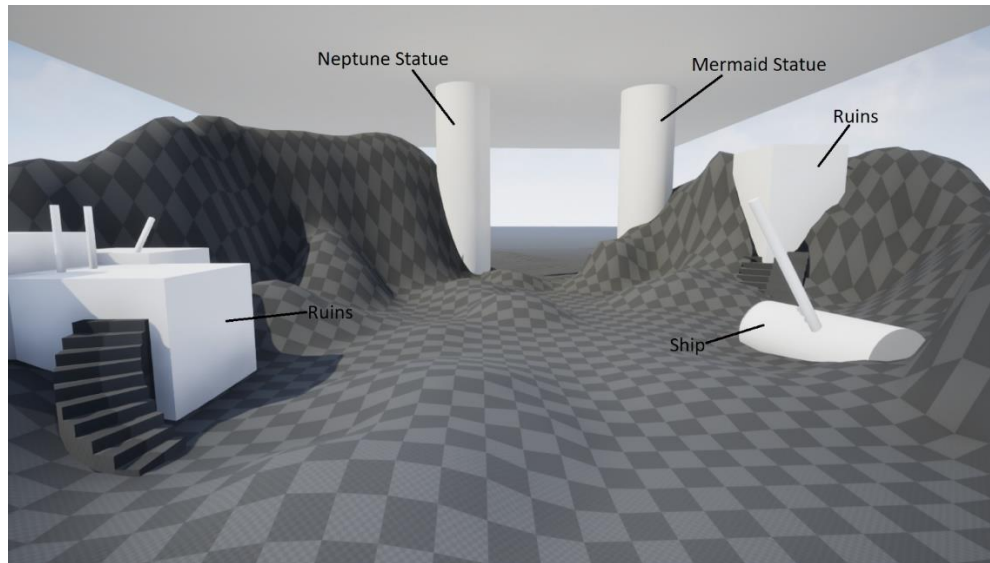*Figure 6: A scene from the movie Lord of the Rings*

Figure 7: Whitebox

However, when applying the real models, the details of the textures didn't show, and they were covered with other meshes. Therefore, I decided to put the two statues in the front instead of the back.

Figure 8: The capstone scene in the first quarter of the semester

b. 3D Production Process

The meshes vary between organic and geometric shapes. I decided to make the architecture by using Autodesk Maya. Some of these items are bridge gate, ship, and pillars:
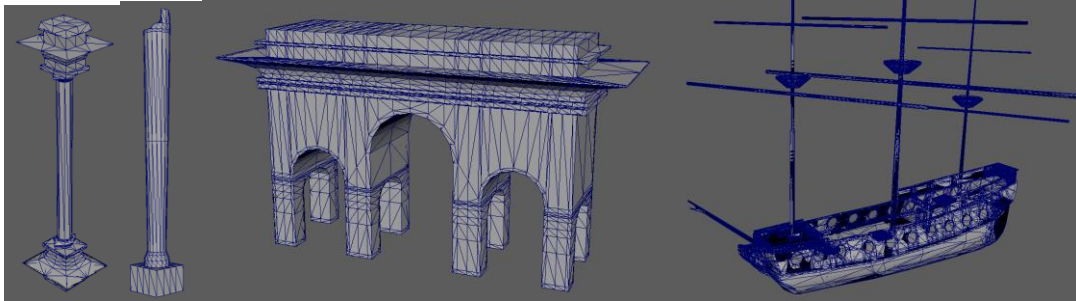

Figure 9: Geometric models for the capstone project

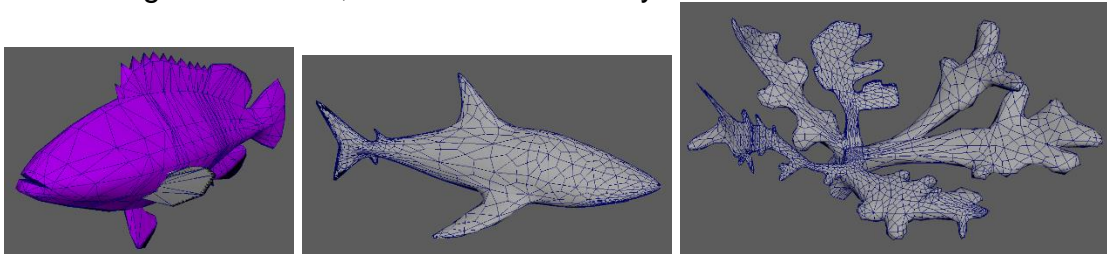For the organic meshes, I used Autodesk Maya and Mudbox:

Figure 10: Organic models done in Autodesk Maya and Mudbox

The statues are inspired by the King Neptune statue located in Virginia Beach, Virginia and sculpted by Paul DiPasquale. The Mermaid statue was inspired by the Resort Gardens of the Club Hotel Letoonia in Turkey:

Figure 11: King Neptune statue located in Virginia Beach, Virginia and sculpted by Paul DiPasquale

Figure 12: The Mermaid statue inspired by the Resort Gardens of the Club Hotel Letoonia in Turkey

c. Texture Production Process

I used the PBR in Substance Designer to do the sand and rock textures for the terrain:
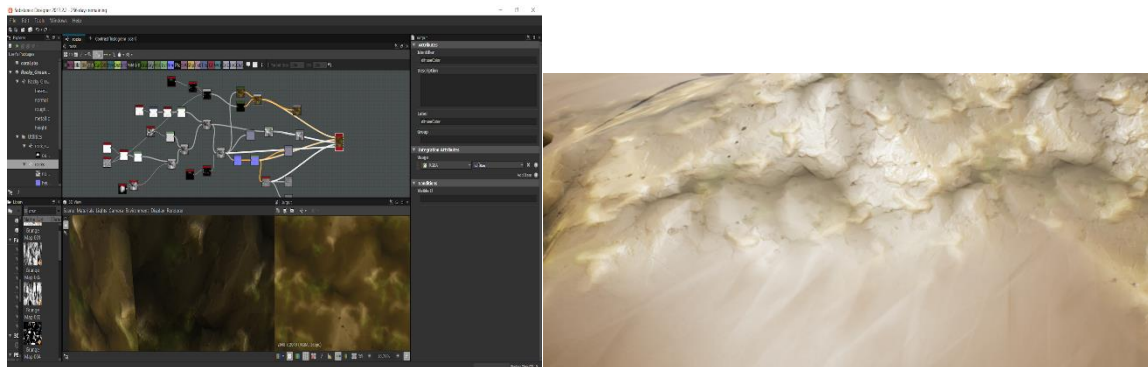

Figure 13: Texture in Substance Designer

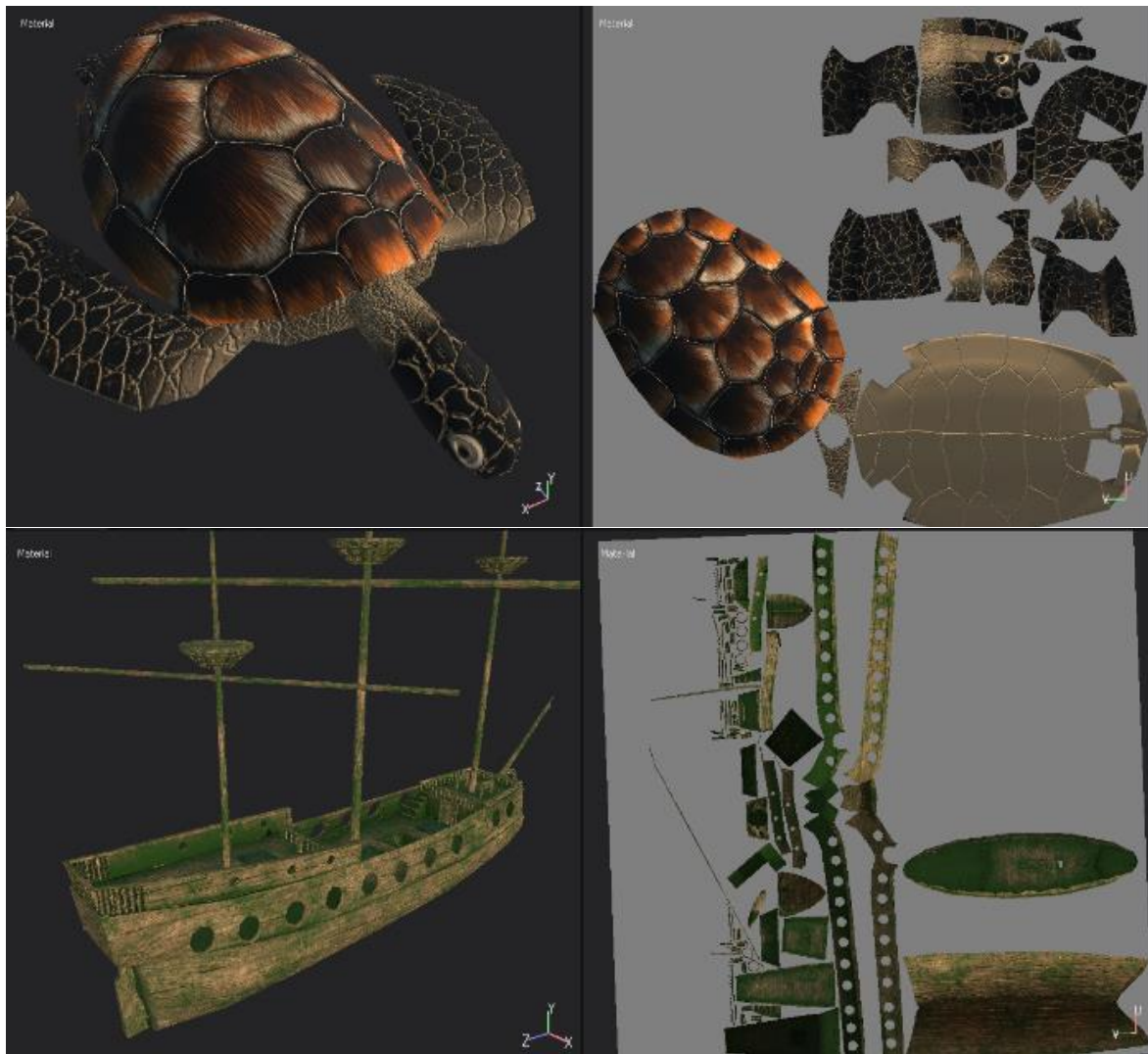Substance painter was used to texture the meshes:

Figure 14: Texture in Substance Painter

Special brushes were created to determine the height and normal of the texture, not to mention the baking of the textures from high poly to low poly using XNormal, Autodesk Mudbox and Substance Painter.
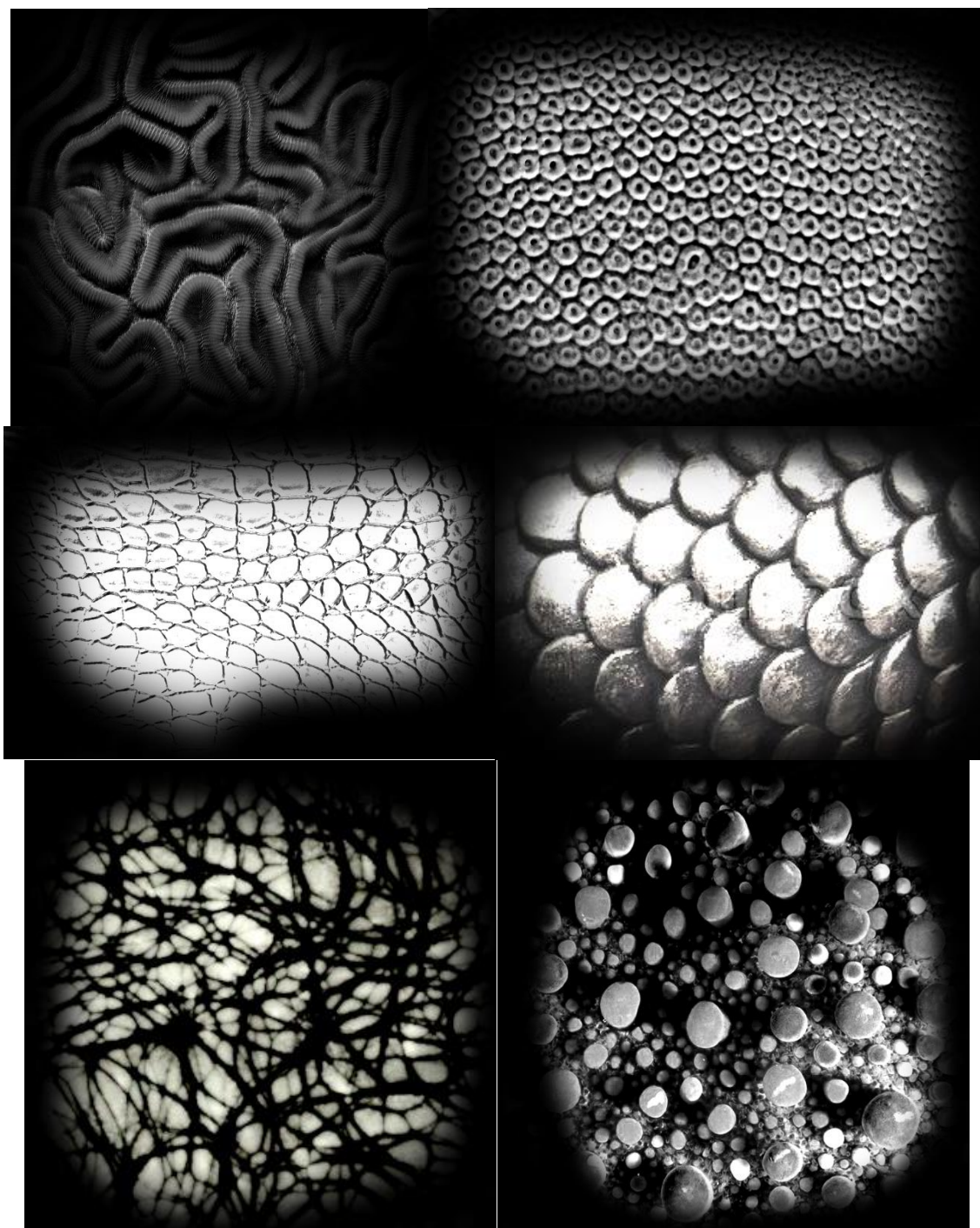
Figure 15: Special alpha brushes were created for textures

d. Lighting

Nineteen lights were used in the scene. One of the directional lights used to light the scene as a keylight, and it was used to determine the sun's direction. The second directional light was used as a light function. A special
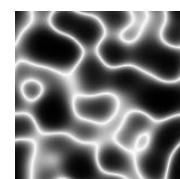

Figure 16: Coastal effect alpha

material (coastal effect) was created in addition to the shaft light to create the god rays.
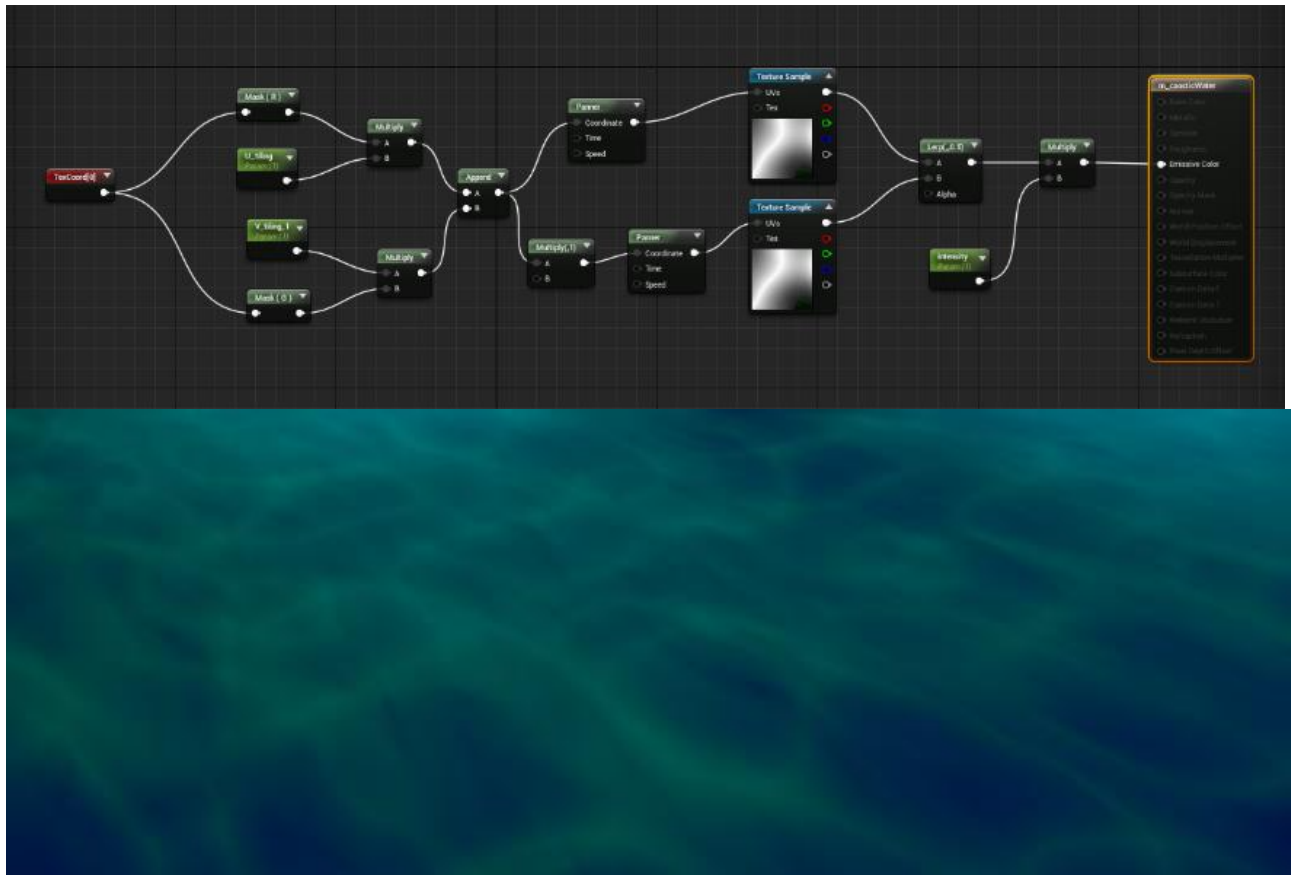

Figure 17: Using the PBR in Unreal Engine in the material to create the coastal effect

The third light is the Skylight which controlled how bright the scene is.

Two point lights were used to light the treasure inside the treasure box. Fourteen spotlights were used, two of them to create the rim light of the statues and the other spotlights to light the frontside of the treasure chest, ship, and some of the ruins.

Of course, fog was used to create a volume for the underwater scene. In the *Global Post Process Volume,* the overall color was tinted blue and contrast was set to higher value. The bloom and depth of field effects were used as well.
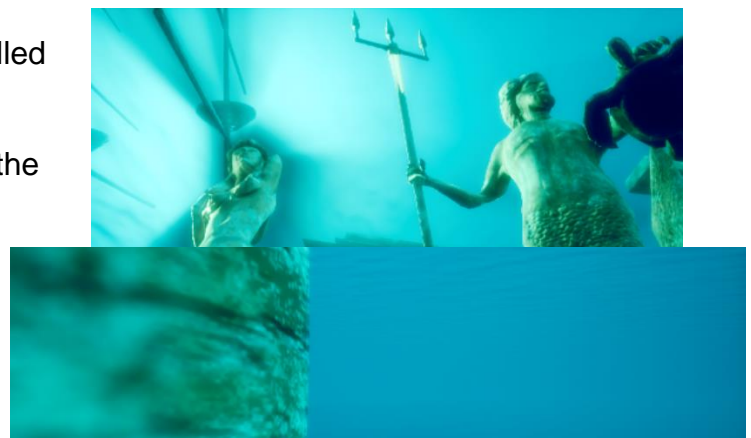
Figure 18: Global post volume effects such as tint, saturation, blur and depth of field

e. Animation Process

At least four types of animation are used in the scene:
1. Animated Shader: The coral seemed to be moving according to the water waves.
2. Particle system using sprite sheet to animate the jellyfish and the schools of fish.
3. The Coastal Effect functional light
4. Main animation for the Red Hind, Parrot and Blue Chromis Fish, Sea Turtle, and White Shark.

Figure 19: Rigging and animation in Autodesk Maya

Figure 20: Sprite Sheet done in Adobe Photoshop. gif picture resource: imgur website. Artwork by: ctyrddp

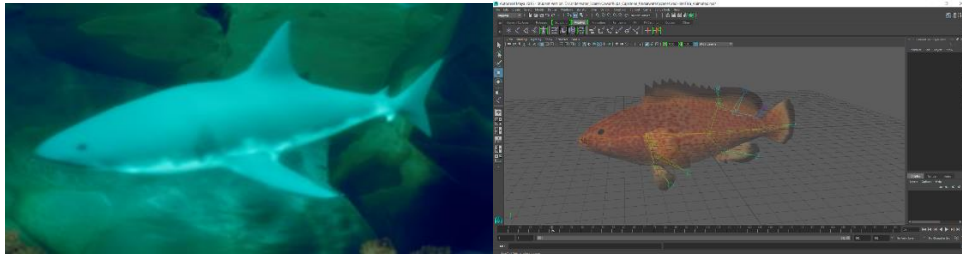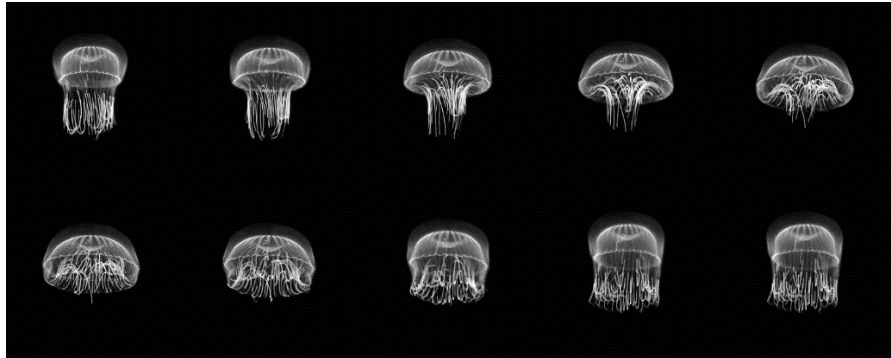# Asset List

#	Priority	Set	Type	Asset	Texture
1	High	Building	Static Mesh	sm_building1_low	T_building1_difuse T_building1_metalic T_building1_normals T_building1_roughness
2	High	Building	Static Mesh	sm_building2_low	T_building2_difuse T_building2_metalic T_building2_normals T_building2_roughness
3	High	Column	Static Mesh	sm_column1_low	T_column1_difuse T_column1_metalic T_column1_normals T_column1_roughness
4	High	Column	Static Mesh	sm_column2_low	T_column2_difuse T_column2_metalic T_column2_normals T_column2_roughness
5	High	Rock Big	Static Mesh	sm_rock1_low	T_rock1_difuse T_rock1_metalic T_rock1_normals T_rock1_roughness
6	High	Rock Medium	Static Mesh	sm_rock2_low	T_rock2_difuse T_rock2_metalic T_rock2_normals T_rock2_roughness
7	High	Rock Small	Static Mesh	sm_rock3_low	T_rock3_difuse T_rock3_metalic T_rock3_normals T_rock3_roughness
8	Low	Rock Addition	Static Mesh	sm_rock4_low	T_rock4_difuse T_rock4_metalic T_rock4_normals T_rock4_roughness
9	High	Ruins	Static Mesh	sm_ruins_low	T_ruins_difuse T_ruins_metalic T_ruins_normals T_ruins_roughness

10	High	Statue	Static Mesh	sm_mermaid_low	T_mermaid_diffuse T_mermaid_metallic T_mermaid_normals T_mermaid_roughness
11	High	Statue	Static Mesh	sm_neptune_low	T_neptune_diffuse T_neptune_metallic T_neptune_normals T_neptune_roughness
12	Medium	Worled Coral	Static Mesh	sm_worled_low	T_worled_diffuse T_worled_metallic T_worled_normals T_worled_roughness
13	Medium	Disk Coral	Static Mesh	sm_disc_low	T_disc_diffuse T_disc_metallic T_disc_normals T_disc_roughness
14	Medium	Pacific Sea Fan Coral	Static Mesh	sm_pacificSeaFan_low	T_pacificSeaFan_diffuse T_pacificSeaFan_metallic T_pacificSeaFan_normals T_pacificSeaFan_roughness
15	Medium	Red Mushroom Coral	Static Mesh	sm_mashroom_low	T_mashroom_diffuse T_mashroom_metallic T_mashroom_normals T_mashroom_roughness
16	Medium	Carpet Anemone Coral	Static Mesh	sm_carpetCoral_low	T_carpetCoral_diffuse T_carpetCoral_metallic T_carpetCoral_normals T_carpetCoral_roughness
17	Medium	Bubble Coral	Static Mesh	sm_bubbleCoral_low	T_bubbleCoral_diffuse T_bubbleCoral_metallic T_bubbleCoral_normals T_bubbleCoral_roughness
18	Medium	Elkhorn Coral	Static Mesh	sm_elkhorn_low	T_elkhornl_diffuse T_elkhorn_metallic T_elkhorn_normals T_elkhorn_roughness
19	Medium	Lobed Brain Coral	Static Mesh	sm_brainCoral_low	T_brainCoral_diffuse T_brainCoral_metallic T_brainCoral_normals T_brainCoral_roughness

20	Medium	Corky Sea Fingers Coral	Static Mesh	sm_corky_low	T_corky_diffuse T_corky_metallic T_corky_normals T_corky_roughness
21	Medium	Geoffroyi Coral	Static Mesh	sm_geo_low	T_geo_diffuse T_geo_metallic T_geo_normals T_geo_roughness
22	Medium	Bulb Anemone	Static Mesh	sm_bulb_low	T_bulb_diffuse T_bulb_metallic T_bulb_normals T_bulb_roughness
23	Medium	Hammer Coral	Static Mesh	sm_hammer_low	T_hammer_diffuse T_hammer_metallic T_hammer_normals T_hammer_roughness
24	Medium	Pink Sponge Coral	Static Mesh	sm_wrong_low	T_wrong_diffuse T_wrong_metallic T_wrong_normals T_wrong_roughness
25	Medium	Orange Sponge Coral	Static Mesh	sm_orangeSponge_low	T_orangeSponge_diffuse T_orangeSponge_metallic T_orangeSponge_normals T_orangeSponge_roughness
26	Medium	Staghorn Coral	Static Mesh	sm_staghorn_low	T_staghorn_diffuse T_staghorn_metallic T_staghorn_normals T_staghorn_roughness
27	Medium	Long Spined Sea Urchin	Static Mesh	sm_spinedSea_low	T_spinedSea_diffuse T_spinedSea_metallic T_spinedSea_normals T_spinedSea_roughness
28	Medium	Branching Vase Sponge Coral	Static Mesh	sm_branching_low	T_branching_diffuse T_branching_metallic T_branching_normals T_branching_roughness
29	Medium	Basket Sponge Coral	Static Mesh	sm_basket_low	T_basket_diffuse T_basket_metallic T_basket_normals T_basket_roughness

30	Medium	Orange Tube Sponge Coral	Static Mesh	sm_tubeSponge_low	T_tubeSponge_diffuse T_tubeSponge_metallic T_tubeSponge_normals T_tubeSponge_roughness
31	Medium	Sea Star	Static Mesh	sm_seaStar_low	T_seaStar_diffuse T_seaStar_metallic T_seaStar_normals T_seaStar_roughness
32	Medium	Blue Parrotfish	Static Mesh	sm_parrotFish_low	T_parrotFish_diffuse T_parrotFish_metallic T_parrotFish_normals T_parrotFish_roughness
33	Medium	Shark	Static Mesh	sm_shark_low	T_shark_diffuse T_shark_metallic T_shark_normals T_shark_roughness
34	Medium	Red Hind Fish	Static Mesh	sm_redHind_low	T_redHind_diffuse T_redHind_metallic T_redHind_normals T_redHind_roughness
35	Medium	Blue Chromis Fish	Static Mesh	sm_chromis_low	T_chromis_diffuse T_chromis_metallic T_chromis_normals T_chromis_roughness
36	Medium	French Grunt Fish	Static Mesh	sm_grunt_low	T_grunt_diffuse T_grunt_metallic T_grunt_normals T_grunt_roughness
37	Medium	White Spotted Eagle Ray Fish	Static Mesh	sm_eagleRay_low	T_eagleRay_diffuse T_eagleRay_metallic T_eagleRay_normals T_eagleRay_roughness
38	Medium	Red Snapper Fish	Static Mesh	sm_redSnapper_low	T_redSnapper_diffuse T_redSnapper_metallic T_redSnapper_normals T_redSnapper_roughness
39	Medium	Hermit Crab	Static Mesh	sm_hermit_low	T_hermit_diffuse T_hermit_metallic T_hermit_normals T_hermit_roughness

40	Medium	Eal	Static Mesh	sm_eal_low	T_eal_diffuse T_eal_metallic T_eal_normals T_eal_roughness
41	High	Ship	Static Mesh	sm_ship_low	T_ship_diffuse T_ship_metallic T_ship_normals T_ship_roughness
42	High	Seaweed	Static Mesh	sm_seaweed_low	T_seaweed_diffuse T_seaweed_metallic T_seaweed_normals T_seaweed_roughness
43	High	Terrain	Terrain	Terrain	T_rockyGround_diffuse T_rockyGround_metallic T_rockyGround_normals T_rockyGround_roughness T_sandGround_diffuse T_sandGround_metallic T_sandGround_normals T_sandGround_roughness
44	High	Light	Light	Directional Lights	
45	High	Light	Light	Spot Lights	
46	High	Particle System	Particle System	Dust Particles	
47	Low	Treasure Case	Static Mesh	sm_treasureCase_low	T_treasureCase_diffuse T_treasureCase_metallic T_treasureCase_normals T_treasureCase_roughness
48	Low	Treasure	Static Mesh	sm_treasure_low	T_treasure_diffuse T_treasure_metallic T_treasure_normals T_treasure_roughness
49	High	Post Production			
50	High	Particle System	Particle System	Bubbles	
51	Medium	Animation		Animating the sea life	

*Asset List with reference pictures: https://docs.google.com/document/d/1hvMzfokys_A7bo5dWaVkHm7sdEfnIysrZ4wP-91I-wA/edit?usp=sharing

Schedule

- *Week One 01/08-12/2018:* Sketching the map of the environment and making the whitebox.
  Also making an asset list of all the meshes, lights, animation, etc. that are going to be used for the scene.
- *Week Two 01/15-19/2018:* Modeling and UVing the meshes used for the environment using Maya, Mudbox and Zbrush.
- *Week Three 01/22-26/2018:* Modeling and UVing the meshes used for the environment using Maya, Mudbox and Zbrush.
- *Week Four 01/29/2018-02/02/2018:* Texturing using Adobe Photoshop, substance designer and substance painter & creating the sound effects using Adobe Audition.
- *Week Five 02/05-09/2018:* Texturing using Adobe Photoshop, substance designer and substance painter & creating the sound effects using Adobe Audition
- *Week Six 02/12-16/2018:* Compositing the objects together and creating the scene in Unreal Engine. Placing them according to the map and whitebox. Getting First feedback from the instructor
- *Week Seven 02/19-23/2018:* Compositing the objects together and creating the scene in Unreal Engine. Placing them according to the map and whitebox. Getting First feedback from the instructor
- *Week Eight 02/26/2018-03/02/2018*: Lighting the scene using Unreal Engine & animating the live objects.
- *Week Nine 03/05-10/2018*: Lighting the scene using Unreal Engine & animating the live objects.
- *Week Ten 03/19-23/2018:* Polishing the scene and submitting. Getting feedback from the instructor.
- *Week Eleven 03/26-30/2018:* First Iterations.
- *Week Twelve 04/02-06/2018*: First Iterations.
- *Week Thirteen 04/09-13/2018:* feedback from the instructor.
- *Week Fourteen 04/16-20/2018*: Final Iterations
- *Week Fifteen 04/23-27/2018*: Finalizing and delivering the Project.

Challenges & Solutions

Some of the challenges faced while doing the project:

1. *Scaling*: When modeling the meshes and then importing the fbxs to Unreal Engine, I found that the meshes had different sizes and didn't match together. I had to re-import them in Maya, change the scale, freeze transformation, delete the history, then export them again for Unreal Engine. It was time consuming but finally accomplished the desired look of the scene.

2. *Mudbox Export*: When modeling the meshes in Autodesk Mudbox, reducing the polys, then exporting them to Unreal Engine, I found that the mesh was still high poly. When I tried to import it in the scene of Unreal Engine, I noticed that building the lights took a long time.
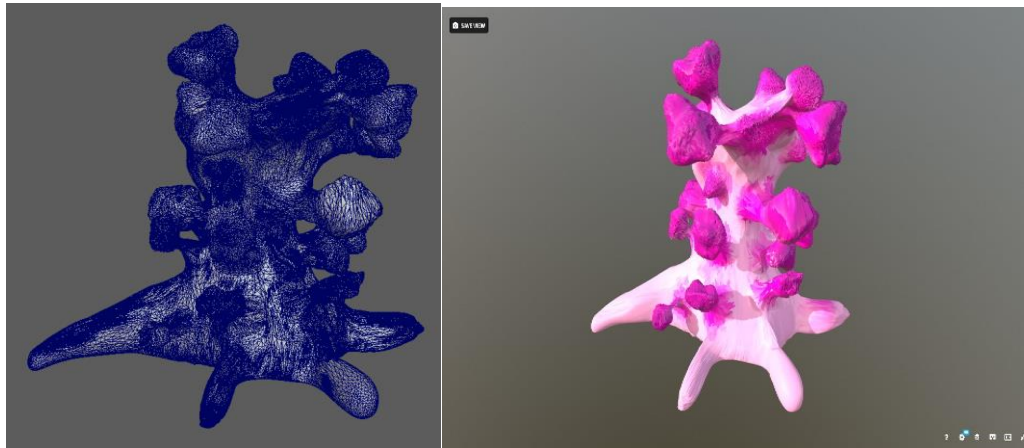   Here are pictures of one of the polys exported from Mudbox:

Figure 21: Model of a Choral made by Mudbox

This coral never made it into the final scene due to the difficulties in building the lights.
I found out the best way to use Mudbox was to model the meshes in Maya first (low poly) then export them. Once importing them into Mudbox, I could make the changes of sculpting. However, the changes couldn't manipulate the basic shape of the mesh, otherwise the baking would not be correct. After that I baked the normals and ambient occlusion and used the textures on the low poly mesh that was exported from Maya.

3. *Baking the Textures*: XNormal was a good tool for baking the textures because it had more options in defining the distance of baking and the details needed to be baked. However, sometimes if there were round meshes, the low poly showed the edges of the polygons and the object looked edgy. The low poly had to be multiplied to a count that would look smooth enough to accept the bake of the high poly. There was no defined rule on what the minimum count of the polygons of the mesh had to be. It

was the designer's call and how he/she wanted the model to look in the scene. The more complicated the mesh was, the higher number of polygons it needed.

4. *Multiplying Textures*: Sometimes, I would bake the normals from high poly to low poly by using Xnormal. Then I used substance painter to apply other texture patterns which required exporting new normals to the same mesh. When using the "multiply" or "add" expression in Unreal Engine, the normals wouldn't blend together to show the details of the textures properly on the model.
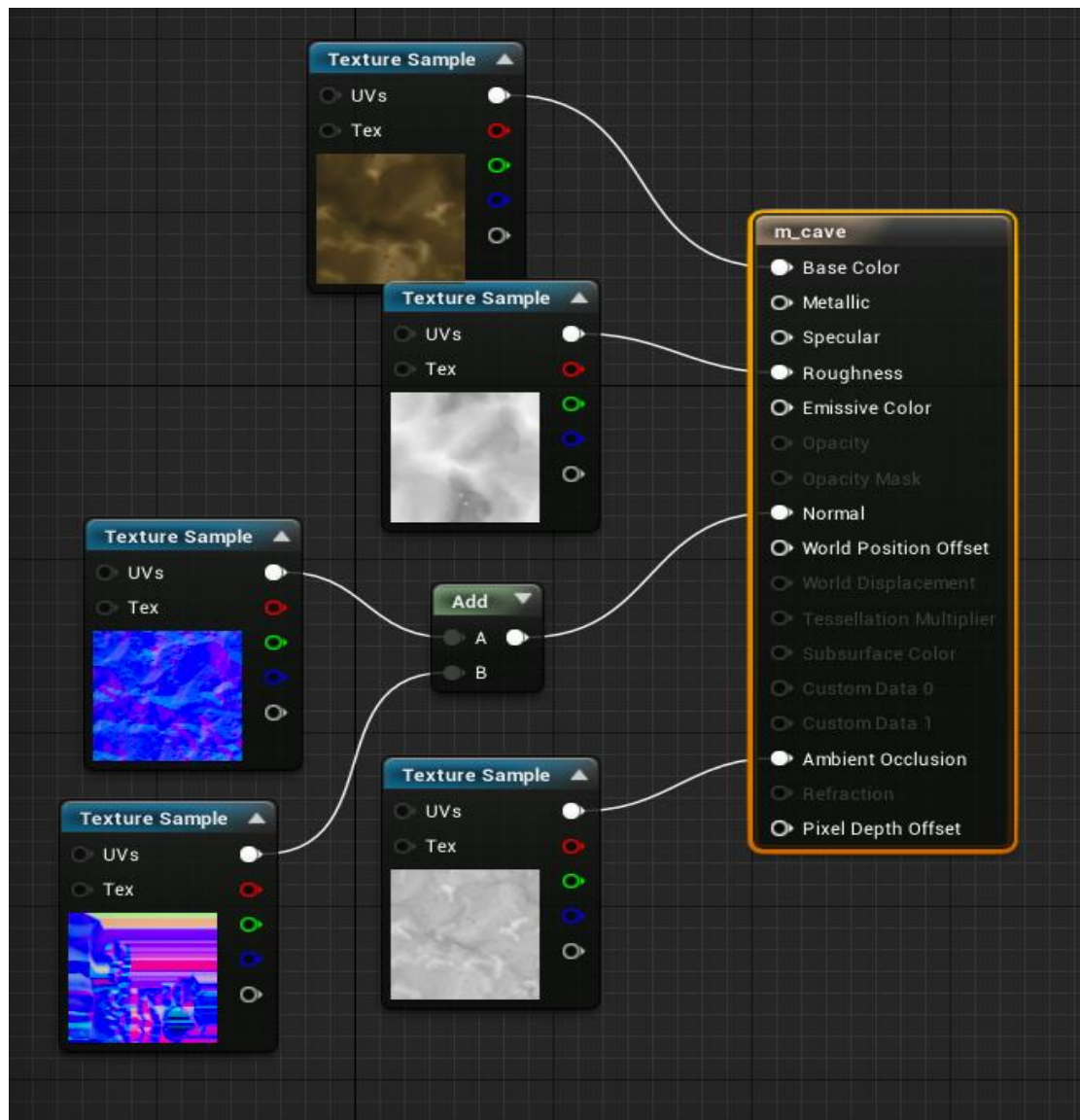

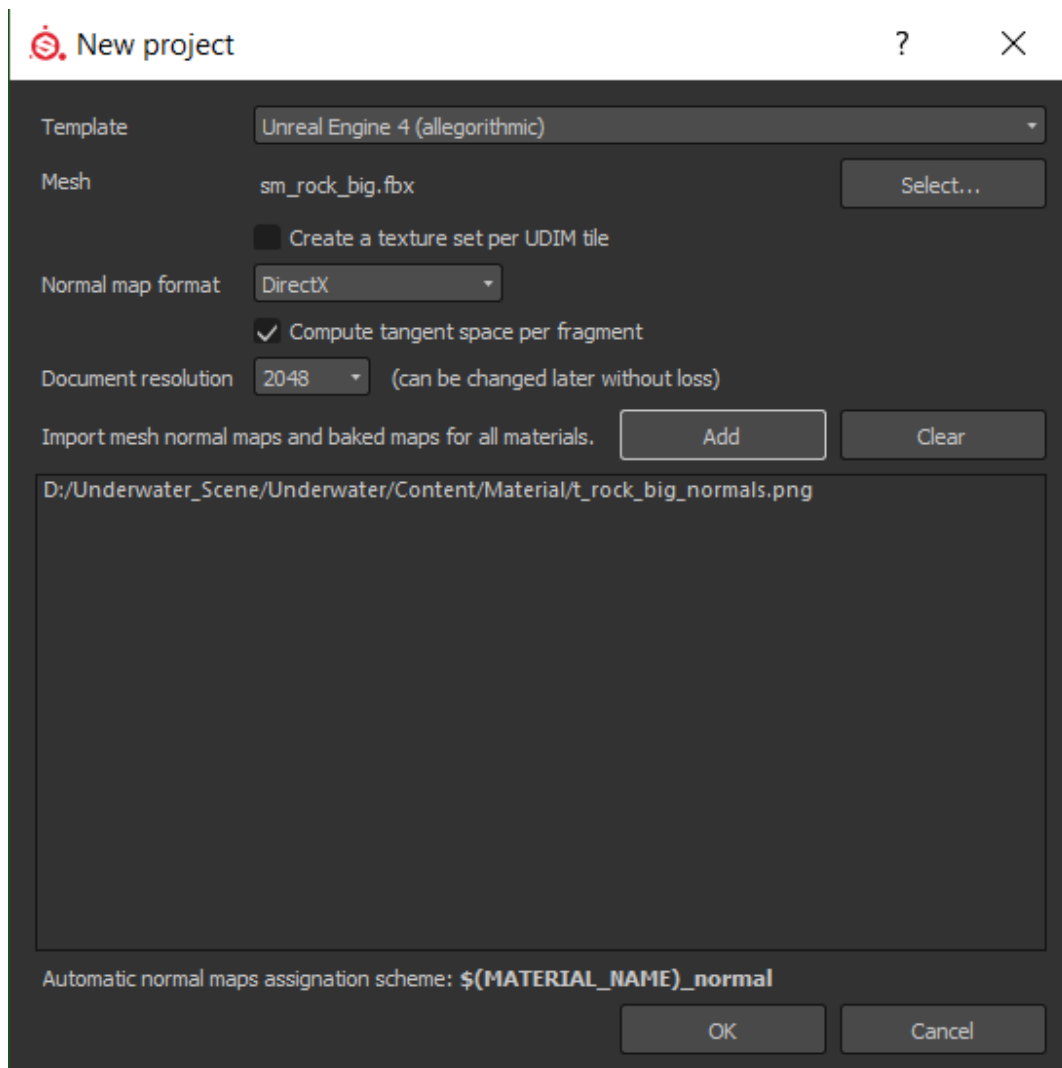*Figure 22: Multiplying normals in the material in Unreal Engine.*

Figure 23: Importing and baking textures in Substance Painter

One way to go around the problem was to import all the mesh normal maps and baked maps into Substance Painter before texturing. When finishing the work of the surfacing, the textures had to be baked - in Substance Painter - and exported again for unreal engine. Substance Painter would combine the normals together into one normal map.

5. <u>*Finding Pathways and Appealing Silhouette*</u>: As mentioned above, when making the whitebox of the environment, the two statues were intended to be placed in the back. However, the plan didn't work in reality. I had to place them in the front to show the details. Also for the first impression, I couldn't fit all the large meshes in the frame. Therefore, I decided to make a fly-through camera to move around and show the objects.
Also, the silhouette of the ruins looked boxy and sharp edged. In other words, when looking at the ruins from a distance, they seemed to be unrealistic and the texture looked flat. Therefore, I imported the low poly ruins into Maya and Mudbox, added more geometry and details, slightly

beveled the edges in order to show some light reflection, and chopped some areas in the mesh to look more like old non-uniformed ruins. Furthermore, I modeled rounded window frames and added them on the portholes of the ship.

Figure 24: Changing the ruins by adding more geometry and details

6.   *Large Space and Many Models*: When the player travels in the scene, it takes time to get to the intended location because of the large distance between the objects. To fix the problem, the ground was filled with corals and the environment was filled with wildlife such as fish, sharks, and sea turtles. The last shot of the camera was set from a distance, and the cave with the treasure box was not a part of the shot, but rather set as a separate shot.

Figure 25: Determining the silhouette of the objects in the scene and empty space in the front

7.	*Feeling Out of the Place*: When placing the large meshes on the terrains for the first time, they felt as they are out of the place. The colors and the patterns didn't match with the ground. I used the sculpt brush of the landscape to raise the terrain up as it clung to the mesh. The mesh looked as if ancient items sitting on the ground for a long time and the sand settled around it.
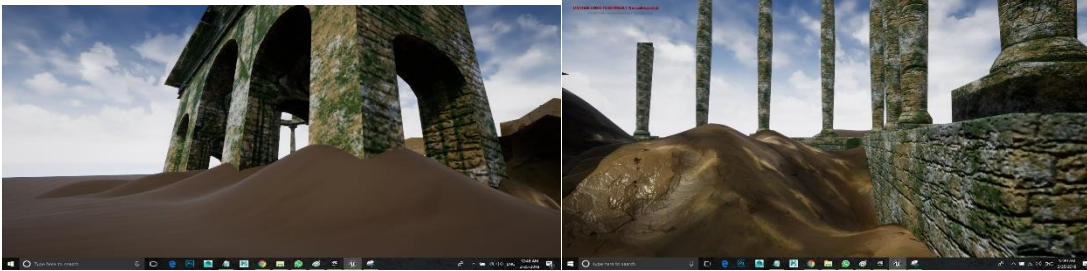

Figure 26: Editing the landscape and placing the meshes to look natural

8.	*Working Under Pressure and Deadlines*: I have taken five classes this semester trying to finish my degree for graduation in addition to my full-time job. I fell behind after the sixth week, but spring break was a good opportunity to catch up with all the late work. Of course, time management was the key to my success in accomplishing the project.

9.	*Getting the Right Blue Color* of the scene was a great challenge for me. I spent at least two weeks trying to get the lighting right. In the *Global Post Processing Volume* I changed the overall tint to a cool color (blue), lowered the sun light intensity a little bit, and increased the value of the *fog scattering* to 3 instead of 1. The colors started to come together and unify. I finally tweaked the saturation of the colors a little to keep the blue while showing the real colors of the textures. I also added bloom effect and depth of field which really made a difference.

Figure 27: The blue color of the sea fades in the distance

10.   _Lights_: At first, I used two directional lights for the scene. Everything looked uniform as they had the same value of lighting. It was suggested that the value of the keylight should have been lowered and then spot lights should have been added in some areas to create contrast between the objects.

The first image shows the scene with two main directional lights and the second image shows the environment after adding the lights in different areas. Special thanks for the critiques of Prof. Peter McCord and his extensive assistance and suggestions in making the scene look more appealing.

Figure 28: Paint over of the suggested light setting of the scene (by Prof. McCord)

Figure 29: The final look of the scene

11.   _Rich Environment_: In the second half of the semester, it was noticed that the scene looked empty; it didn't have enough elements, the lights did not show the surface details properly, and one side of the image had more visual weight and content than the other side. It was advised to composite in a bunch of ground elements. They were all basic and did not have a ton of colors. Adding too much color to the floor could detract from many of the other visual elements. Also, it was suggested to realign the key composition according to the rule of thirds. The camera was translated slightly to the left and down, rotated slightly right and up. The statues were placed closer to the right side, and the camera looked up at them, angled into a slight depth compared to the camera. Overall, this should have made them feel more monolithic/epic.

I would like to extend my gratitude and thanks to Prof. Tim Lewis, for his invaluable advices and guidance. Prof. Lewis was never late in answering my questions and concerns despite his tight schedule. He helped me exceed my abilities and reach my expectations.
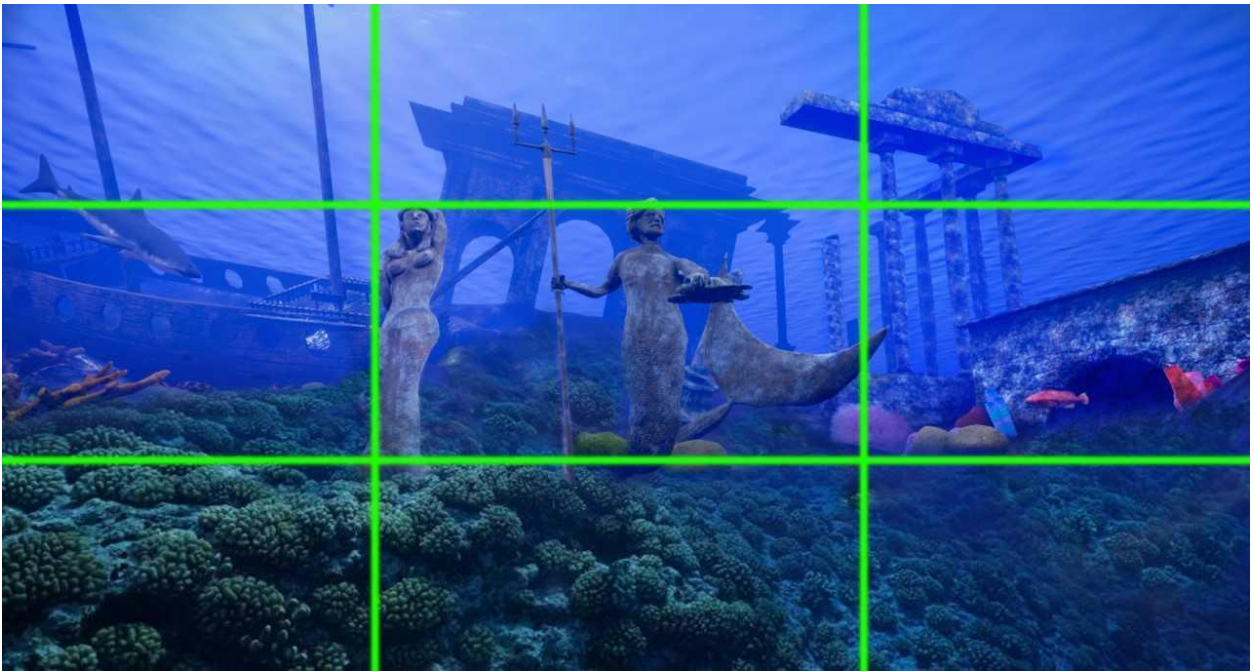

Figure 30: Paint over of the suggested models that can be added in the scene and following the rule of third (by Prof. Tim Lewis)

*Figure 31: The final look of the scene*

Finally, I would like to thank Prof. Daedra Christopher for her encouragement and supervision. I would also like to thank her for all the time she has given me in meeting up with her and taking her advices.

Achievements

Please find the link of the fly-through (demo-reel) here:
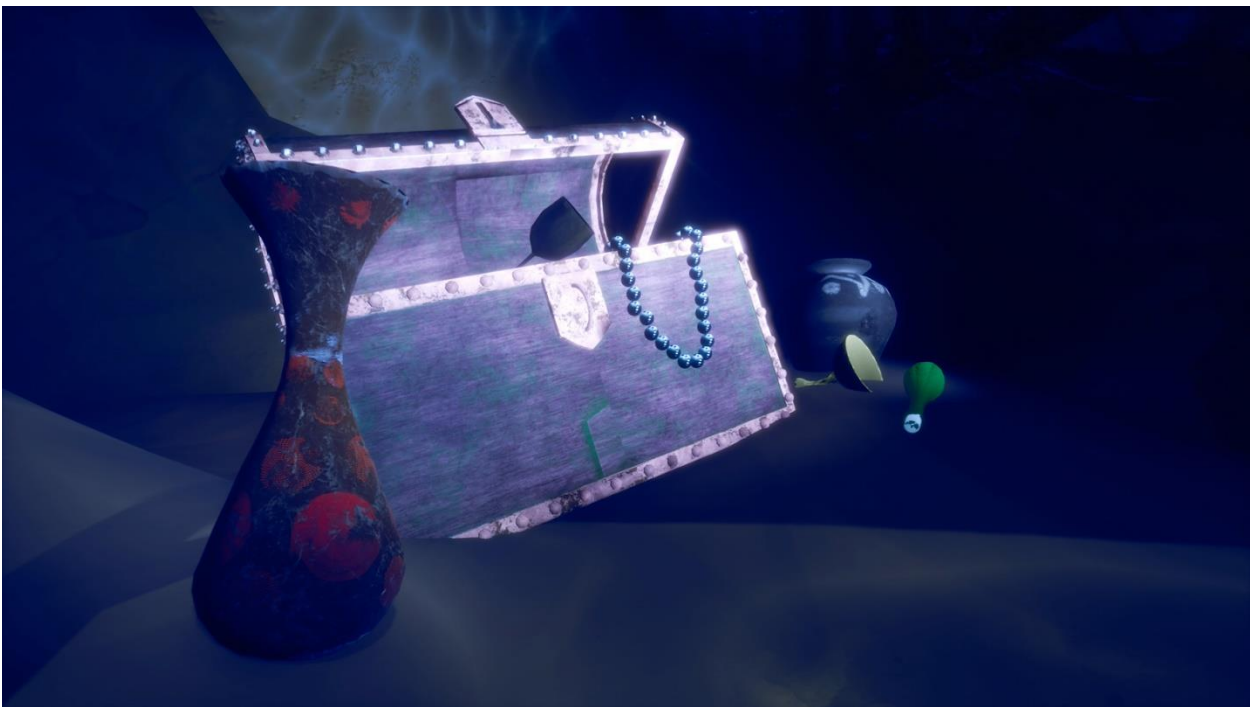https://youtu.be/b0jpWDYvsgg
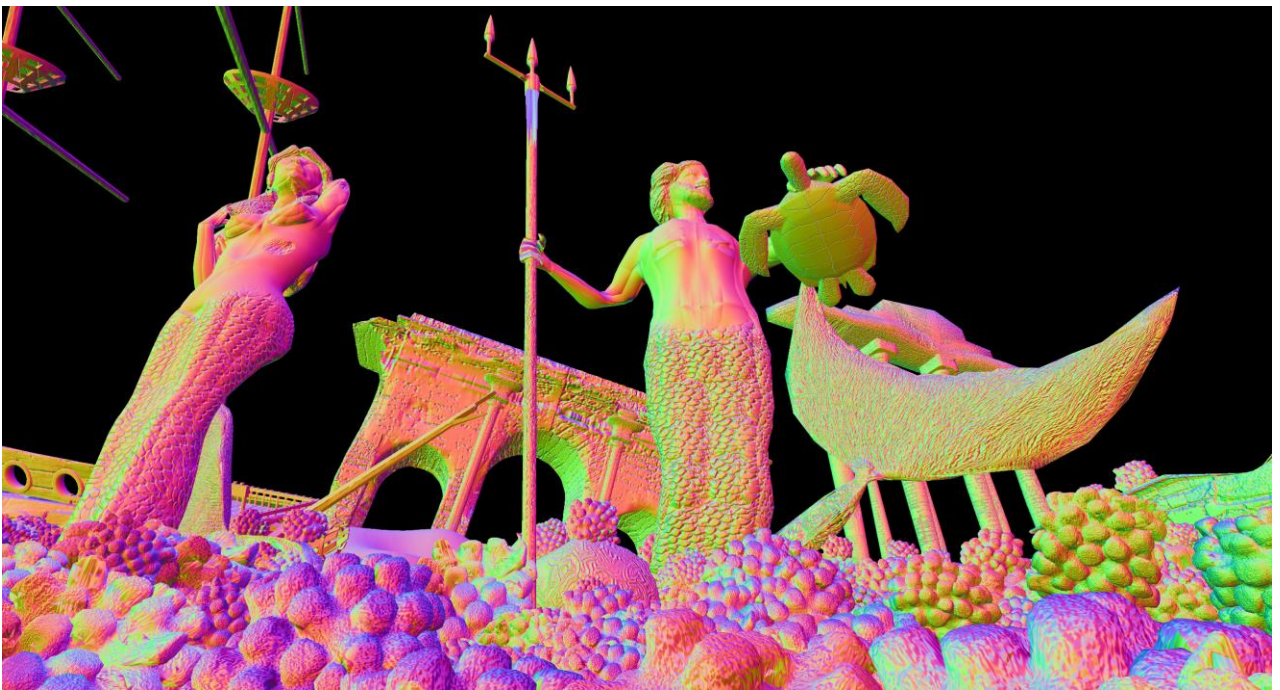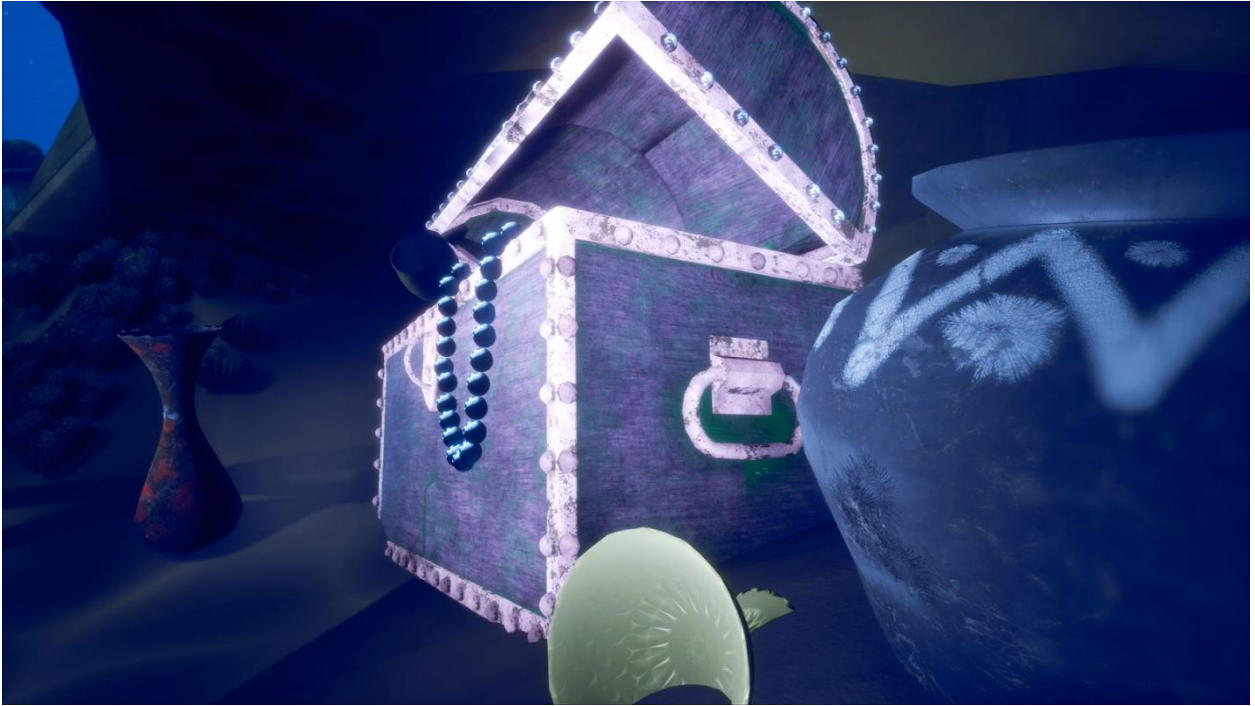Here are some of the screenshots of the Capstone Project of the Underwater Scene:
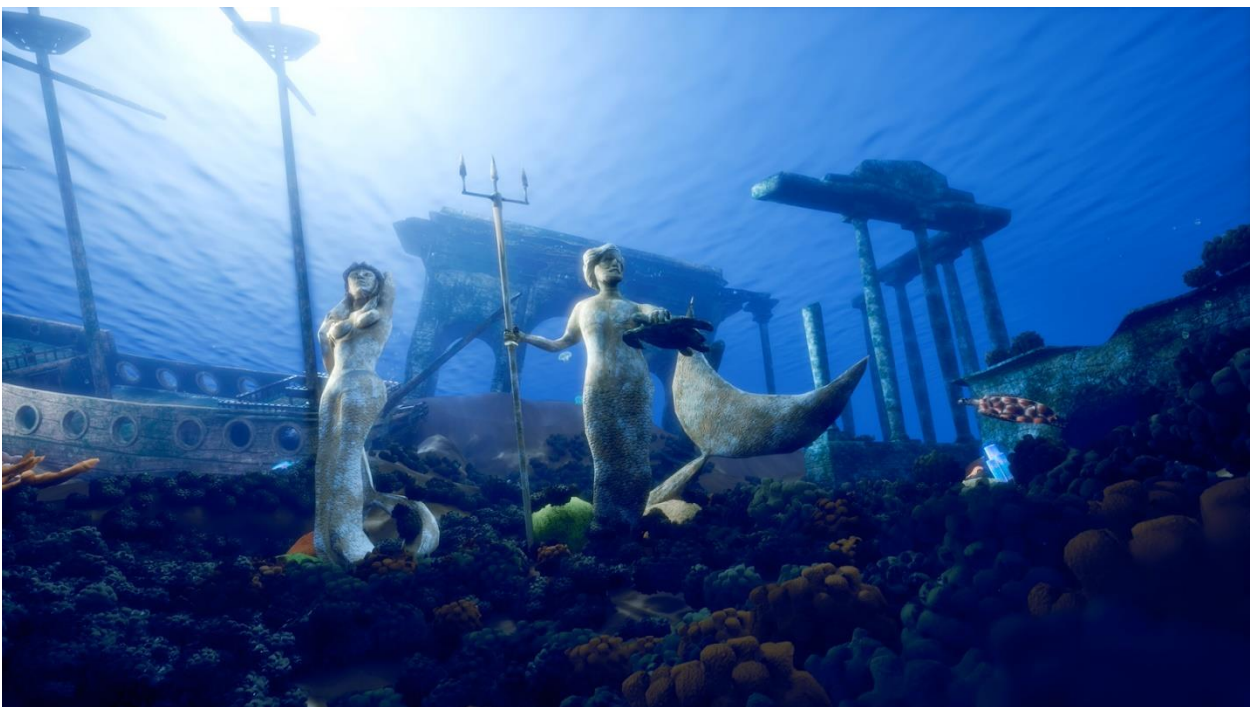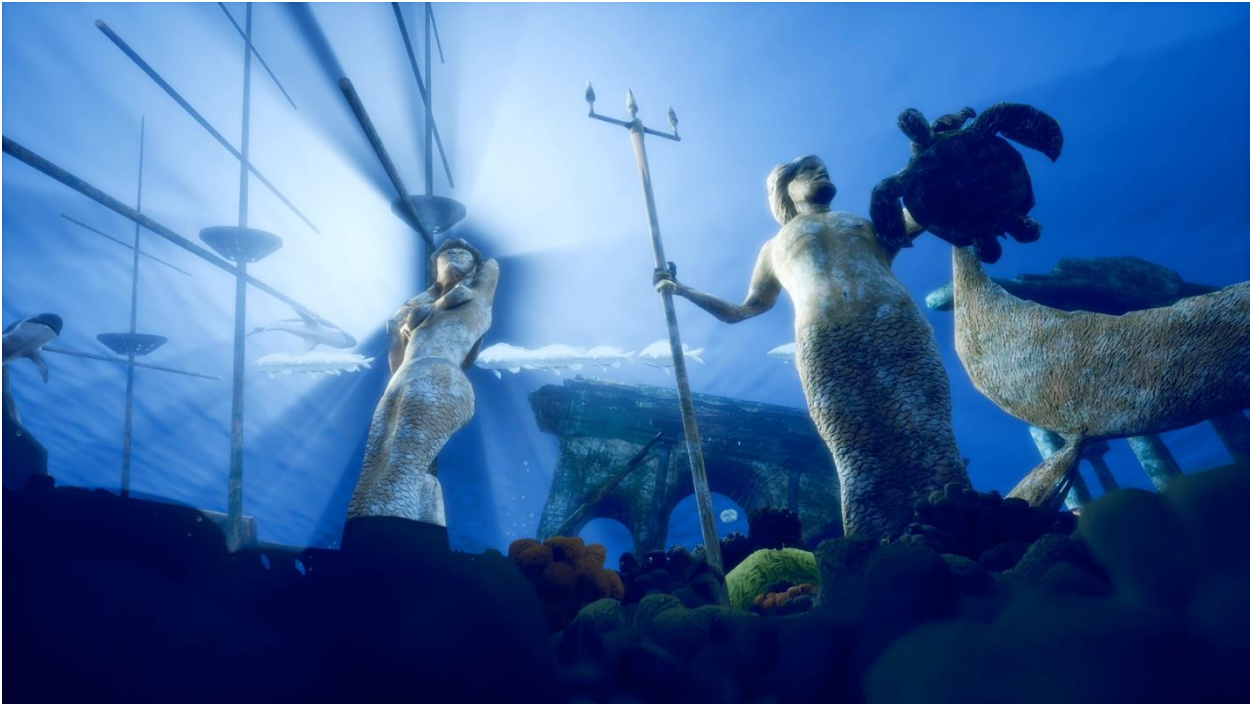
Figure 32: The normals of the meshes