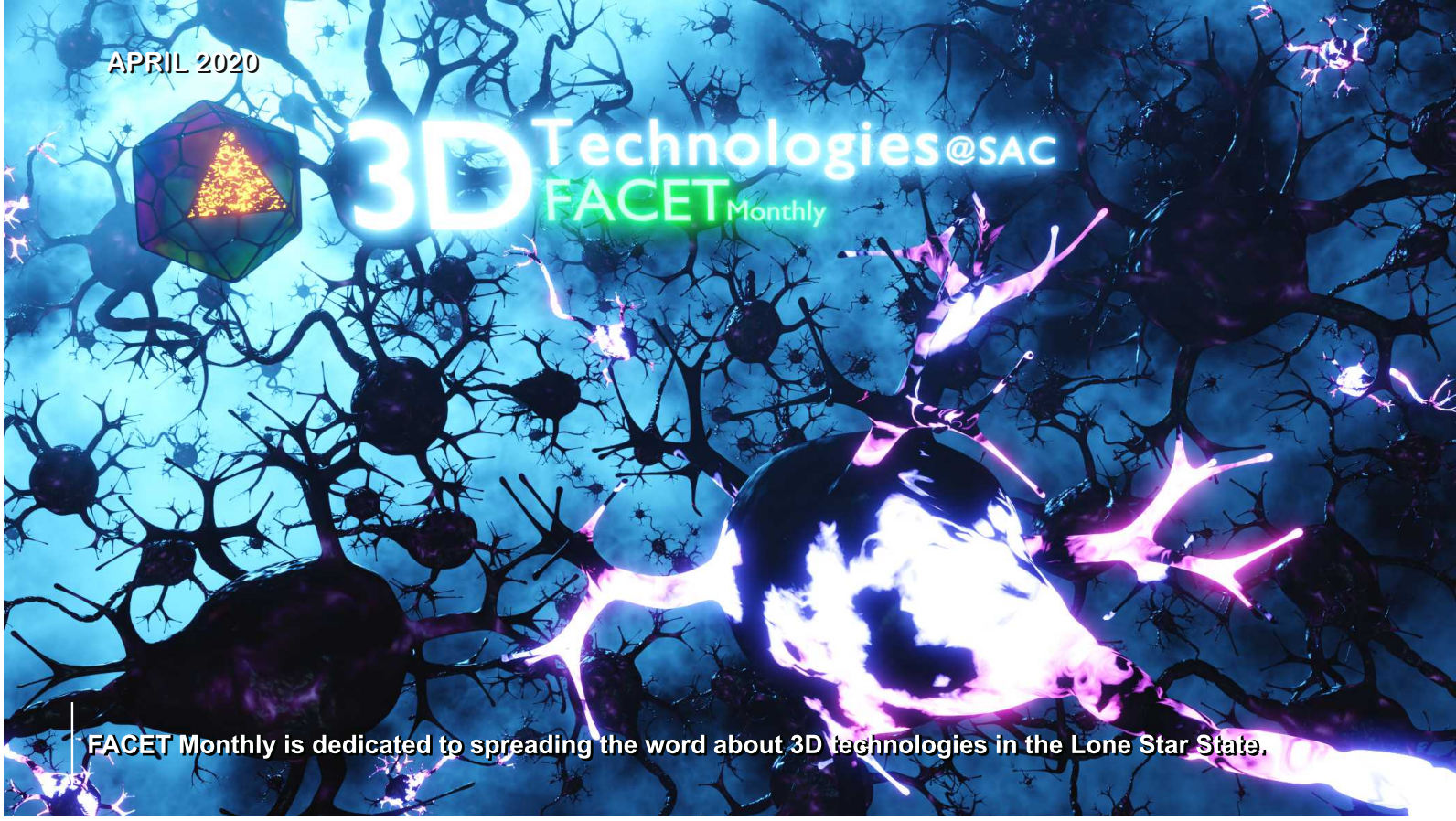

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EDITORIAL: VICTORY HOBBIES

by **Aaron Ellis**

As I write this article, I'm sitting in my dining room/home office sporting a San Antonio College Victory T-Shirt with a quote from George S. Patton on the back. I hadn't planned on wearing this particular shirt and didn't have an agenda when I put it on. It just happened to be the next one on top of the stack in my drawer. The quotation, which I had never noticed before, took me by surprise today. It reads "Accept the challenges so that you can feel the exhilaration of victory."

That the message on the shirt dovetails so well with the March and April FACET editorials is intriguing. Last month I wrote in these pages of a worldwide struggle against an invisible foe and also about the novel changes imposed on all of us due to the Covid-19 pandemic. From academia to industry, and everywhere in-between, we were all caught off-guard by a sudden, unexpected existential threat. As noted last month, the response to the disease has dramatically changed much of what we do and how we do those things. Crises are catalysts for change.

During World War II, embattled western nations encouraged citizens to plant and grow "War Gardens" to help ease the burden on food resources. This push was well organized and marketed and the people responded. With our current crisis, minor tyrants in state-houses around the country are starting to ban the sale of seeds. In the time of Covid-19, travel restrictions, and empty shelves, many are discovering a small something of our ancestors' struggles with food insecurity and supply-chain disruption.

The victory gardens of old helped alleviate shortages, but reports suggest they also served to reduce feelings of helplessness and to restore a sense of purpose in those who worked them. These gardens could meet a practical and tangible need and at the same time bolster hearts and minds.

If you've been stuck at home for a while, you may have already finished binge-watching everything on all of the TV streaming services. If you're looking around for something to do between scouring the news for scraps of hope for a cure, now could be a great time to learn something new to you. Picking up an interesting hobby can be a productive way for us to free our minds of the troubles that surround us.

Which hobby you choose (if any at all) is entirely up to you. With a patch of soil, some water and seed, you could certainly go the victory garden route. You might even surprise yourself with the food and herbs you grow. Maybe you could try your hand at carpentry, or candle-making, or bee-keeping. Another option I can whole-heartedly encourage would be to start learning a bit about using 3D tools. It could be for something as simple as making backdrops for your presentations or study-guides for your classes. All you need is a computer, some power to keep it running, and the time to pursue it.

If you do decide to take up a hobby during the pandemic, there are great resources online that can help you. Of course, FACET Monthly can offer some tips, tricks, tools, and inspiration as well. ▲

PROJECTS:
EMBRYONIC TAG TEAM

by **Aaron Ellis**

Many of the projects that the FACET team pursues are initiated by faculty at San Antonio College. And of these projects, most of them are related to course content that might be out of reach for first-hand examination or study.

This was especially the case when SAC biology instructor, Mercedes Alba, asked if we could create replicas of human embryos at four important stages of development. As the first two months of human gestation represent some of the most profound physiological changes, accurate modeling is helpful to student understanding of the process.

Unfortunately, in those eight important weeks, the human form is exceptionally tiny. Not only are the details for such small shapes difficult to see, they are, by design, hidden from view. Ms. Alba hoped to provide her students with enlarged versions of embryos at the second, fourth, sixth and eighth weeks of development. In those stages human embryos actually range in size between a grain of salt and a bean.

This project was a perfect opportunity to demonstrate not just our team's ability to sculpt replicas of organic forms, but was a great chance to show off our 3D printing and mass fabrication capabilities as well.

The first step in the project was to study the subject matter to make sure the models would accurately depict all the necessary shapes. This was perhaps the most difficult part of the entire process, as finding good reference images for human embryos can be a challenge.

Once useful examples were located, I started on the easiest of the four embryonic stage models. The Two-week human embryo, or blastula, looks a bit like a golf ball and was easy to make. The starting point for this model was a sphere and once finished, that model became the foundation for all of the subsequent embryos.

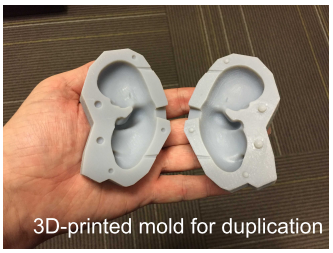
After the two-week embryo was built, I turned on Symmetry sculpting mode and made the four-week embryo. At this stage, humans look a bit like tadpoles. Symmetry allowed me to duplicate each sculpted feature on both the left and right sides of the model with more accuracy and fewer strokes.

At this point, I handed off the four-week model to SAC student Juan P. to transform it into the six- and then eight-week models. The eight-week embryo looks most recognizable as a developing human and Juan did a great job on its details.

With the embryo replicas sculpted, a 3D printer finished-up the project. Ms. Alba was pleased with the final product and began using the embryos in her classes. Soon, other San Antonio College biology instructors learned of the project and requested printed embryos for their classes, too. ▲

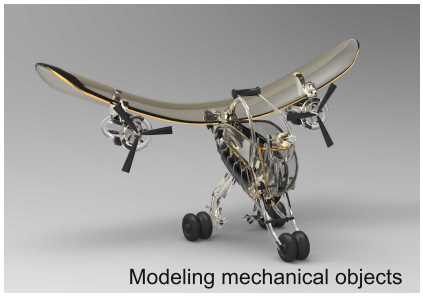

Digital human embryo sculpts

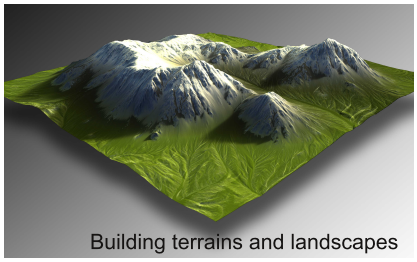

Oversize and actual size replicas


3D-printed mold for duplication

NEWS:
SAN ANTONIO COLLEGE TO OFFER VIRTUAL 3D SUMMER CAMP IN 2020

by **FACET Staff**


Modeling mechanical objects


Building terrains and landscapes


Sculpting creatures and organic shapes

It's almost Summertime again and San Antonio College is gearing up for Kids' Camp 2020. For the past three years, SAC has offered 3D skills training to junior and senior high school students from around San Antonio. This year will be a bit different however due to disruptions from the Covid-19 pandemic.

In previous years, SAC hosted several four-day camps focusing on two distinct disciplines each week. Campers learned how to model objects, sculpt creatures, scan artifacts, print toys, animate scenes and create virtual landscapes in this collection of on-campus training programs.

The format this Summer will be a bit different as it will be more highly condensed. This year, campers will learn about each of the main 3D disciplines all in one camp instead of having that training spread out over three weeks. This new format will provide more of a "survey" style experience rather than offering in-depth focus on particular topics.

Also, the delivery method has changed since the San Antonio College campus is currently under lockdown. Camp content will now be delivered through pre-recorded video lessons to allow campers to follow along at their own pace. This also gives the children a chance to repeat the material multiple times and improve their skills.

SAC will not be using ZOOM or other realtime conference-streaming platforms for its Summer Camp activities due to potential security issues those services have experienced since the 2019 pandemic began. The media content for our camp will be available for parents to view in its entirety. In addition, the lessons will be available online indefinitely.

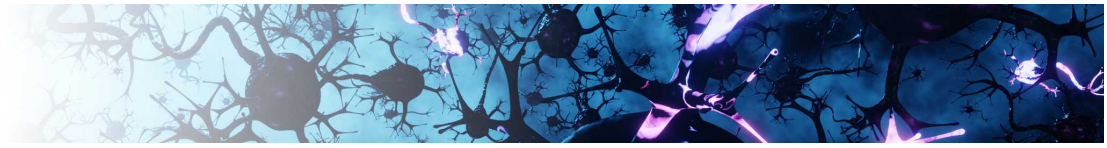
Every effort has been made to recreate the interactivity that our traditional Summer camp provides, but some concessions should be expected. Parents of campers will need to ensure that computer hardware, software and materials for lessons and activities are available to their children.

These changes to this year's Summer camp mean that it is something of an experiment for our team. Because of this, the camps will be offered free of charge. However, our camps will still have enrollment limitations and are available in a first-come-first-served manner.

For more information about SAC's Summer camp program, e-mail aellis43@alamo.edu ▲

IDEAS:
BLAZING TRAILS

by **Aaron Ellis**



On the cover of each issue of FACET, we feature a new piece of artwork that somehow connects with the topic of one of the articles that month or relates to something from current events with respect to 3D or education. Each of these images is an original work, built from the ground up in Blender and they are all a lot of fun to make.

The feature image this month might look like an ominous swarm of squid-like aliens on the attack, but instead it is intended to depict, in dramatic fashion, neurons in the brain sending signals to each other. This process is at the heart of any learning that we humans do. And it's all about reaching out and making connections.

If you've ever hiked a marked trail then you've probably followed meandering swaths of bare ground. In some places these patches of dirt are wide and well-defined. Others may branch off from the main path with thinner delineation. How often a particular route is traversed dictates the definition of a trail. As a result, the more it is traveled, the more easily followed that path becomes for future hikers.

Skill acquisition and memory maintenance work the same way. The more often we repeat tasks and review pasts, the more facility we develop with those things. It is often said that "practice makes perfect." But maybe instead of perfection, we can say that focused practice makes fluency.

The speed with which we recall information and the ease at which we perform a skill are connected to how often the specific, related neural pathways are activated. The things we want to remember most and the tasks we hope to perform best should be the ones we think about and repeat the most.

What memories do we hold most dear? What skills do we want most to master? Whatever those are for you, and for me, let's resolve to remember them often and put them into regular practice. ▲

Note: a short video clip on the making of "The Neural Host" is available on YouTube at https://youtu.be/oEQ5G7npWdw

3DIVERSIONS:
GALLO-ROMAN DODECAHEDRA

by **Aaron Ellis**

Bronze Dodecahedron

While researching last month's article on platonic solid shapes and gaming dice, I happened upon references to mysterious artifacts known as Gallo-Roman dodecahedra. These objects are based on the dodecahedron, a 12-sided polyhedron with pentagonal faces. However, these objects have holes of varying diameters on each face and strange knobs at every corner. The structure of these objects is directly tied to one of the platonic solids I described making last month, but with the corner protrusions, they also vaguely resemble the crowned SARS CoV-2 germ.

The purpose of these strange shapes is currently unknown, but like so many curiosities of antiquity, these are surrounded by an abundance of conjecture. Maybe they were military range-finding references for artillery units. Or perhaps knitting tools for making gloves. They could even have been a form of currency. Those are but a few of the possible explanations for the Gallo-Roman dodecahedra, but we may never know their real purpose.

Inspired by some of these awesome artifacts that have emerged over the past two hundred years, I decided to model one in 3D for myself. One of the coolest looking bronze dodecahedra has a series of concentric circles replacing each of the twelve pentagonal faces.

As a throwback to last month's article, I began this project with the creation of an icosahedron primitive object at the lowest level of subdivision. This process adds a 20-sided polyhedron to a Blender 3D scene. From there, as before, I added a Bevel modifier to the object and almost maxed-out its width setting to transform the d20 into a dodecahedron.

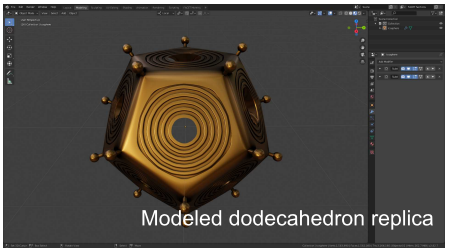
By setting the Bevel modifier width to a high value (around 1.06), I was able to avoid the problem of hidden extra vertices that extreme beveling can sometimes produce. Also, this provided caps at all the corners and a ridge along each of the edges. Those were important to getting the design to match the original reference object.

The triangular caps were useful starting points for making the knobs seen in all of the historical artifacts uncovered so far. In Edit mode for the object, turning the corner faces into knobs required a series of extrude operations along with some scaling at various steps along the way. Normally an extrude function would only work on one object/direction at a time, but Blender has a cool feature that allows extrusions to respect the origin points of all selected regions and identically mimic those actions on each. An easier, but less satisfying, solution would have been to place multiple small spheres at each of the corner posts.

Once the main structure and the knobs were created, the next step was to build the concentric circles on each of the pentagon faces or sides. This was accomplished using the Inset tool (which is a flatter version of extrusion) to create smaller duplicates of each face. That was followed by two Subdivide commands for all of them. The subdivision actions quadrupled and then quadrupled again those selected surfaces.

To change this pentagon-looking, but n-gon-sided ring into a more circular shape, I used Blender's handy "To Sphere" command. For spatially-separated shapes, this command can make almost anything spherical. But for edge loops, it turns them into circular rings. That's what was needed in this case.

With this done, I used the Inset command several times on the new circular-looking face to create the concentric rings. The result ended up resembling a target. I also selected alternating rings and extruded them to create ridges and a sense of depth. It is at this point that I selected and deleted some interior rings to duplicate the varying diameters of the center holes that are seen in nearly all of the original artifacts. While my finished object is not identical to the reference photos I found online, this new object compares favorably to those mysterious bronze doo-dads. ▲



Modeled dodecahedron replica

Note: a video example is available at https://youtu.be/CqXiWuktoy8

TECHNIQUES:
MATERIAL EYES, pt. 1

by **FACET Staff**

When we think of 3D, we often think of objects in space – structures, vehicles, and creatures. We may not immediately think of colors as being spatial, but they are. Or, at least, they can be when assembled properly. Making materials is one of the easiest tasks to perform in 3D. All you need is to select an object, pick a color, and then you're done. Sure, you can always adjust a slider or two, but that's not needed.

But if this is true (and it is), then why would this topic merit a multi-part series of articles? The fact is that while materials are most often used as simple coverings for objects, they can also be the most powerful, complex, and processor-intensive aspects of any virtual scene. And they are capable of accomplishing things that defy belief.

Making things in 3D isn't always easy, but it's at least relatable to real-world skills like sculpting and wood-working. Coding new materials, on the other hand, is like advanced calculus. Or maybe magic. With the proper material programming skills, flat, featureless surfaces can instead be transformed into lofty mountains, and simple spheres into insects, along with cubes into raging tornadoes. All of these things and more are achievable with materials – and a bit of vector math wizardry.


Cube tornado and the code that created it

Before we can start making magic, however, we need to begin with the basics. First, we will need to add a few target objects to our scene. At startup, Blender 3D already contains a plain cube. The easiest way to add more cubes is to copy and paste them into the scene. Just like in a word processing program, Blender can copy selected content if the user holds down the CTRL key and then taps the C key on the keyboard. Pasting is just as simple. We only need to hold down the CTRL and tap the V key for each duplicate needed. In this example, let's add five more cubes, for a total of six in our scene.

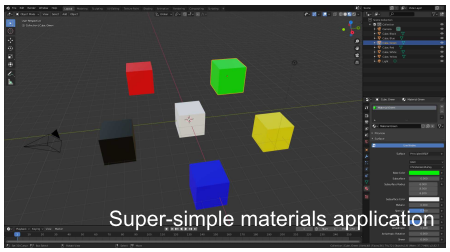
Once we've added a handful of objects to our scene, it might be hard to notice due to their current positioning. We will need to space them out a bit so they aren't all jumbled up together. This can be done by clicking/selecting each cube and dragging it to a new location. Alternately, we could tap the N key on our keyboards while our mouse arrow is in the 3D viewport and in the panel that appears to the right, we can change the X, Y and Z Location values in the vertical Item tab.

By default, Blender displays scenes without showing material settings. That's great for speeding up modeling, sculpting or layout work, but it is counter-productive to making materials. To solve this problem we will need to switch from "Solid" Viewport Display mode to "Look Dev" mode by locating the solid white sphere icon in the upper right corner of the 3D viewport and clicking the checkerboard sphere-looking icon next to it. If we did that correctly, we will be all set to see colors and material effects without guessing if we got it right.

With all of the cubes in place and the correct display mode activated, we can move to the Material editor properties panel. It can be found on the right side of the Blender window, toward the bottom. The one we need looks like a red and gray checkerboard sphere. Once located, we can click on it to see the material properties for the currently selected object. Depending on which duplicate cube you selected last, the listed material might read **Material** or **Material.002** (or something similar). If you want to change the names to something more descriptive, you can double-click on a material name and rename it to **Material Green**.

Now that everything is ready, we should be able to select a new Base Color for the selected object and material by clicking in the Base Color rectangle or block. This reveals a color-picker wheel and allows us to select the shade we like best. For the sake of organization, it helps to choose colors that match whatever name we assigned to each material.

If we repeat this process a few times for the remaining cubes, we should now have a scene that looks very similar to mine. Yes, it's boring. No, it's not as flashy as a lightning stroke. Blender materials can do some amazing things, but for now, we need to make sure we've mastered the basics first. Since this may be the first time some readers encounter 3D material design processes, we will have to move slowly and carefully lay the foundational skills needed to make magic.


Super-simple materials application

In the next issue, we will learn how to apply these colors to a single cube – with a different material assigned to each side. Be sure to save your file, as we will be using it as our starting point next month. ▲

Note: example video can be found at https://youtu.be/kArDLonM8qQ

CLASSES:

San Antonio College has offered non-credit 3D Technology classes every month since September of 2018. Most of our classes met in person once a week for three hours on Fridays and met for two, three or four weeks, depending on the discipline. Class costs were low and our 3D Visualization class was always free of charge. However, things have recently changed. New classes are planned but course delivery will now occur online using video streaming and other technologies. Contact us for more information about our classes. E-mail: aellis43@alamo.edu.