ALAMO COLLEGES DISTRICT
San Antonio College

FACET Monthly
3D Technologies @ SAC

Volume 1, No. 5

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Funding:
FACET is funded through a U.S. Department of Education Title III HSI grant. (#P031C110039)

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EDITORIAL:
THE LONG MARCH THROUGH POSSIBILITY SPACES

by **Aaron Ellis**

The Chinese philosopher Lao Tzu once wrote that “a journey of a thousand miles begins with a single step.” In our day of planes, trains, and rocket ships, perhaps an initial, literal “step” isn’t entirely required, but the idea remains the same.

Every journey certainly does start somewhere. But before the first crawl, or step, or pedal in any direction, there is a thought or a desire to be in another place. That visualization of elsewhere, even if it’s just at the mall or back in bed, is the impulse for all of our conscious motion.

That initial idea of wanting something that doesn’t exist or wishing ourselves somewhere we aren’t is a kind of teleportative futurism. We see before realizing – the end, before beginning. We shape the vision of a final form in our mind’s eye.

When families, organizations and societies embark on collective journeys, they crystalize their visions for a shared future into plans to get there. Where should we go for dinner? What movie should we rent? Should we use nukes to deflect the asteroid or build a super-laser instead? Our paths start with ideas.

Before a NASA probe could travel to Jupiter and peer into its turbulent mists, a single person in a team of someones had to imagine it first. Passing that notion along to others who could help make the fantasy real was the next necessary step. How many ‘footprints’ did Juno leave before finally reaching our largest planet and opening her eyes for the first time?

The publication that is now FACET Monthly began as an idea in early 2019, but not articulated aloud until later that Fall, during a bi-annual grant review meeting. The primary goal of FACET was to draw more students into our 3D technology classes at San Antonio College by spreading the word about what our team had to offer. While this journal now mostly matches the original vision, it hasn’t delivered on the goal. Life, and the fear of death, just... got in the way.

The original plan for the 3D classes we offer was to make them available as “art electives” so that all students, regardless of their majors, could learn how to apply these new tools to their future careers. But that didn’t work out either. Colleges around the state of Texas have gradually stripped applied art classes from art elective eligability as Art History is all the creativity training our trades students will ever need.

Not all of our future-far visions will turn out as we expect. Sometimes the places we want to go are temporarily closed when we get there. Other times we find they have been bull-dozed forever. Our current moment feels a bit like the latter, but it isn’t. San Antonio College won’t always remain empty.

Where are we now? Where do we want to be? What do we want to see in ourselves or in the world around us? Can we develop a plan for realizing the vision? Who might we need to help us? How might we pivot if things don’t work out?

It’s up to us. Our next steps are waiting. ▲

PROJECTS:
CLEAVE. LAND. ROCKS.

by **Aaron Ellis**

After reading a few of the Projects articles in FACET, one might suspect that our team bounces all around – from one unrelated subject to another. That observation is mostly true. And we wouldn't want it any other way.

Among the many projects the FACET team has undertaken over the years, each one offers us opportunities to learn new things about the world around us in the process of completing the assigned tasks. My work-study students and I are not experts in geology, paleontology, entomology or a million other -ologies, so we find ourselves learning from our partners, who actually are subject matter experts in their fields.

In 2016, San Antonio College geology instructor Dwight Jurena brought an interesting challenge our way in the form of multi-faceted cleavage plane models. Cleavage (or splitting) in minerals occurs along planes of structural weakness. Various crystalline materials cleave differently from others and the specific ways they separate aid in identifying those substances.

With this said, it is important for geology students to know the many ways minerals cleave and how to visually identify such features in the samples they observe. Historically, students refer to illustrations in textbooks or physical models in the classroom. But of course, thanks to modern technology, we have another option. Interactive 3D models of cleavage plane shapes allow students to view enlarged examples of each and rotate around to see them in their entirety on a computer, a digital tablet or a smartphone.

Of the 21 cleavage plane models requested by Mr. Jurena, most were fairly simple – a rhombus here, a platonic solid there. None were terribly difficult to make, but each shape was a new spatial puzzle to solve. However, a few of the objects required a deeper understanding of the essential structures before modeling could begin. And that meant digging up accurate reference materials buried within paper and pixel pages.

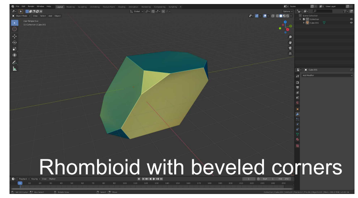
Once I understood each shape, modeling began and ended quickly – just a few minutes per object in most cases. That seemed fast enough then, but looking back on this project now, with the benefit of more mature 3D development tools and workflows, I realize how much faster and easier these puzzles would have been to solve if I had used today's Blender software.

How could I have improved on the few minutes it took to make these shapes? In some cases, with Blender, those same objects could have been completed in just a few seconds instead.

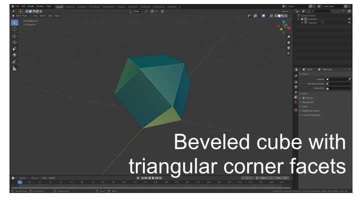
After all the models were finished, I uploaded them to the Sketchfab 3D model hosting service for Mr. Jurena's students (and the rest of the world) to access. Collectively, the objects have been viewed over two thousand times. That's not much when compared to YouTube cat video view counts, but it's not bad for a niche educational topic.

While it is impossible to know for sure how many of these cleavage plane model views came from SAC students, it's great to know that these online geology references will remain available to students both near and far for years to come. ▲

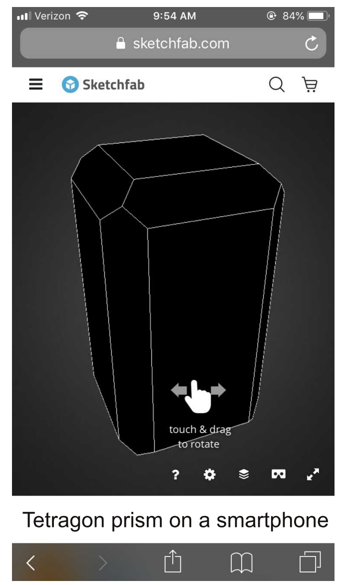
Note: to view this interactive 3D collection of geological cleavage plane models online, visit: https://sketchfab.com/aellis43/collections/cleavage-models



Rhombioid with beveled corners



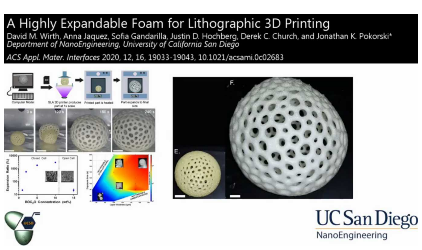
Beveled cube with triangular corner facets



Tetragon prism on a smartphone

NEWS:
EXPANDING 3D MATERIALS BURST ONTO THE SCENE

by **FACET Staff**



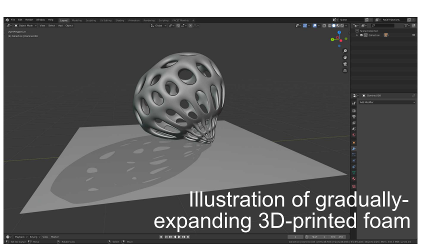


Illustration of gradually-expanding 3D-printed foam

One of the limitations of many 3D printing technologies is diminutive print volumes. Most consumer-grade printers have build volumes measured in just a few inches. As a result, 3D-printed parts are often, by necessity, very small.

But researchers at the University of California, San Diego have made a breakthrough in 3D-printed materials design that could dramatically expand print sizes for SLA and DLP devices.

By introducing a blowing agent bound within photo-sensitive liquid resin, researchers at UCSD's Jacobs School of Engineering were able to demonstrate dramatic size increases in 3D prints – after a bit of post processing. Blowing agents like these are what make expanding polyurethane foam home insulation possible.

In this new 3D fabrication approach, objects are printed normally on a small print bed with the modified resin. After removal from the printer and initial cleaning, the parts are then placed into a heated vacuum chamber and left to 'cook' for seconds or minutes, depending on the application.

During the curing period, the bound gasses inside the resin begin to expand, eventually deforming the surrounding structures up to 40 times the original size. This expansion isn't uniformly distributed all at once. Time-lapse video shows some parts of a model growing before the rest of the shape catches up.

This technology might just be the next big thing in additive manufacturing. We can't wait to try it here at San Antonio College. ▲

Note: for more information about this innovative 3D-printing approach, researchers have provided a video demonstration of the expanding foam material at: https://youtu.be.com/PoAvYRy21qw

IDEAS:
REFERENTIAL TREATMENT

by **Aaron Ellis**

When the members of our team scan people, places, and things, we don't generally have to do a lot of research first. Sure, we stage the scene, prep the subject, and fire-up the equipment, but that's pretty much it. Yes, we also spend hours processing and cleaning up the data to get it ready for visualization or printing, but there's not much discovery to the whole endeavor – at least not on our part.

However, when we model or sculpt something from scratch, that's when the research pushes into overdrive. This is especially true if the subject we are making is a real thing – and if we are trying to build it with fidelity in mind.

Whether it's faithfully-reproduced human embryo sculpts or accurately-depicted orbital spacecraft models, access to reference images is vital. Sometimes we are graced with an abundance of high-resolution, clear photographs of subjects from multiple angles. Since our recreations are likely to be viewed from different vantage points, those objects need to be crafted completely – on all sides.

Whenever possible, we also try to gain access to the artifact in question or to obtain a physical model of it for our review. But, for a variety of reasons, that isn't always doable.

In the case of super-small subjects, lost artifacts, or whenever authoritative sources disagree, sometimes useful reference images are difficult to find or trust. In those situations, we are forced to make our best guesses on the structure of the thing we are trying to recreate. When that happens, we usually get at least some of the details wrong.

Oddly enough, that's the way it works for photogrammetry 3D scanning as well. No, the scanner isn't hitting up Google's image search tool for references. Instead, the equipment captures the reference images needed – directly from the subject – during the scanning process. The more high-quality images the system captures from many angles, the more accurate the resulting model. As in artist-based modeling, when the scanning system is missing data, it fills in the gaps with manufactured (erroneous) geometry.

Several years ago, I was a member of an online 3D artists forum. One of the things that shocked me most about that community of creatives was how many of them exhibited their work while proudly exclaiming "No Refs!" It's great if someone's knowledge of human anatomy in all its shapes and sizes, poses and reposes is accurate enough to not require source references. But such a claim isn't likely true – especially for a wide variety of subjects.

As for me, I find myself snapping sequential photographs of whatever catches my eye everywhere I go. Motorcycles, mountains, bugs, furniture, art, toys – all the things I might want to make.

Whatever it is we do in life, having exemplary references to guide us is of paramount importance. Do you want to sculpt an accurate cicada? Start by examining a real specimen. Do you want to pass a just law? Begin by studying the constitution. It's that simple.

Select your refs. Check your refs. Then do the work. ▲

3DIVERSIONS:
PHUN WITH PHYSICS

by **Aaron Ellis**

FACET Monthly frequently praises Blender as a powerful, free 3D content-creation program. But what often goes unsaid is how addictive the software can be. That's a difficult quality to quantify. I use it every day and lose myself in it quite frequently, but seeing others tumble headlong into Blender is particularly satisfying.

Last year, during the San Antonio College 2019 Summer Camp, one of our campers got lost in a seemingly simple activity. No, not lost in the sense that he didn't know how to complete the task – but lost in the sense that he was mesmerized by the process.

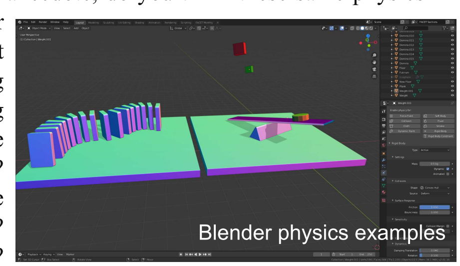
The activity in question was to use Blender's built-in rigid-body physics system to simulate the action of a projectile moving as a result of a weight acting on a lever over a fulcrum. In other words, make a catapult. In Blender, it's pretty easy to add virtual physics properties to objects within a scene. After a bit of parameter tweaking, the "play" button initiates the process of calculating and progressing the forces of motion as initially set. The results are accurate enough for most uses.

For that Summer Camp lesson, the original assignment was to create a catapult with multiple objects working together to launch another object within the scene. Students were instructed to apply physics constraints like mass, friction, bounciness, etc. to the various shapes and then play it all forward to see how the simulations resolved themselves. Adding physics to objects is as simple as clicking one button in Blender. It really is that easy! Of course additional parameters are always available to fine-tune the spatial relationships.

All of the campers worked through the same assignment pretty much as expected. However, one camper (mentioned above) went even further by adding several extra objects and steps to the process. This student added a new object, applied some settings and then hit play. He repeated the process again and again. Many times, in fact. At each stage, the projectile bounced in a different direction – only to be ricocheted elsewhere in the following step.

Eventually, the camper finished his simulation, with the projectile landing in a basket after more than 20 bounces around the scene. This was certainly a diversion from the original assignment, but the student internalized the operation of Blender's physics tools much more in this extended play session than the original activity would have allowed.

So, based on this simple anecdote, do you think these same physics tools could be used for other fun tasks? What about stacking and tipping dominoes? Maybe rolling some of the dice that we built in the March issue? How about making a Rube Goldberg-like contraption? Does cloth fit in as well? The delightful answer to all of these questions is yes.



Blender physics examples

But wait. Could the same answer apply to simulated wind, fluid and smoke effects as well? Tune in next issue to find out. ▲

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

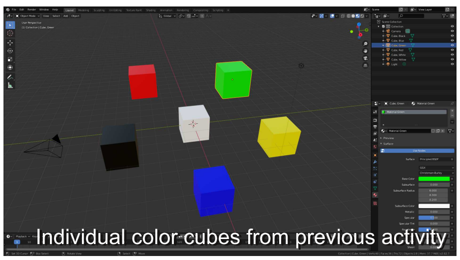
TECHNIQUES:
MATERIAL EYES, Pt. 2

by **FACET Staff**

In last month's Techniques article, we began our series on creating and applying materials to objects in Blender 2.82. In this issue, we will expand on that concept a bit. As we demonstrated last time, adding materials to objects is a simple affair. Thankfully, applying multiple materials to a single object is almost as easy.

This is possible because Blender has the ability to assign materials to the individual faces of a 3D model. For example, a cube could have as many as six different materials assigned. An Icosahedron could sport up to twenty materials. As you might imagine, even more detailed objects could hold hundreds, thousands, or even millions of materials each if someone had free time and the interest to pursue such a task.

Making minor magic with materials in Blender isn't hard, but it is a multi-layered skill that builds upon itself. Because of that, each of the activities in the "Material Eyes" series of articles is important to the next. Readers who did not finish last month's activity should work through all of those earlier steps prior to starting this project, as those skills build the foundation for most of the tasks covered here.


Individual color cubes from previous activity

For this activity, we will keep things simple and apply six materials to a single cube. If you followed along with last month's activity and saved the file, you should already have six materials in your Blender scene. The materials we created then corresponded to Black, White, Green, Blue, Yellow, and Red coloring.

We can start by adding a new cube to our Blender scene by clicking the Add menu option, followed by the Mesh sub-menu, and then the Cube sub-menu option. A brand new cube should then appear and should be automatically selected.

With this new cube as the active object, our next step is to enter Edit mode. We won't actually be editing the geometries of the object. We really just want to select individual faces on the model and apply materials to them. But selecting faces can only be done in Edit mode.

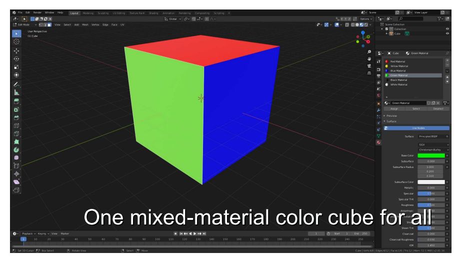
To switch from Object mode to Edit mode, we could click the Object Mode button in the upper-left corner of the Blender screen and drop it down to select editing instead. However, it's generally easier to simply press the Tab key on our keyboards one time to begin editing a shape.

The default selection type in Blender is Vertex (or point) but we will need to switch over to Face selection instead. The easiest way to do this is to press the top-row number 3 on our keyboards, but we could click the appropriate icon in Blender's interface if preferred. It looks like a square and is preceded by a dot icon and a vertical line icon.

Once Face selection has been enabled, we can then select one side of the cube. For most Blender 2.82 users, this can be done by left-clicking the mouse on the appropriate face. However, the traditional Blender setup uses the right-mouse button for selection instead. Either way, after a cube face is selected, let's locate the Material Properties panel (the icon looks like a red and gray beach ball) and then select one of the color-named materials from the Materials list. I have identified mine with names like **Material Green** but yours may be different. With that done, we should locate and click the Assign button.

If you followed those steps but didn't see a color change on the appropriate cube face, you may not be in the Look Dev or Material Preview display mode. You can check out last month's article for a refresher on switching display modes or click the white and gray beach ball icon in the upper-right corner of Blender 3D viewport window.

Now that the first color material is assigned to the first cube face, we can repeat the process five more times to finish up our new multi-colored cube. If we've done it all properly, we should now see a single cube with a different colored material on each face. At this point, it is ok to switch back from Edit Mode to Object Mode (Tab again). And that's it! This activity may not seem like much, but it leads to even bigger things.

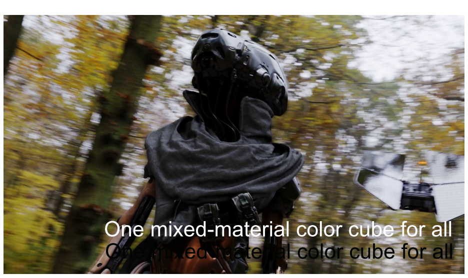

One mixed-material color cube for all

Next month's article will take us into the strange new world of material editing with nodes. Using nodes in Blender is a little like computer programming, but with spaghetti noodles in place of code. ▲

Note: a video example of this activity can be found at the following YouTube address: https://youtu.be/xxxxxxxxx

2020 SUMMER CAMPS:

San Antonio College will host 3D Technologies Summer Camps for teenagers during June and July of 2020. The June camps will be dedicated to 13 and 14-year-old students while the July camps will host 15, 16, and 17-year-olds. Campers will learn the basics of 3D visualization and animation, modeling mechanical objects, sculpting organic creatures, creating believable landscapes, scanning artifacts and 'printing' small items. Camp enrollment is free, but space is limited. For more information, contact us by e-mail at: aellis43@alamo.edu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