

Featured Stories



Liz Carey and Greg Peters have been running the Extraterrestrial Simulants Lab in Building 117 for six years, creating a variety of materials for JPL scientists and engineers, from comet samples and fluffy ice to cutting Mars-like rocks for 2020 drill testing. The team plans to share their work with the Lab at an upcoming event later this fall.

Meet the Two ‘Chefs’ Behind JPL’s ET Simulants Lab

By Celeste Hoang (Story) and Ryan Lannom (Photos)

High above Lab, in a six-room, single-floor building with a black and white pirate flag waving out front, two technologists are concocting special recipes to help JPL scientists and engineers explore the myriad possibilities within our solar system. Some of the sample ingredients include cement, foam, rocks and ice—perhaps not the most palatable, but for the sake of experimental testing, they’re just right. The Extraterrestrial Simulants Lab, founded by then-JPL scientist Jackie Green in 1995, is located in Building 117 and currently run by technologists Liz Carey and Greg Peters. Between the two of them—and a handful of enthusiastic interns who enter their doors throughout the year—they help answer questions such as, can a bi-blade cut through a comet surface and gather samples? Or can the Mars 2020 rover drill into a rock of a certain size?

“If you have an idea of an instrument that’s going to take some kind of measurement or a system that will interact with the surface in some way, in order to validate that it’s going to work in those environments with those materials, this lab provides that,” explains Peters. “It’s a place that was probably missing before it came along.”



Over the years, the simulants lab has worked on a dozen or so missions and proposals, from a comet sample return mission—the impetus for the lab’s creation—to Rosetta and InSight. The team develops simulants for icy satellites, the Moon, and the surfaces of Mars and Venus, to name a few.

Currently, Carey and Peters oversee experimental materials for Mars 2020, MSL, Dawn and the proposed Europa Lander. During the recent sweltering September days, the duo have often been outside the front doors of the lab, cutting large red rocks—Arizona Buff Sandstones, to be exact—with a commercial-grade blade that can slice through a 70-pound rock in seconds.

“It’s like a hot knife through butter,” Carey says of the machine.

The rocks are used for Mars 2020 drill testing in a liquid nitrogen vacuum chamber set to -70 degrees celsius that simulates atmospheric pressure on Mars. That testing will help form a picture for 2020 scientists and engineers of what’s possible for their instruments when the rover arrives on the Red Planet in 2021.



A Series of Fortunate Events

Neither Peters nor Carey could have guessed early on in their careers that they would end up supporting some of the most important missions to explore our solar system—especially in this capacity. Prior to JPL, Carey was working as a tour guide at the Griffith Observatory and thought she would be “studying exoplanets my whole life from a computer,” she says. Peters grew up riding bulls two hours north of Los Angeles and dreamt of becoming a rodeo star.

Through a series of fortuitous events, however, a path to JPL started to take shape for each. A fellow observatory tour guide helped Carey land a job in an ice lab at Caltech, and Peters became a plant manager in the mining industry. His company also produced concrete, which caught the eye of Green in the mid-90s; she hired him to design and produce concrete simulants to test an anchoring system for a comet lander at JPL. When she created the E.T. Simulants Lab, she brought him on as a contractor and later as a full-time JPLer to run it. In 2013, an intern came on board: Carey, who had joined JPL thanks to referrals from Caltech.

While their paths to JPL were on the less traditional side, both had a formal education in the sciences: Carey earned a bachelor’s in astrophysics and a master’s in physics, and Peters held a bachelor’s in geology.

For the first few years, the simulants lab was very much an experiment at creating experiments.

“At the time, it was like a start-up,” Carey recalls. “There was no formal training. We were just responding to the needs of people who came to us looking for something. It was mostly a place to do some dirty testing.”

But then a particular group came knocking on their door: 352A, better known as Planetary Sample Acquisition & Handling. Led by Lori Shiraishi, whom Carey refers to as “the engineering guru of surface sampling,” the group started requesting a variety of projects from the simulants lab and continue to send through a steady stream of requests to this day.

“Lori was a very strong advocate for us and everything involved in simulants,” Carey says. “She’s like a mentor to us. We’re adoptees of her group.”



Writing A New Recipe Book

With the new projects, however, came new problems to solve. In the lab's early days, there was no playbook on what would or wouldn't work when creating testing material.

"It was a lot of trial and error," says Peters, citing one example of how they tried to stick materials together in the beginning. "We were using hair spray or sugar."

Now that the two have run the lab together for the past six years, they're much more familiar and confident with their recipes—Portland cement and foam make a great sticking agent, for example—and have prioritized keeping the lab an efficient, well-managed space.

"We've really built up the lab so it's fully functioning," says Carey, adding that there are formal processes in place to figure out what a client is looking for and how the lab can best meet their needs. Everything they do is on a project-to-project basis and requires a WAM from the requesting group.

Over the years, the duo have been part of tasks far and wide: There was the time a proposed Earth project wanted to test a deep ocean diver system that would pick up rocks from the ocean floor, so Carey and Peters were WAM'd just to bring them rocks. Then there was the drive up to Napa Valley because the Mars 2020 team needed one specific type of rock identified on the private property of a vineyard owner, so Carey and Peters—after the appropriate permissions were sorted out—went to retrieve it. And of course, they had to make use of their walk-in freezers by creating fluffy ices for Enceladus and small samples of salty ices for Europa experiments a few years ago. At the moment, engineers working on the proposed Europa Lander mission are occupying the freezers, cutting large ice chunks for testing in the -20 degree celsius space.

What has been the most challenging material they've ever had to create?

"The comet simulants from back in the day," recalls Carey. Those simulants were part of Green's original project to create comet-like material and pierce it with a bi-blade to collect a return sample. "The [foam and cement] materials just never came out the way we expected. It's like if you made banana bread, stuck it in the oven, and then opened it and out popped Jell-O."



That particular assignment was tough because it required making sure the recipe was perfected to the point where the results could be recreated exactly every single time.

“There were just so many variables,” says Carey, who tracked everything from time and temperature of the day to humidity levels with Peters. “Which one of these was the culprit?”

After a couple of years—yes, years—of tracking, testing and tweaking, the two finally found the right set of “recipes” to match the range of properties expected on a comet so the bi-blade could complete its test program.

“It was really satisfying to hone in on a set of mix designs that would yield simulants matching what scientists were reporting,” Carey says.

Their most significant contribution? Peters points to their creation of Mojave Mars Simulants (MMS), a crushed basalt material that’s chemically similar to volcanic rock on Mars. It has been used in research and engineering projects for mobility and sample handling at universities and other NASA centers. A paper he authored on MMS in 2008 has been cited over 80 times since.

Between the two of them, Carey and Peters spend about 25 percent of their working hours authoring papers on a variety of topics, including mechanical properties of rocks and other geological materials, ices and icy mixtures, and reporting on the characterization of the materials developed in the lab.



It's A Dirty Job But Some Lucky Few Get to Do It

Ask Carey and Peters about the most rewarding aspect of their job and they have a quick answer: collaborating with talented interns throughout the year.

"This space adheres really well to students who want to come in and get their hands dirty," says Carey. "It's a lot of fun for us to guide them."

Sometimes, the lab's former interns come back to work on a variety of projects. Former interns Sophia Mitchell and Lara Panossian are working on their own project in the lab creating simulants that replicate the strength and drilling properties of the Organic Check Material mounted on Curiosity.

While Carey and Peters envision a future where their services are even more on-demand and streamlined, the lab's quirky charm won't be going anywhere anytime soon: Along with the pirate's flag outside—"a signal to passersby that things be done differently on this ship," says Peters—there's also a large, rubber black widow hanging inside one of the rooms. It was a gag gift from Peters to an intern who was terrified of the eight-legged critters that sometimes find their way into the lab. They aren't the only ones who like to visit, either: deer and snakes are known to wander inside or nearby from time to time, too.

Still, the lab is a working home to Carey and Peters and a testament to their passion for the job.

"We get to come up with creative solutions to problems, and that's probably my favorite thing," says Carey. "It's not just a task with a plan laid out and you follow the steps. You get to use your experience and your knowledge, but you really rely on your creativity. You have to wear all of your hats."



Brad Pitt shows off his Mars "boarding pass" with JPL Fellow Jennifer Trosper, the Mars 2020 project systems engineer, in von Karman Visitors' Center (she was his tour guide).

JPL Goes to Hollywood and Vice Versa ... With 'Ad Astra'

By Jane Platt

While many JPLers are subject matter experts about the stars, from time to time, we connect with stars of a different type for a dose of Hollywood-style excitement.

That's the case with the new Brad Pitt sci-fi movie, "Ad Astra." JPL was at the Cinerama Dome on Sunset Blvd. on Wednesday, Sept. 18, for the movie's premiere. Mars 2020 engineer Farah Alibay was on the red carpet, available for media interviews along with the movie's stars, NASA astronaut Tracy Caldwell Dyson and NASA Chief Financial Officer Jeff DeWit.



Pitt in the Bldg. 317 In-Situ Lab.

This wasn't the first interaction between JPL and "Ad Astra." Some may have noticed extra activity and closed venues on Friday, Sept. 6, when Brad Pitt was touring JPL. During the visit, two production crews—from National Geographic and Good Morning America—were also here, in advance of the movie's opening in theaters on Friday, Sept. 20. You may recognize the von Karman Visitors' Center as the setting for this Good Morning America interview.

Pitt spent a few hours at JPL visiting some of our special sites, including Building 230 Mission Control, the floor of the Bldg. 317 Mars In-Situ Lab, and the von Karman Visitor Center. Engineering Fellow Jennifer Trosper was Pitt's JPL tour guide.

In keeping with the philosophy that ya can't leave JPL without a souvenir, Pitt made an unscheduled stop at the JPL Store. He also received a Mars 2020 boarding pass to send his name to the Red Planet as part of the current Send Your Name to Mars campaign.

In the film, Pitt fights his way across the surfaces of the Moon and Mars on his way to Neptune. His mission is to uncover the truth about his father, who went missing on a doomed expedition to the farthest giant planet 30 years earlier and whose experiment threatens the solar system. The film also stars Tommy Lee Jones, Liv Tyler and Donald Sutherland.



JPL Mars 2020 engineer Farah Alibay on the red carpet at the "Ad Astra" premiere, and Brad Pitt, the actor, in front of Pitt the astronaut at the premiere (Poster is a Fox Movies promotional photo).

Pitt also visited NASA Headquarters on Monday, Sept. 16, where he had an opportunity to discuss what it's like to live and work in space with a NASA crew member living aboard the International Space Station. You can watch that video clip [here](#).

This is not the first-ever visit to JPL of a big-name star representing a high-profile movie. Before the release of "The Martian," actress Jessica Chastain visited the Lab to prepare for her role as Mars mission commander Melissa Lewis, as did other cast members, producers and crew members. Click [here](#) to read more about the role JPL played in that film.



Winds of Change Arrive in the Earth Science Offices

By Celeste Hoang

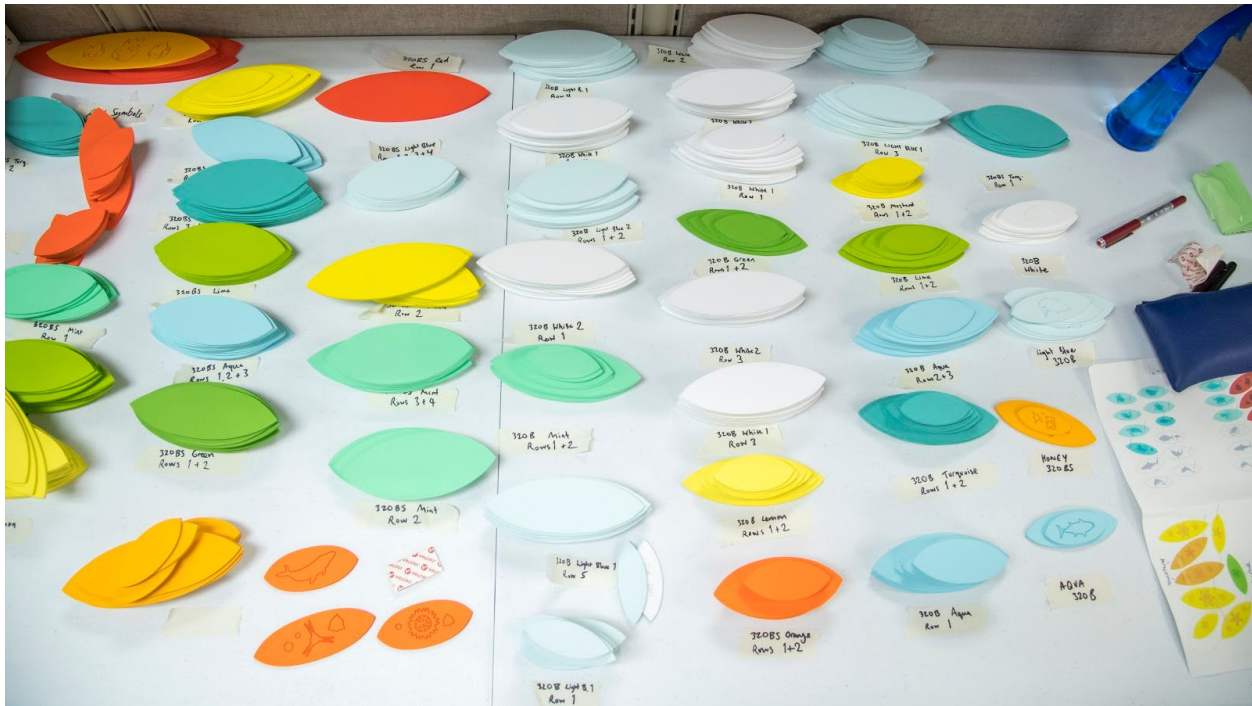
It all started with a bland wall.

Randy Friedl—manager of the Earth Science Research and Mission Formulation Office—and staff assistant Cathy Thomer were feeling uninspired by their space on the third floor of Building 301.

“It was pretty drab in here,” Thomer recalls. “We had an outdated poster of the solar system, and nothing in our offices that brought it back to Earth Science.”

Friedl knew just who to call: David Levine of The Studio at JPL, who had recently finished producing a mural of the Colorado River along the third floor hallway leading into the Earth Sciences Research and Mission Formulation/Instruments and Technology offices.

For Levine, traveling down the hallway—and along the river artwork—felt like a natural crossing of state lines on a map, where the door to the Earth Sciences office would be the border of the Golden State.



“When we finished [the Colorado River mural], we thought, ‘This office is California. What is a relevant Earth Science story about California that can we represent here?’” says Levine.

Friedl pointed Levine in a few directions, including to Timothy Liu, a senior research scientist for the Ocean Circulation and Air Sea Interaction group at JPL. Years prior, Liu had written a paper on how the Santa Ana winds were actually helping marine life by shaking up surfaces and depositing more nutrition into the water for sea creatures.

“When we think of the Santa Ana winds, we think about the negatives: fires, allergies, mudslides,” says Levine. “But there’s a whole other story to it and we wanted to tell that story.”

And those bland walls just outside of Friedl’s office? They were just right to represent the California coast.

Drawing from Liu’s work and other scientific sources, Levine presented concepts to Friedl, who involved several people from his group in discussions to ensure the end result would be a collaborative effort enjoyed by all.

“For me, art seeks to help us see what scientific understanding truly is: an ode to the beauty of nature,” Friedl says. “My hope is that it will remind us to be good storytellers in our proposal concepts.”

Once the idea was greenlit, Levine knew the perfect artist to pull off a mural such as this one: Owen Gildersleeve, a London-based paper artist known for handcrafted design and illustration.

“His work is done by hand, which a lot of people don’t do,” says Levine on the selection of Gildersleeve for the project. “He uses a scalpel, which is a crazy skill. He also has a really beautiful sense of color, and he loves space and is fascinated by science.”

Adds Thomer: “I think he really understood the science and art connection. He delved into what it meant, rather than just making something pretty.”

For Gildersleeve, being approached by JPL for the project was as thrilling as it was intimidating.

“It was a real mixture of fascination at the interesting subject matter, as well as a slight sense of trepidation about the magnitude of the task ahead and wanting to do everything justice,” he says. “But the best projects are the ones that scare you out of your comfort zone, so I knew it would all be worth it.”



What came to life was the idea of representing movement of the Santa Ana winds across California through paper leaves that would cross the desert, mountains, foothills, coast, and eventually, the ocean. The size and color of the leaves were also symbolic, representing wind velocity and temperature drifting off into the deep blue Pacific.

“We refined the idea and made sure it had this balance of being true to science but also being imaginative and fun,” says Levine.

Throughout the process, the team met with Gildersleeve via video conference to finesse details, with Gildersleeve’s London-based production team helping him paint and cut nearly 1,000 paper tiles for the mural—what he considered to be the most challenging part of the project, he shared.

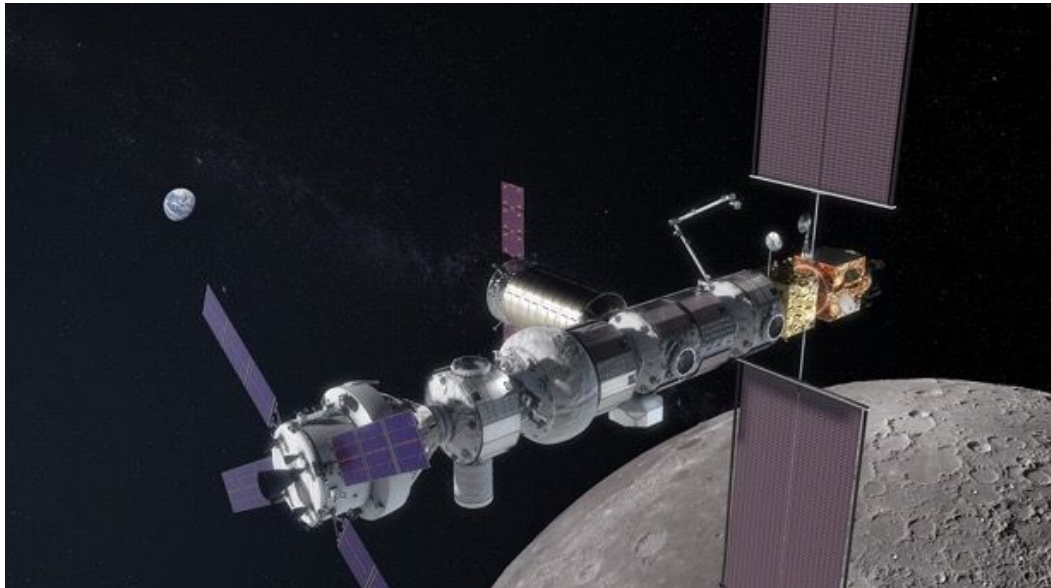
In mid-August, Gildersleeve flew to Los Angeles to install the mural alongside his assistant Chloe Lamfers and Levine over two days. They offset the paper leaves from the wall to create dimension and shadows, and those with keen eyes will notice there are carvings in some of the leaves, from snowflakes in the colder regions to turtles and whales in the ocean.

“It causes quite a reaction,” says Thomer, whose desk is adjacent to the mural. “No one has walked in and not noticed it. It has really transformed our offices.”

For Levine, the hope is that visitors will take away the many layers of storytelling present in the piece.

“There’s the first experience when you see it because of the angle of the entrance, and then you notice the colors,” he says. “It’s done in a beautiful, artistic way that brightens up the space. It’s about making people have a conversation, potentially look at the Santa Anas in a new way, or just come in and smile.”

Events



AI: Powering Human Exploration of the Moon and Mars

Wednesday, Oct. 23

10 to 11 a.m.

180-101

Artificial Intelligence: Powering Human Exploration of the Moon and Mars
Presented by Jeremy Frank from NASA Ames

Abstract:

NASA is committed to landing American astronauts, including the first woman and the next man, on the Moon by 2024. Through the agency's Artemis lunar exploration program, we will use innovative new technologies and systems to explore more of the Moon than ever before. In support of this vision, NASA plans to construct Gateway, a habitable spacecraft, in the vicinity of the Moon.

Small crews cannot take on all Gateway functions performed by ground today, so vehicles must be more autonomous to reduce the crew workload for such missions. In addition, both near-term and future missions will feature significant periods when crew is not present; Gateway shall provide for autonomous operations for up to 21 days, independent of ground communications, when crew are not present.

Artificial Intelligence (AI) is a growing field of computational science techniques designed to mimic functions performed by people.

Over the past decade, the NASA Autonomous Systems and Operations (ASO) project has developed and demonstrated numerous autonomy enabling technologies employing AI techniques. Our work has employed AI in three distinct ways to enable autonomous mission operations capabilities.

Crew Autonomy gives astronauts tools to assist in the performance of each of these mission operations functions.

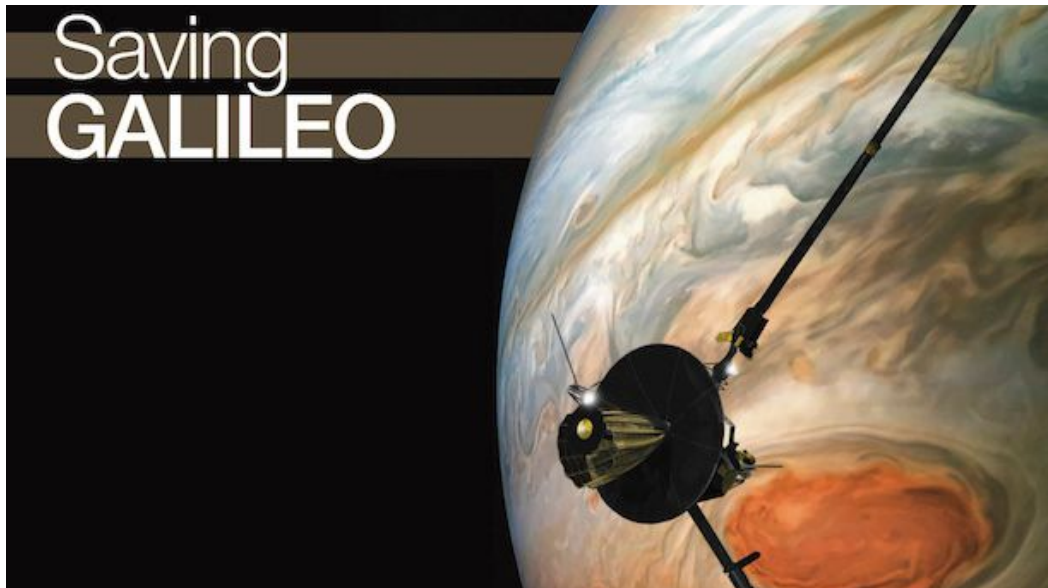
Vehicle System Management uses AI techniques to turn the astronaut's spacecraft into a robot, allowing it to operate when astronauts are not present, or to reduce astronaut workload.

AI technology also enables Autonomous Robots as crew assistants or proxies when the crew are not present.

We first describe human spaceflight mission operations capabilities. We then describe the ASO project, and the development and demonstration performed by ASO since 2011. We will describe the AI techniques behind each of these demonstrations, which include a variety of symbolic automated reasoning and machine learning based approaches. Finally, we conclude with an assessment of future development needs for AI to enable NASA's future Exploration missions.

Bio:

Jeremy Frank is the group lead of the Planning and Scheduling Group, in the Intelligent Systems Division, at NASA Ames Research Center. He received his Ph. D. from the Department of Computer Science, at the University of California at Davis, in June 1997. He also has a B.A. in Mathematics from Pomona College. Frank's work involves the development of automated planning and scheduling systems for use in space mission operations, the integration of technologies for planning, plan execution, and fault detection for space applications, and the development of technology to enable astronauts to autonomously operate spacecraft. He has published over 60 conference papers, nine journal papers, and three book chapters, and received over 40 NASA awards, including the Exceptional Achievement Medal, the Silver Snoopy, and the NASA Engineering and Safety Center Award.



Saving Galileo: The First Spacecraft to Orbit Jupiter

Saturday, Oct. 26

7 to 8:30 p.m. (Doors open at 6:30 p.m.)

Caltech's Beckman Auditorium

If any spacecraft could be said to have had nine lives, it was Galileo. The latest in JPL's documentary film series on the Lab's key role in the Space Age, "Saving Galileo" is the story of how NASA's Galileo mission – designed, built and operated by JPL – was kept alive despite a multitude of technical challenges, including a years-long launch delay and the devastating failure of its main antenna to open properly in space. It is also the story of a tight-knit team of scientists and engineers, forged by adversity into a what many came to call a family. In the end, despite its many challenges and limitations, Galileo proved a resounding success, leading to profound scientific insights that continue to draw NASA and JPL back to Jupiter for new adventures.

The one-hour documentary – written, produced and directed by JPL Fellow Blaine Baggett – will be preceded by a short, informal panel discussion about the mission and its legacy at Jupiter. Free Admission. Open seating. Early arrival advised.

JPL Family News

Retirees

The following JPL employees recently announced their retirements:

Shelley R. Norman, 32 years, Section 3317; **Gay Y. Hill**, 17 years, Section 1872; **Michael A. Garcia**, 33 years, Section 389L; **Gregg Vane**, 40 years, Section 4000.