



PREPARATION IS KEY
Jacob believes one of the most important things to do when working on a project like this is detailed research into the environment you're creating

ZBRUSH | UNREAL ENGINE 4

LEARN PLANT MODELLING FOR VIDEO GAMES

Jacob Norris shares his workflow for creating realistic foliage for video game environments



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When creating environments, foliage is always a great tool to add interest, colour and detail into an otherwise bland scene.

Some games I have had the opportunity to work on, such as Uncharted 4 and Metal Gear Solid V: The Phantom Pain, undoubtedly benefited from the use of foliage, and many consider these games to be very beautiful – partly due to their heavy use of foliage throughout the environments.

Foliage can also become overwhelming, detracting from the realism of a scene when not used correctly. That's why it is important very early on to do a lot of research to determine the climate of the environment you are creating. Even though a scene may have a summertime setting, does it snow in the winter time in this environment? Is it rainy throughout the year? Is the area known for wildfires? All of these factors contribute to the type of foliage that will be in the scene.

It's usually best to simply pick a location in the world that you want your scene to be in, because then you can easily begin researching your foliage to start gathering plant names for your environment.

With specific names and biomes that the plants come from, you can create detailed Google

searches for leaves, bark, soil, lighting and weather, in order to find similar complementary plant types for your environment.

In this tutorial, we're going to take a look at some fundamental concepts for creating foliage, as well as how to keep your foliage optimised while making it look good. You'll learn new information about foliage creation for video games and can apply it to your future work. For more tutorials and video tutorials, visit my site at www.purepolygons.com, now turn over to start learning. >



DOWNLOAD YOUR RESOURCES

For all the assets you need go to
www.bit.ly/vault-216-starwars

01 FIND PLANTS THAT BELONG TOGETHER

Finding a plant biome definitely increases the realism of your environment when everything actually works together. It can help to layout blueprints for your entire scene and add another layer of detail that will show itself in the consistency, harmony and composition of your final renders. Your biome can help you to discover all of the plants that grow within a given location. This will lead you down the right track to know what colours will be in your scene, how your plants can complement your environment's story, and help tie everything together.

02 WHERE CAN I GATHER RESOURCES?

It's always best to try to go out yourself and capture photos, textures and references for your project. If you can't do that, a search engine is definitely another option. Personally I find that going to a location and seeing it for yourself is always the best method. It allows you to see an environment from every angle and capture exactly the references you want. That's why I have recently finished a series of photo reference images, textures, and photogrammetry from many different locations in Europe, where I capture some of these biomes, climates and environments. They are already helping me in my environment artwork and if you are interested in taking a look they will also be available on my website and Gumroad pages under the name PurePolygons.

Do your research

People tend to ignore things that appear to be correct – that's great! It's only when something appears wrong that it's noticeable. That's why the research is important. All of this 'stuff' matters if you want your environment to be believable.



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03 IS ALL OF THIS NECESSARY?

It may seem like this is going too deep when creating your environment. Why can't you just simply find a concept image or a picture that you can start working from? Well this is fine if you are simply recreating the image that you found, but if you are working on an environment for a game, your level will be much larger and contain a lot more information that you won't simply find in that picture. For example, if more elements start entering the scene, such as buildings, houses, mountains, rocks, vehicles, lakes, rivers... how will all of these interact with each other? In image 03 we see a perfect example of this. The nearby trees are littering the ground with seeds, berries, nuts, and leaves. We are also seeing the intricate connecting tree root systems along the ground. This is highly relevant to how we will create our textures and models for this

area. All of these details add layers and layers of realism to your scene. It matters.

04 REALISM IS SUBTLE

As humans, some things we perceive are subconscious and when we have seen all of these environments in nature, or in movies and TV shows, we'll start to notice that something isn't right. These plants don't work together or these trees don't play well with each other. So avoiding that moment where people say, "something doesn't look right," is what makes your environment feel natural. That's why the research is important; the biomes, the complementary plant types, the climate information, and all of this 'stuff' actually matters if you want your environment to be believable. This leaf is in a damp environment where dirt and dust from the rain drops build up on its surface. The wet environment also pushes the lush green saturation of



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the leaves. Check out the roughness response on the leaf as well; knowing the plant this well will help the overall read of your plant from far away, when your materials are reacting to light properly.

05 GATHER PLENTY OF REFERENCE IMAGES

This is also extremely crucial to the process of creating a unified environment. Now that you have your plant names, climate, biome, and all of the important information, this is your chance to use it. Search far and wide to find all parts/life cycles of the plant. Find the dead version, the live version, the branches, leaves, dying leaves, possibly eaten leaves, bark, moss growing on the tree, or better yet, if you live near that type of environment go out and take some pictures! Image 05 is an example of some corresponding references for plants within a specific biome.

Be thorough

Search far and wide to find all parts/life cycles of the foliage. Or better yet, if you live near that type of environment, go out and take some pictures!



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06 PICK APART YOUR REFERENCE

The next step is to start planning out your workflow. You can save yourself a huge amount of time at this stage, because perhaps there are similar leaf types amongst your trees or bushes. Even if they aren't exactly the same, think of a way that you may be able to slightly alter the leaf you are making to work for your other plants.

to everything. It will most likely be the same type of moss growing on the tree trunk as the moss growing on the rocks nearby. The grass can be re-used for your grass cards, as well as laying flat on the ground in your landscape texture. In image 07 I am using the same ZBrush grass blades that I created for the ground and turned them into alpha cards to populate on top of the same ground surface. It makes everything feel very connected.

07 DON'T WORK HARDER, WORK SMARTER

Twigs and branches can usually be shared between many of your plants. Don't make extra work for yourself and create unique twigs and branches for all of your assets. See if there are similar shapes again between your trees or bushes. Then you can create a simple base mesh branch/twig that can have slight adjustments made to it to change the bark, or to create broken/dead branches. Spread this idea

08 START SMALL AND THINK MODULAR

Now that you have started to plan your workflow and pick apart your reference images better, it's time to start modelling. Start small and create some re-usable ZTools or alphas inside of ZBrush, or Mudbox, depending on your software of choice. Create your leaves, flowers, branches and so forth, and then you can start to piece them together to make larger pieces. An entire tree



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canopy of branches/leaves can be built with just a few assets used in a smart way. Image 08 is an example of starting small, where Colin Valek began building individual leaves for these pine tree branches in the PurePolygons' Procedural Nature Pack Vol.2. After he has some simple pieces that he can re-use, it becomes very easy to branch out and make larger pieces, all starting from those first small pine leaves!

09 ZBRUSH IS YOUR FRIEND

There are tons of great plugins and workflows inside of ZBrush to create your foliage assets. Take for example FiberMesh. Let's see how quickly we can create some grass using FiberMesh. Start by going to your ZTools in the upper right-hand corner of ZBrush and



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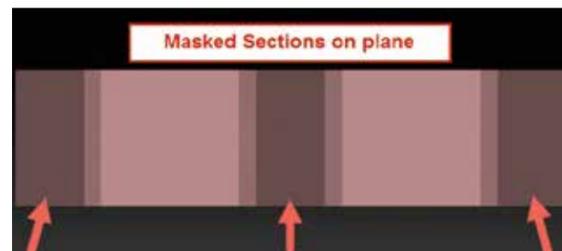
creating a Plane 3D ZTool using the ZTool slider.

10 CONVERT YOUR PLANE TO A POLYMESH

Simply click and drag anywhere in the empty scene to pull out your Plane 3D ZTool. If you hold [Shift] while you are doing this you can ensure that the plane is aligned properly to your camera view. Then click the button Make Polymesh 3D. You will find this button in the same ZTool box that you found the Plane 3D ZTool in. Your scene should now look like image 10.

11 PREPARING OUR FIBERMESH PLANE

We are going to use this plane to paint some FiberMesh on and create our grass. This method will allow us to capture an Alpha,



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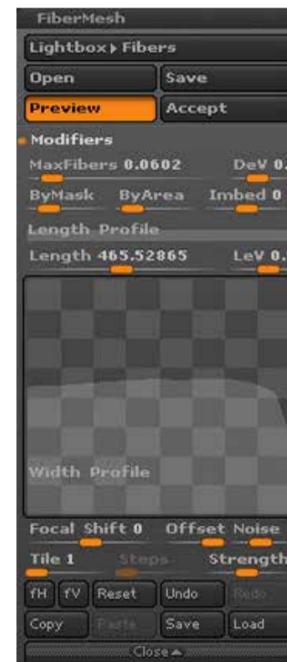
ZBrush options

There are so many great plug-ins and workflows inside of ZBrush that you can use to create your foliage assets – get exploring!

Normal, and Albedo map from the grass blades. It's super quick and can provide really nice results, with just a bit of tweaking here and there. Let's go ahead and make our plane a bit thinner now, since we only need a couple of grass blades for our alpha. Go to the Deformation menu and adjust the size in the Y axis. Then decrease the size to -100. Do this again to -100 so that our plane becomes much thinner.

12 PAINTING OUR GRASS MASK

We're then going to hold [Ctrl] on the keyboard as we paint three evenly spaced lines on our flat plane. This will create a mask on top of our plane that is roughly the same width in each line. Inside of these masks is where we are going to



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spawn our FiberMesh for the grass. We are doing this so that when we capture our grass alphas, they are spaced far enough apart to keep them separate. For another quick screenshot of what our plane with masks looks like at this point take a look at image 12.

13 CREATING OUR FIBERMESH GRASS

Under your Tools menu on the right, scroll down to find the FiberMesh option and open it. In here you will see a tab for Lightbox>Fibers – select this, it's where we will find our FiberMesh. I personally prefer to use Fibers78.ZFP for my grass, but feel free to experiment and see what works best for you. Go ahead and double click on it and that should load the FiberMesh onto your plane into the three masked areas that we set up earlier.

14 ROTATE YOUR PLANE SO IT'S INVISIBLE

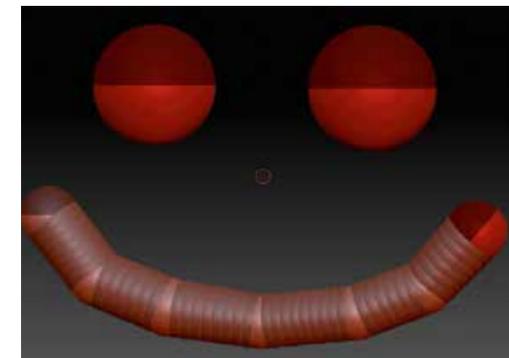
At this point we are able to rotate our plane so that it lays flat from our camera view, and the only thing that can be seen is the grass FiberMesh. If you hold down the [Shift] key while rotating the camera view around the plane, it will snap your view so that the plane is perfectly flat. This means you can now see the FiberMesh better.



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15 TWEAKING YOUR FIBERMESH

Open up the Modifiers tab under the FiberMesh menu to start playing around with the settings for your grass. There are tons of great options in here to really create some very custom and unique looking grass. Try to keep your grass count low here. Decrease the Max Fibers number. We don't want our grass too thick or it starts to look like fur when we begin populating our environment. Increase the number of segments for more detailed blades of grass, with less polygon looking bends. For a screenshot of my settings and resulting grass from the FiberMesh, see images 15a-15c.

16 CAPTURING YOUR NEW GRASS

Once you are satisfied with the result simply click the Accept button in the top right of your FiberMesh menu. You now have some fully realised 3D grass. From this point there are a number of ways you can turn it into a usable foliage in your scene. Bake it down in your favourite baking software such as xNormal or 3ds Max. Or simply GrabDoc the grass and its alphas directly inside of ZBrush and create the textures from the results of that GrabDoc. If your scene can handle it, you can even use this grass as actual

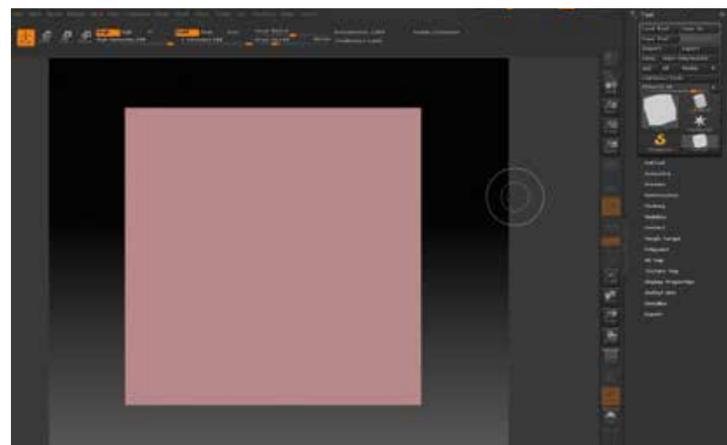
3D models, but this is definitely not recommended for real-time projects, videos games, or VR projects. Enjoy your new grass!

17 USING ZSPHERES FOR BRANCHES

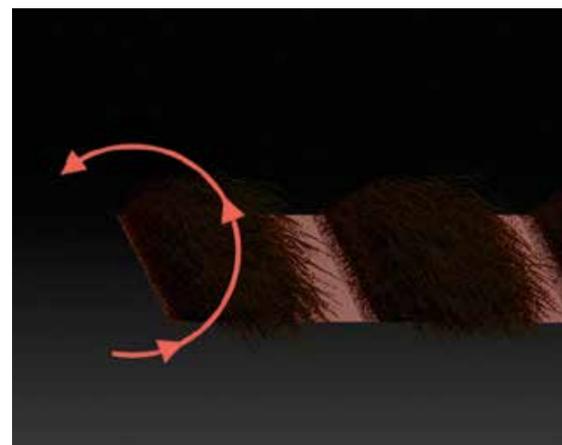
Let's see what other types of fun things we can use ZBrush for. It's really great for creating branches and twigs! If you have never used ZSpheres before, then you are missing out. It turns modelling the base mesh of a branch into a 30 second process instead of a 30 minute process. Using ZSpheres can take some getting used to, so definitely take some time for yourself to get acquainted with using them and make a bunch of branches, models, bugs, people – anything you like once you get the hang of them. ZSpheres could be a whole tutorial in itself, so I also recommend Googling some more information and finding some YouTube videos if this part is a bit difficult for you.

18 CREATING A ZSPHERE

We're first going to select option 46 from our slider in the ZTools section in our menu, on the right. It should say ZSphere_1. If not, then keep moving the slider around until you find the ZSpheres. Make sure you are in Edit Mode by pressing [T] on your keyboard and



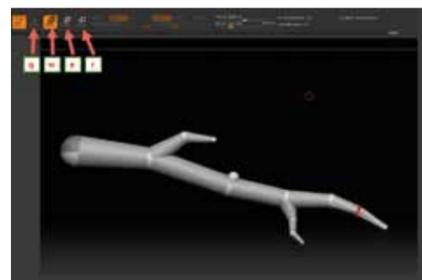
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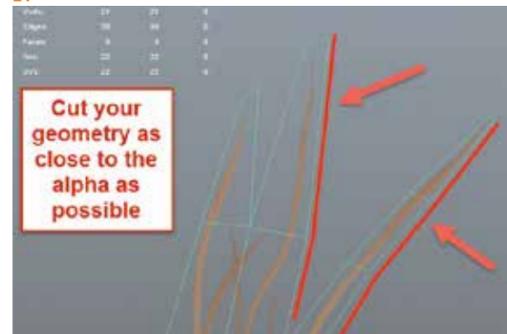
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checking the icon is highlighted in the top left of your ZBrush window.

19 ADDING MORE ZSPHERES

Now from here, you draw ZSpheres simply by clicking and dragging on the screen. Once one ZSphere is drawn on the screen, you can only add more by drawing another ZSphere that touches any part of the ZSphere mesh that you have created.

20 GETTING CRAZY WITH ZSPHERES

Hopefully you now have two ZSpheres on your screen. You can press [W] on your keyboard to change to the Move tool and move your ZSpheres away from each other

Further tutorials
ZSpheres could be a whole tutorial in itself. I recommend researching some more information about them and finding YouTube tutorial videos, to really see their full potential.

and around the screen. You can also scale each ZSphere by pressing [E] on your keyboard to switch to the scaling tool. If you press [R] on your keyboard, this is the Rotation tool to rotate your ZSpheres. Once you want to draw another ZSphere on your screen you now have to press [Q] on the keyboard to go back into your Draw mode. And as before, you can only draw ZSpheres on top of other ZSpheres, or on top of the connecting mesh that bridges two ZSpheres together. After playing with them, drawing some, rotating, scaling, and moving them around, we can then make ourselves a branch object that looks similar to image 20.

21 PREVIEWING YOUR ZSPHERE MESH

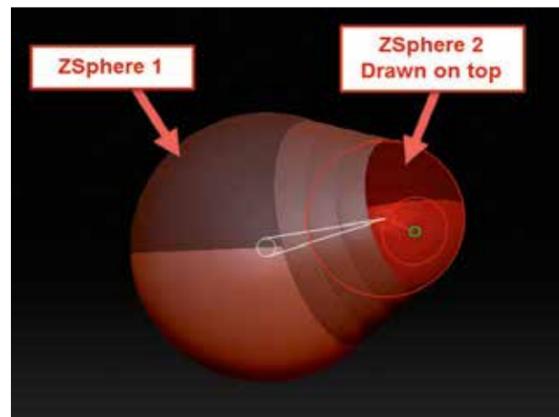
While you are creating your ZSphere mesh, you may be wondering, "What is this thing going to look like when I'm done?" This is easily achieved by pressing [A] on your keyboard at anytime with your ZSphere mesh active. It's a great way to see what is or isn't working, and what you might need to adjust/change while creating your mesh. I'm pretty happy with this one for now so I am going to call it done and move on to the next phase, which is finalising the ZSphere mesh.

22 FINALISING YOUR ZSPHERE MESH

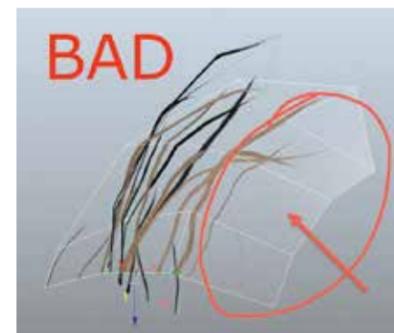
In order to convert this to a usable mesh, press [A] on the keyboard again, to preview the mesh. You will see that once you do this, the option now appears in your ZTools menu to Make PolyMesh3D. Once you click this button it will now convert your ZSpheres into an editable mesh that you can sculpt on, add detail to and make into a beautiful branch of your own.

23 EXPLORE OTHER OPTIONS

ZBrush isn't your only option for creating foliage, meshes, and other environment details. While it creates the most unique results, since everything is handmade, it can also be time consuming for bigger projects. So perhaps it's time to look into other options for your specific needs. SpeedTree can be excellent for making quick trees and even optimising them for games. It provides really nice models out of the box, but perhaps not as photo realistic as some would like. Even if it gets us to 70 per cent of what we want, we can take it from here and add our own textures. Add some custom sculpts on top of here, or any other updates that you feel can help bring it to that 100 per cent quality you are looking for.



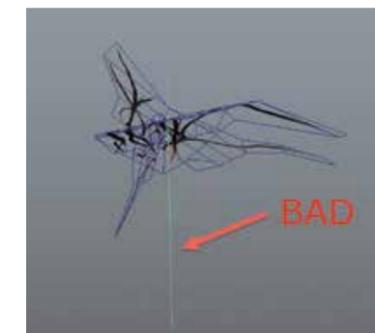
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24 IT'S NOT ME IT'S VUE (AND PHOTOGRAMMETRY)

I've seen many people using Vue for creating grass and simple foliage as well. There are also some great tutorials for this directly on YouTube that you can find really quickly. So definitely check out all of these programs and see what might work best for your needs. Many people are taking to photogrammetry these days as an option for creating foliage. You simply scan leaves, branches, stems, twigs, and then bring it into your favourite 3D program to create some re-usable assets that can be placed around your scene. Let's take a look at how we can use photos and photogrammetry to our advantage.

25 OPTIMISATION AND GAME READY FOLIAGE

After you have captured your foliage alphas with photos, taken them from Quixel Megascans, exported them from Vue, created them in ZBrush, or any of the above, you will need to set up your alpha planes to be used with your textures. I am using Maya in this example, but the basic idea is the same in any 3D modelling program. You will apply your foliage material to a flat plane, then start cutting the geometry around your alpha texture. In the example (image 25) you will see that I am trying to cut my geometry as close to the alpha texture of the grass as possible. I am also trying to keep the grass alpha card decently low poly, at around 22 Tris.

26 TRY AND AVOID OVERDRAW

This is all for optimisation purposes of course. Because when an alpha card like grass or leaves is rendered in real time in a video game, since

Details matter
The more care and attention to detail you put into every aspect of even the smallest parts of your environment, are what helps the scene as a whole to really shine.

it is not a solid opaque texture, objects behind the grass have to always be rendered and cannot fade out or occlude from the GPU's rendering (Graphics Processing Unit). This is called Overdraw. Normally with a solid object like a crate or a barrel, objects behind this crate/barrel don't need to be calculated by the GPU, because they cannot be seen at all. In the case of these grass blades though, the GPU has to do double the work. It has to render the grass alpha card first and then also render everything behind it, so the more sloppy your cards are cut, the more grass card geometry will be overlapping each other in your scene and the more work your GPU will have to do. This can start to slow down your game and increase frame rate very quickly. So be accurate, concise, and create your foliage correctly at this stage.

27 EVERY SINGLE POLYGON MATTERS

The same goes for polycount; don't add too many polygons, because these are small blades of grass and when you end up placing 10,000 of these in your scene, every single polygon matters. Deleting three

polygons on your grass alpha cards will then save you 30,000 polygons.

28 TRY TO AVOID COMPLETELY FLAT ALPHA CARDS

Here we have a completely flat alpha card in this grass clump. You can see why this would be a bad thing to have in your grass. When an alpha card is completely flat, there will be certain camera angles where your grass card will completely disappear. This causes you to lose a lot of density in your foliage that could very easily be fixed with some small bends and rotations in your geometry. Notice the other alpha cards; they have subtle twists, rotations, and bends in their geometry and it doesn't take much. It gives you much more bang for your buck!

29 IT'S THE LITTLE THINGS THAT MATTER

I added some simple bends to this dying grass and now this grass will look good from whichever angle you choose to look at it. Adding in those subtle touches and doing just a teeny tiny bit more work helps your final result just that much more, and people will notice. ●



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