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MROI Staff (Pages 11-13)

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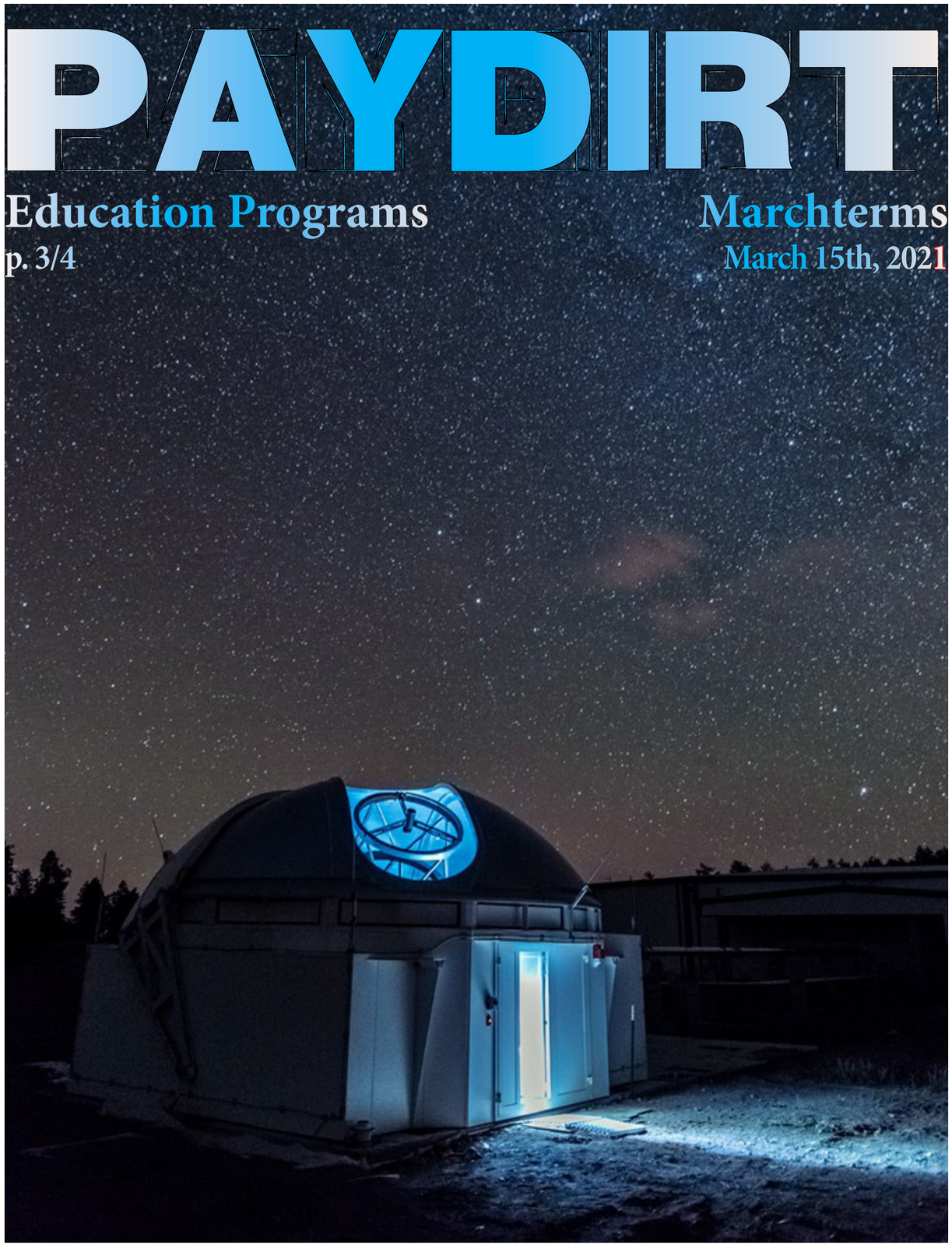
PAYDIRT

Education Programs
p. 3/4

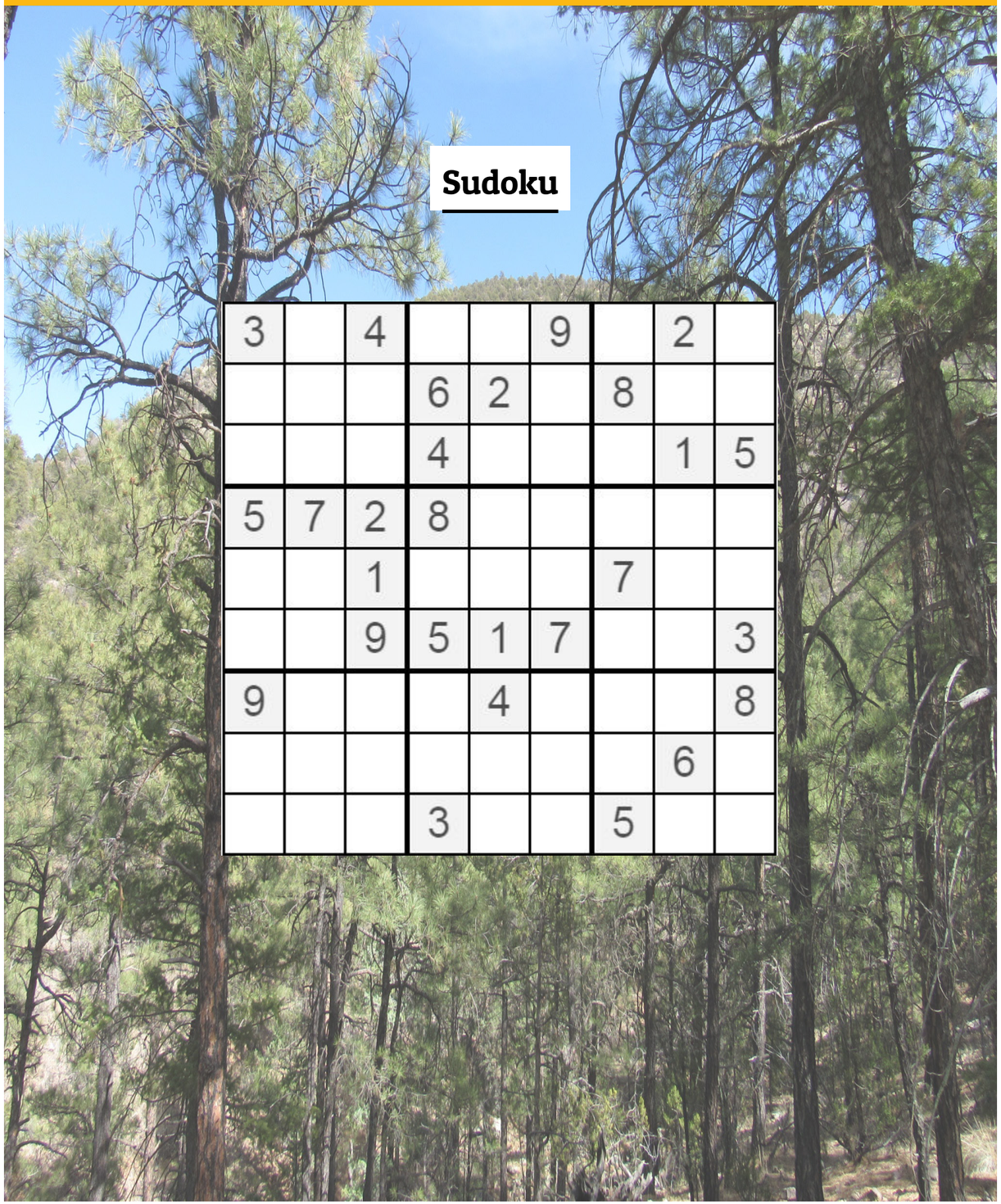
Marchterms
March 15th, 2021



In This Issue:

SGA Meeting Rundown: 03/09/21

1. NOTE: Please make sure to use best practices when reading and sharing Paydirt to minimize the spread of COVID. Please keep in mind that articles are written several days before publishing.
2. COVID-19 vaccines are being administered much more frequently. Employees, faculty, and other staff are high up on the priority list, including students who fill these positions. Sign up at https://cvvaccine.nmhealth.org.
3. Administration is working to get a reduced price for those in town purchasing internet services. They are looking at up to $50 off per month.
4. SGA meetings are looking to get back on campus in Macey. Those in attendance will be required to have gotten a COVID test the previous Thursday.
5. The contact tracing app is live on the Appstore for those who wish to download it.
6. The Board of Regents voted to not increase tuition.
7. There are 18-19 events planned for Spring Fling pending approval.
8. The Minecraft server is almost completed, with mods installed and a Code of Conduct being approved.



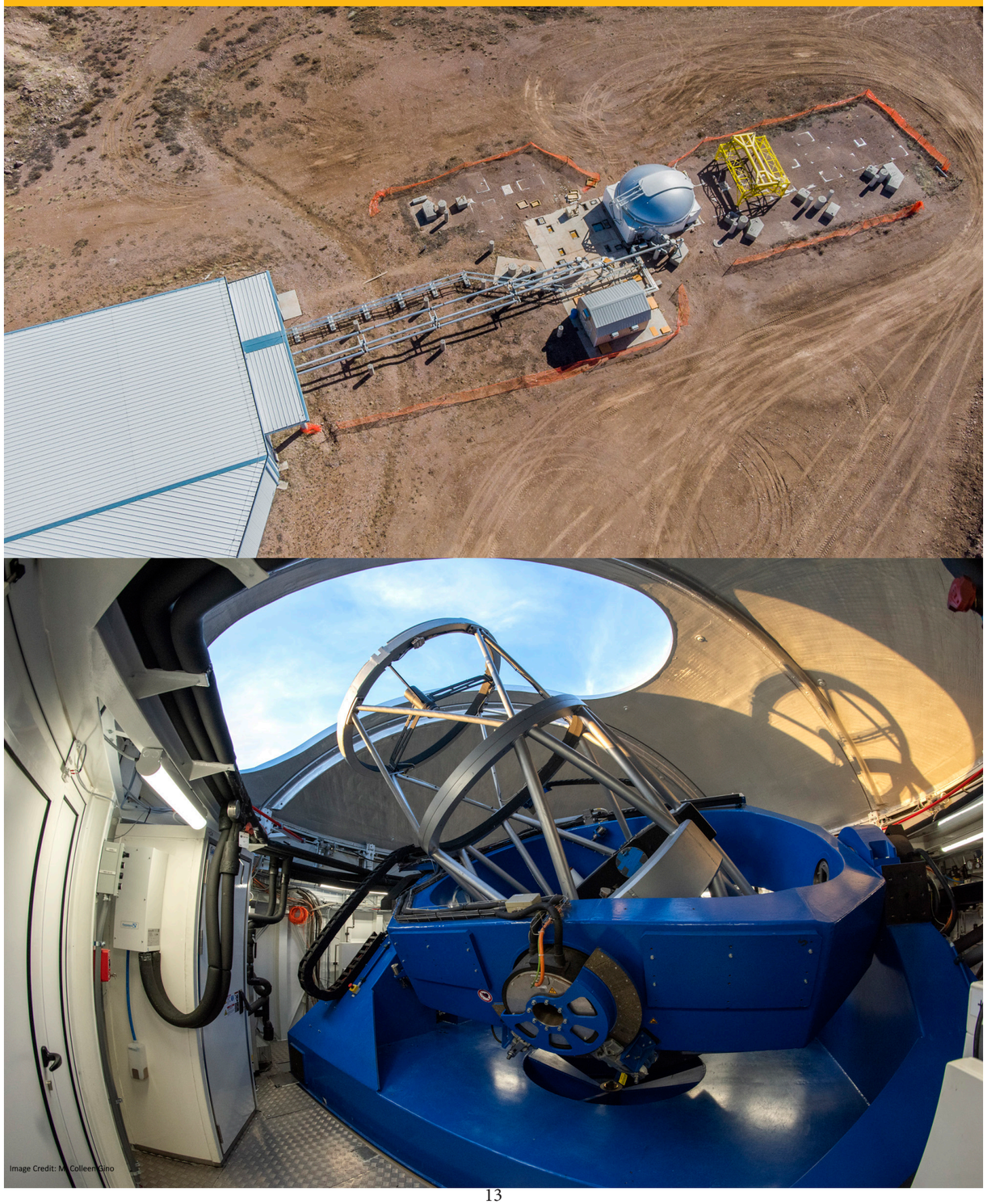


Image Credit: Mr. Colleen Gino

Creativity Submission Contest

Hello Paydirt reader,

Have you ever felt that this newspaper has been lacking in the creativity department? Have you ever thought that it needed something fresh? Well, here's your chance!

We'd love to see your photos, short stories, poems, or anything else creativity related that we can put in our pages. You can request to be anonymous, or put your name out there. Your photo submission might even be showcased on the front page!

Here are the requirements: Your submission must not contain any hate speech, overly violent content, or anything else that would not be allowed per NMT's general rules. If you have questions, feel free to email us. If the submission is in text, the word count must be less than 1300 words. This gives us space to include photos and format your submission the best we can.

We will always consider your submissions, but if you send them to us through the 22nd of March, you might win a Cards Against NMT deck! The best submission will be decided by our team and the writer/photographer will be the winner. The issue with your content will come out, bar any problems, March 29.

We can't wait to see what you come up with. As mentioned before, everything sent is subject to review, but for the most part feel free to embrace your creative side and come up with something special!

Send your submission to paydirt@npe.nmt.edu.

Education Programs at Tech

A few weeks ago, I was approached by email regarding an article idea featuring the teaching licensure program we have here at NMT. I am sorry to admit I only knew bits and pieces regarding the program, and seeing that the goal was to increase student awareness and involvement, I figured the article would be a good way to share the program with all of our readers. I interviewed three individuals: Brisa Garcia, a student in the program currently, Theresa Apodaca, a professor teaching some of the required classes, and Megha Khandelwel, the brains behind the operation. Due to the required brevity of this article, I will be summarizing their thoughts when needed in order to inform you on what this program is and does.

There are a total of three programs: the Masters of Science for Teachers, which is aimed at those off-campus to bring them in, the Minor in Education, which provides a teaching license for those looking to teach in New Mexico or elsewhere in the country, and the Alternative Licensure Program, which is aimed for those with their Bachelor's degree looking to get into teaching.

Although the Masters of Science for Teachers (MST) program has been around for 50 years, due to low enrollment and other issues, the Teaching Licensure program was shut down about 15 years ago. Megha was originally hired to solely coordinate the MST program, but due to local need within the community, Academic Affairs approached her to restart the license program. The idea was to bring broader education courses back to Tech instead of needing educators in Socorro to drive up to UNM to take courses.

My questions with these three ladies focused primarily on this program, the Minor in Education, as many of our readers are undergraduates who might be interested in picking up teaching during their stay at NMT. If you would like more information regarding the other two programs, which are usually for after you have attained your Bachelor's degree, contact Megha at megha.khandelwal@nmt.edu.

Professor Theresa Apodaca summarized for me what the students of the program complete: "There are five courses, plus supervised field experience. The five courses include instructional strategies, classroom management, differentiated instruction, writing unit/lesson plans, and implementation. It seems my students need more practical than theoretical instruction, so we do a lot more hands on where they write a plan and teach it to me and their classmates. Not only am I reviewing my students' teaching, but so are the other students."

Megha added on to this with her own information, stating that "students go to local schools for a couple of hours a week to work with the [school's] students and their teacher, so they get experience. When they go into some other teacher's classroom, they work with the kids and with a teacher who has been teaching for many years; they can learn from the mentor teacher."

Brisa, who is currently taking the education courses, said that "for lesson plans, every school has a different format that they want, but they all rely on the same main concepts. The biggest thing a lot of teachers have to learn how to do is read the Common Core standards. At first glance they are completely confusing [and] you don't know how to read them. Theresa has really broken down how to read them, rewrite them, and teach the material to the students so we don't teach them really hard content directly from the Common Core."

She continued, stating that "with different teaching styles, it's mostly just learning how to reach every student. Some learn by reading the text, some by visuals, some by rewriting notes. Knowing how to reach out to each of those students is what we work on, and challenging them from being at a lower level of learning to a higher level. Reflecting on what I've been learning now, I saw it when I was back in primary school. It's really cool to see how the teachers do all these things and the students don't really notice it."

After getting a good background into what the coursework looks like, I asked about what the goals of the program were and what experiences had been like. This might seem like a simple or broad question, but it was interesting to hear the different sides of all three women from different positions within the program.

Brisa explained that "even though I am getting my degree in Mechanical Engineering, there's no shame in becoming

Relax and Unwind

"It always seems impossible until it's done." - Nelson Mandela

Magdalena Ridge Observatory Interferometer Photo Gallery

Image Credit: M. Colleen Gino

Image Credit: Dylan Kitcorn & M. Colleen Gino

a teacher because teachers are the building blocks for students, and they're the ones who impact them and their future decisions. If I can make an impact on one student to do something great with their life, I feel my job has been done as a teacher." Theresa, who teaches these classes, said "I can tell you I made the right choice in accepting this position. I have found it really interesting to teach teachers. My students really have grown; they've really taken hold of what it means to be an effective teacher."

As for benefits regarding the program, I was told that the program supports a wide array of schedules and backgrounds. The classes are sometimes offered in the evening to assist with balancing other schoolwork, and there are scholarships available to help with costs. There are also teacher loan repayment programs in which the state itself will pay back loans if you decide to begin teaching.

Especially during COVID, there is a high demand for teachers. The job is stable, as wherever you go, there will be a teaching opportunity available. The license is a great backup to have in case your main goal has not taken off, even more so for those with the ability to teach math and science, which are the two most desired types of teachers nationally.

While talking about why students would enroll in the program, Theresa recalled a story from her teaching past: "When I taught 4th grade, one of my students did not understand long division. He felt bad, was losing confidence. We just put everything to the side, his classmates were so kind, and we just kept doing problems. Finally, it must have been a while later, and he said 'oh I get it!' and he went to the board and he did the problem! It was like a celebration. It was so much fun just seeing him get it. I'll never forget that, it makes me smile just thinking about it. We were a team, we didn't give up on each other."

Megha had a similar story: "When I was teaching HS, the thing that encouraged me was that you are teaching many students, but even if one student is learning, and they are thinking of going to college because of you, that gives you the feeling that you are changing the life of at least one student. It gives you the satisfaction that you are doing good teaching the next generation."

To wrap up this article, I will summarize what the trio talked about as their response to why students should take the program. Teaching has a lot of self-satisfaction involved. Presenting ideas to your students and having the lightbulb turn on in their head generates a feeling like no other, and the stability of such a position attests to why teaching is such a great career choice. Even if you hold onto the license, it is there as a backup for if and when you decide to teach the next generation.

Please contact Megha Khandelwal at megha.khandelwal@nmt.edu for more information regarding any of the programs.

-Skyler Matteson

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Focusing on the Future: Interferometry at Tech

For many Tech students, an observatory is just a large golf ball-like dome cut in half that can open up to reveal a giant telescope inside, waiting to view far-off galaxies and planets. For Dr. Michelle Creech-Eakman and Dr. Ryan Norris, an observatory is just a single piece of their multifaceted plan to unlock the secrets of the stars. Dramatic, perhaps, but as astrophysicists seeking to understand the why's and how's of a star, it is their line of work.

Dr. Creech-Eakman, a long-time member of the Magdalena Ridge Observatory Interferometer (MROI) project, joined the Tech faculty in 2003 after working on the more instrumental side of interferometry at CalTech, later switching to the Jet Propulsion Laboratory in California in order to continue her work on the Keck Interferometer. As she describes it, her introduction to the MRO Interferometer came at the best possible time in the project; Since the MRO's current location sits within the Research Park assigned to Tech through Congress, an Environmental Impact Survey (EIS) required approval before any ground could be broken. Though the EIS required three to four years to complete, it was all necessary to ensure good stewardship of the land. As the approval coincidentally arrived soon after Dr. Creech-Eakman joined, the team was able to begin construction. Today, she continues to lead the team at the MROI as the Project Scientist, making sure that the project continues to meet its goals.

As for Dr. Ryan Norris, his time at the project has been a bit shorter, as he joined in August of 2020, where he had previously worked on Georgia State University's Center for High Angular Resolution Astronomy (CHARA) array, a six-telescope interferometer setup working to measure the diameters and temperatures of stars. Here, the largest portion of his work is devoted to working with the fringes retrieved by the MROI to reassemble the pictures of stars, although once the project is able to obtain greater support and add more telescopes to the array, he will play a much more involved role in developing the techniques needed to reconstruct the images harvested from the data, as well as testing theories on star behavior and evolution through the interpretation of the aforementioned images.

Interferometry, for those who are unfamiliar with the term, is the use of several light sources being bounced off of a collection of telescopes. The telescopes are paired up across from one another in whatever pattern the researchers desire (typically something resembling a circle or a Y-shape), where the distance (or separation) between any two telescopes forms a baseline, which in turn creates the diameter of the "virtual" telescope; The result is a number of images (referred to as "fringes") which, put together, contain the imaging information for the celestial body.

To properly understand the workings of an interferometer, Dr. Creech-Eakman typically uses the analogy, "...of a piece of paper with the image on it coming down from the [sky, where the] paper is the wavefront or phase of the light." The telescopes arrayed on the ground are able to catch bits and pieces of the paper, but only that; In order to reassemble the pieces, a delay is added to the device. "The analogy [works well since] you can crumple up the paper to show how the atmosphere distorts it," says Dr. Creech-Eakman. "... [The] adaptive optics and the interferometer are used to flatten it out again." The only difference between using infrared and radio here is that the atmosphere affects the two wavelengths differently (the atmosphere changes very slowly with radio waves as compared to the IR waves), which enables scientists to capture the data on radio and reassemble it with software; The IR wavelength, on the other hand, is changed by the atmosphere too fast for that method, requiring scientists to capture the fringes on a piece of glass and use a Fourier transform in order to retrieve the completed image. This requires matching the paths between different optics in the interferometer down to the wavelength of the light itself.

For the team on Magdalena Ridge, three science goals must be achieved, the first of which is to study star and planet formation, specifically where the latter is forming around the dust disks left by the formation of the system. This is accomplished by observing excited spectral lines and dust signatures, though to do so, a number of extremely high-resolution images are needed on the nearest star forming regions.

Greek Education

As Tech students, our lives are consumed with education. Occasionally, consumed to the point where we consider dropping out because of all the stress. It can be hard to take a step back and look at all we have learned and are able to learn because of centuries of refinement in education.

What's the first civilization that pops into your head when thinking about ancient forms of education? Is it the Ancient Greeks? With some of the most profoundly known philosophers, it's hard not to consider the Ancient Greeks a sort of pinnacle of classical education. I mean, yeah, most of them were wrong on a lot of stuff but some of them really hit the nail on the head, or...the lengths on a triangle? (thanks Pythagoras)

Education in Ancient Greece is actually considered to be a heavy influence on modern higher education, so you can thank the Greeks next time you have to get up for your 7:30am class. Education in Classical Athens took on two forms, the physical and the intellectual. The physical education, called "gumnastike," focused on building strength, stamina and power for war. The intellectual education, called "mousike," put an emphasis on music, dance, lyrics, and poetry.

Classical Athens (508-322 BCE) liked brawn over brain for a very long time, thinking that a physically fit body was one of the most important things for a man. I mean, talk about unrealistic body standards, jeez. That is, until 420 BCE when there was a fundamental shift in importance. Formal higher education began to expand, allowing for more specialized and specific knowledge in areas such as, mathematics, philosophy, rhetoric, and political training.

The biggest example of this emphasis on higher education comes with Plato. Plato, another fancy philosopher of the time, was a student of Socrates. He, in 387 BCE, established the Academy, named after Academus. The Academy is actually considered to be one of the first universities. Plato believed that higher education was the key to producing citizens that could function and contribute to a civic society.

Plato's Academy started as an informal meeting outside of a gymnasium. He came to a grove, sat down and just started talking to those interested in listening. His small collection of students would meet there for these highly informal lectures. Can you imagine just walking up to someone on the sidewalk and listening to them teach Gen Chem II on purpose? Yeah, me neither. This informal setting was the place of Plato's teaching until he was funded by the aristocracy to get an actual building.

Unlike America's current higher education system, attending the Academy was free. Plato survived on donations and gifts from his students. This allowed for essentially anyone to obtain a higher education. Although, Plato regularly encouraged his students to remain celibate and live a very disciplined and self-denying life. So, figuring out if sex or education was worth more to you was important.

The Academy focused on teaching mathematics and pursuing the truth through formal education. This fell in line with Plato's belief that the perfect person had at least 10 years of mathematics, 15 years of political training and 5 years of dialectical training. Most of Plato's students stayed for around 4 year, but his most well known student, Aristotle, stayed for approximately 20 (overachiever much?).

The Academy and other forms of formal higher education in Greece are considered to be a huge influence on how education developed through the centuries and modern day academia.

"From the beginning, the university ideas of ancient Greece have been the elements of western tradition. The university is aimed at pursuing truth and human progress to present the essence of human virtue. Humanities is its lifeline, no matter how fantastic this word is and how deeply the word has changed its meaning." (Karl Jasper)

A common theme in modern and the ancient Greek university system is the concept of areté. Areté refers to moral and sometimes even general "excellence." Plato aimed to create virtuous students that would be able to contribute back to society. Modern universities aim to create highly educated individuals that will help further academia and society.

-Alexandra Sartori

Dan the Rock Man

Caving is a very serious and dangerous profession, it involves exploring the depths of the Earth in the pursuit of knowledge. One of the most important parts is the kind of clothing that the cavers wear, especially the pants. The pants will help protect from rock debris and potentially dangerous acidic solutions. So, what type of pants do cavers wear? Stalac-tights.

Daniel Jones, an Earth and Environmental Science (E&ES) assistant professor, was recently featured in an NMT Skeen Spotlight. He discussed his experiences in the caving and karst world, research, and affiliations with the National Cave and Karst Research Institute (NCKRI).

Dan began his work in geosciences during his undergraduate years at Carleton College, receiving a degree in Geology. He then went on to pursue his PhD geosciences, as a geomicrobiologist, and biochemistry. Now, geomicrobiology can sound a little confusing at first, I mean what does biology even have to do with rocks? Actually, a lot!

Microbes have a huge impact on geology because of their ability to control chemical transformations. Microbes can cause the precipitation and dissolution of minerals, fundamentally changing the geology around them. Certain structures could not exist without the influence of microorganisms, such as stromatolites. Stromatolites are biochemical accretionary structures that form in shallow water by photosynthetic cyanobacteria that produce a film that traps sediments that will form layers.

Dan applies his knowledge of geomicrobiology to his research in caves and karst. He specializes in the sulfur cycling of microbes and the interaction between microbes and minerals within cave systems. Though, you likely know what a cave, karst is a slightly more jargony word. Karsts are landscapes that house stone such as limestone that can be eroded by dissolution, but they're better referred to as "cave country." Karst landscapes actually account for around 20-25% of the world's geography.

Dan currently also works as the Academic Director of NCKRI. This position entails his involvement in research, both undergraduate and graduate, through grants for students interested in caves and karst. Dan Is currently working on promoting two different outreach projects, one in undergraduate research and the other in a communications program.

The undergraduate research program known as Undergraduate Research Opportunities in Caves and Karst, which has the best acronym of "UROCK" is a fellowship program here at NMT. A student reaches out to a professor that they would like to work with and work to find a research topic that interests them within the cave and karst world.

The communications program, NCKRI Communications Internship Program (NCIP), is an internship that promotes making science more accessible to everyone. NCIP is a summer internship that trains students in science communication and allows them to work with a NCKRI scientist to help celebrate the science of caves.

If either of these programs inspire you, reach out to your local E&ES professor to discuss options. Or, if caves sound like the coolest thing ever (because they are!) look into taking courses with Dan Jones, NMT's resident cave expert and enthusiast.

- Alexandra Sartori

The MROI's second goal is to study black holes; As can be remembered, a Nobel prize was awarded in April of 2020 to a group of astrophysicists who were able to capture the first images of a black hole. It should be clarified that what is seen in the photo is not strictly the black hole itself, but rather the presence of the mass which it pulls in. A similar method is intended to be used by the Tech team, where statistics on black holes will be gathered from the one hundred or so active galactic nuclei (AGN) they can image, which will, in turn, allow the MROI team to understand the statistics of whole classes of astronomical objects as opposed to only the few that have been studied with other interferometers.

The third and last of the MROI's goals is considered by Dr. Creech-Eakman to be a potpourri of astrophysics - that is, it is a multi-faceted goal. One aspect of this is the study of unstable stars at various stages in their lives, which pulsate in a regular pattern. As an aside, these pulsations do not necessarily occur regularly around the star, as they can also pulsate in a single spot in a regular pattern. A famous example of this comes from the Betelgeuse star, which is notorious for its extraordinary dimming in 2019, as it is suspected that the event was caused by pulsations. A second aspect of this science potpourri is to study the effect of sunspots upon stars. Another aspect of this scientific focus area is to discover what causes the disintegration of stars, where the stars lose mass and basically fall apart over a period of time, eventually becoming supernova remnants or planetary nebulae. Another aspect of this science focus area is to try to understand the stars formed in binary and triple systems and how they evolve over time, where the former is the more typical of the two scenarios.

In a binary system, two stars orbit around a common center; In a triple star system, the pair of stars orbits around a common center, whilst a third star often orbits about the pair itself. In both of these systems, scientists are interested in studying the planar placement and change in angular momentum of the stellar systems, though the problem is that greater resolution is needed to gain images of acceptable quality. Higher resolution equals better telescope optics, and better telescope optics equates to a greater cost. But the results are often unprecedented so the expense is worth the effort.

As of today, only five infrared interferometer arrays exist, including the one situated on Magdalena Ridge, compared to the fifteen plus interferometers that existed over a decade ago. While most interferometers have at least three telescopes to work with (two being the minimum number required to have an interferometer count as active), the MROI currently contains a single telescope on the Ridge, which Dr. Creech-Eakman hopes to add two additional telescopes to in the next few years. Unfortunately, the process through which the MROI receives funding encountered a slight obstacle somewhere along the extensive paper trail of the Federal government, which led to its current state of furlough. Rest assured, however, that as soon as the mistake is amended, the MROI will be back in full force. What's more is that the team is always looking for bright Tech students to join its ranks, regardless of the major.

"It's really kind of the perfect project for Tech since it includes aspects of nearly every major offered here," states Dr. Creech-Eakman. "We've had mechanical, civil, computer science, technical communications, physics, biology, and electrical engineering students join us from year to year." For any students who are looking for experience in a hands-on project such as this, please contact Dr. Michelle Creech-Eakman at Michelle.CreechEakman@nmt.edu or Ryan Norris at ryan.norris@nmt.edu. Until then, I've been Isaiah Padilla, interstellar Paydirt journalist, signing off.

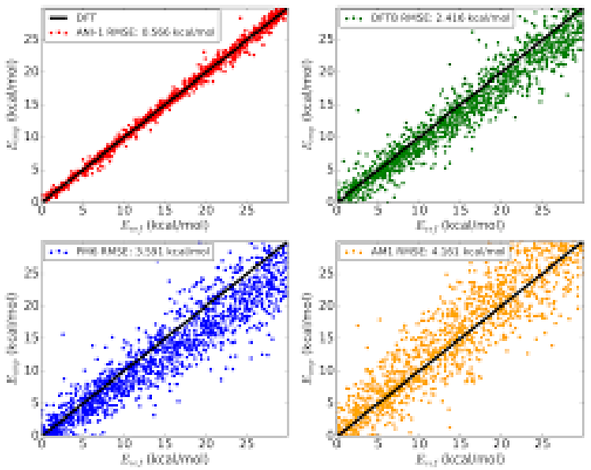
- Isaiah Padilla

Quantum Physics and Star Wars: Neural Networks in Solving the Universe

When Adrian Roitberg first began the project dedicated to answering the question of whether or not neural networks could be used in conjunction with chemistry to solve quantum chemistry problems, he, alongside many others, had no doubt in his mind that the resulting paper would prove that the two did not mix. However, as he was soon to find out, the opposite was true, which led to an even greater question: Is quantum chemistry amenable for machine learning?

Before we look more closely at the answer to that question, let's first start with a few necessary definitions; Quantum chemistry, to put it simply, would enable scientists to accurately predict the properties of materials and molecules, should they are become able to properly use the equations and theories of quantum chemistry.

"'Turns out we do know the physical theories that govern the laws of physics and chemistry,'" says Roitberg, quoting Paul Dirac, founder of quantum chemistry. "'We just can't solve them.'" He then went on to compare quantum chemistry equations to the more general chemistry equations, where in the latter you have a given set of rules which can be followed each and every time, but in the former no such rules exist, demanding, therefore, that every calculation will be different and therefore vastly long and difficult. To make matters worse, the time estimate for supercomputers to complete the calculations of a single molecule is around ten years.



So what good does quantum chemistry do the human race if we can't even solve it? Well, instead of directly solving the equations, quantum chemists use approximate practical methods, the results of which tell us about the actual system. Unfortunately, the problem with this is that once again, we wind up with an equation which describes everything but is impossible to solve.

Roitberg is determined to fix that, however. "I consider it my promise to you all," he says, "To deliver upon a method that is as accurate as a high level of theory, which is [also] really cheap." Done properly, such a method could create lead to the creation of drugs which are far more effective at treating illnesses or ailments than the ones currently available.

When neural networks exploded into popularity a number of years ago, it didn't take long for the quantum chemistry community to try and put the two together. These networks are vastly complex programs capable of "learning" through trial and error; By feeding one of these networks data sets and allowing it to learn the patterns of the calculations, it can acquire new knowledge, using previous information to make the necessary corrections.

And so, the Accurate NeurAl networK engINe for Molecular Energies (ANAKIN-ME, Roitberg's nod to the Star Wars franchise) was born. Roitberg's process for teaching this program was laid out in terms of the movies themselves: "First we start off with little ANI, who makes mistakes and doesn't know what he's doing," Roitberg chuckles at the analogy, "But then we give him the training tools and techniques through our data sets and gradually turn him into a Jedi Master capable of accurately predicting the molecular energies of substances in a matter of milliseconds. Only problem is we need to stop him before he becomes an evil Sith lord."

During their first attempt at testing ANI-1, the first iteration of the program, Roitberg's team took sixty-thousand molecules and disrupted them to give to the program as a data set. This data set was composed of twenty-two million data points, though the first plot of ANI-1's trial (depicting given values versus ANI-1's calculated values) only used one hundred and thirty-one randomly selected molecules and ten heavy atoms.

Despite the expectation that the program would fail, the first graph which came back showed nearly identical results which were incredibly accurate and precise down to an incredibly miniscule value. This was, of course, a shock to everyone, most of all Roitberg, who sent the student in charge of delivering the graph back to obtain a second one, which, like the first, was nearly identical. What's more is that the program finished the calculations in a little over three milliseconds.

Needless to say, there was more to this neural network-quantum chemistry combination that met the eye.

Currently, Roitberg and his team continue to improve the ANAKIN-ME program with further iterations, even going as far as to put it up on the Internet for others to test against their own data sets. As of yet, it still holds up to the accuracy and precision it was designed to maintain, and will continue to developed into a full-fledged system. The next step is to test it in an actual lab experiment, and after that, the sky's the limit. And until that happens, I've been Isaiah Padilla, esteemed Paydirt journalist, signing off.

-Isaiah Padilla