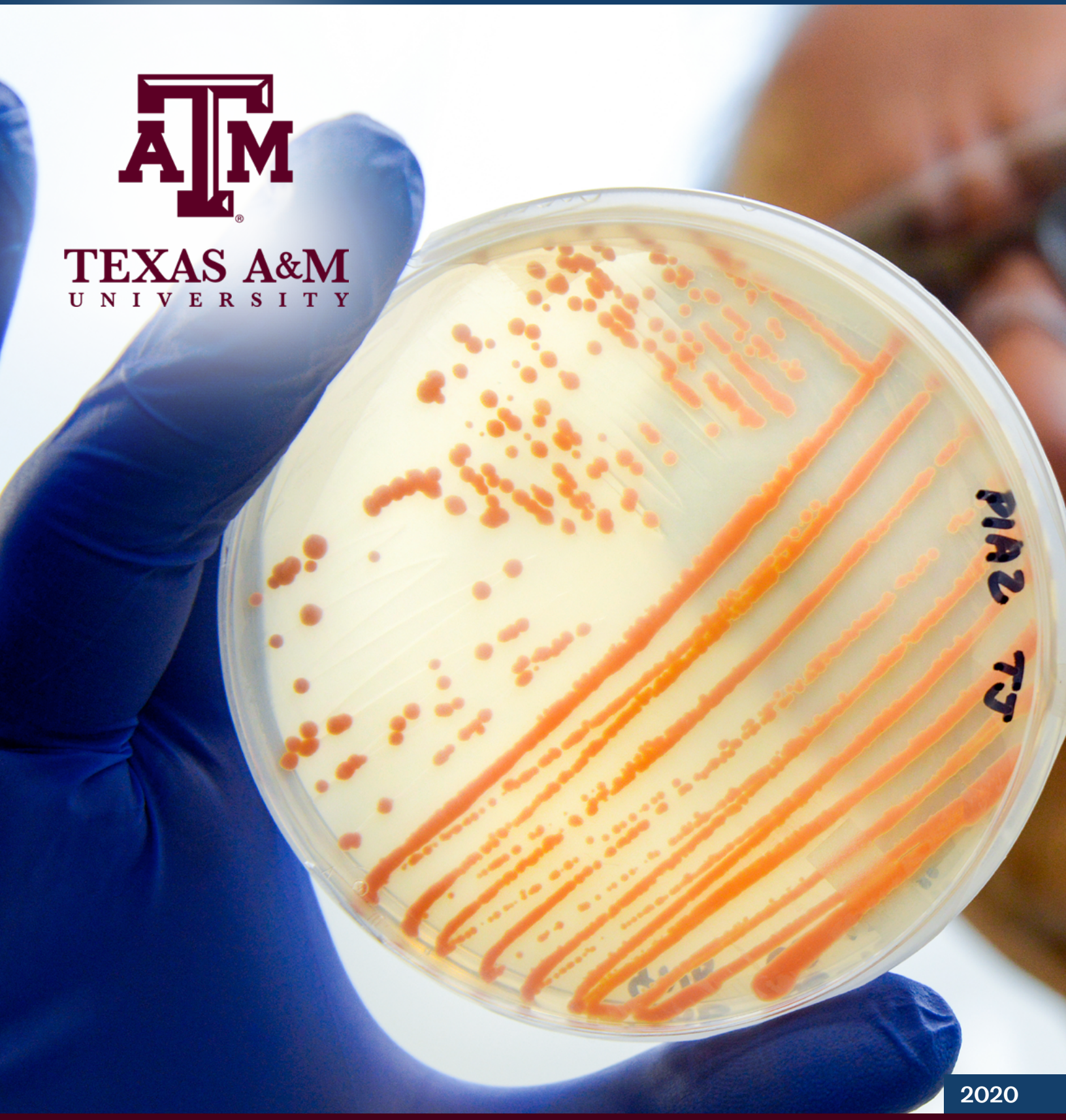


TEXAS A&M UNIVERSITY

2020

ARTIE MCFERRIN DEPARTMENT OF

CHEMICAL ENGINEERING

LETTER FROM THE DEPARTMENT HEAD

Friends,

2020 is set to be an excellent year for the Artie McFerrin Department of Chemical Engineering. During the fall semester, our total enrollment reached 1,048 students. Of this, 848 are undergraduate students. In the last year, we have awarded 273 degrees, our second highest total to date.

Our growth and success are reflected in the department's rankings. According to *U.S. News and World Report*, our undergraduate program is the 10th best among public institutions, and our graduate program is the 17th best among public institutions.

Our outstanding faculty has played an instrumental role in these successes. The department has become a major hotspot for chemical engineering research, with our faculty producing more than 320 refereed journal publications and generating total research expenditures in excess of $15 million last year.

The value provided by the faculty goes well beyond research. We empower our students with access to the best experts in their respective fields. The quality and size of the faculty is only increasing. In the last year, the department added three new tenure-track faculty members, as well as two new professors of practice and an associate professor of practice. These professors of practice bring years of real-world experience to their classrooms. They add tremendous value to our students' engineering education.

While this is set to be an excellent year, we are quite confident that the best days are ahead.

Sincerely,

Arul Jayaraman
Department Head
Professor
Presidential Impact Fellow
Holder of the Ray B. Nesbitt Endowed Chair

TEXAS A&M UNIVERSITY

Artie McFerrin Department of Chemical Engineering

BY THE **NUMBERS**

RANKINGS (2021)

#10 Undergraduate Program
Ranked No. 10 (Public)
(*U.S. News & World Report*)

#17 Graduate Program
Ranked No. 17 (Public)
(*U.S. News & World Report*)

ENROLLMENT*

(FALL 2020)

1,048 Total

849 Bachelor's

61 Master's

138 Ph.D.

**preliminary*

FACULTY

42 Total Faculty

5 Endowed Professorships

6 Chair Holders

4 Endowed Faculty Fellows

DEGREES AWARDED (FALL 2019 - SPRING 2020)

218 Bachelor's

27 Ph.D.

GRADUATE DEGREES

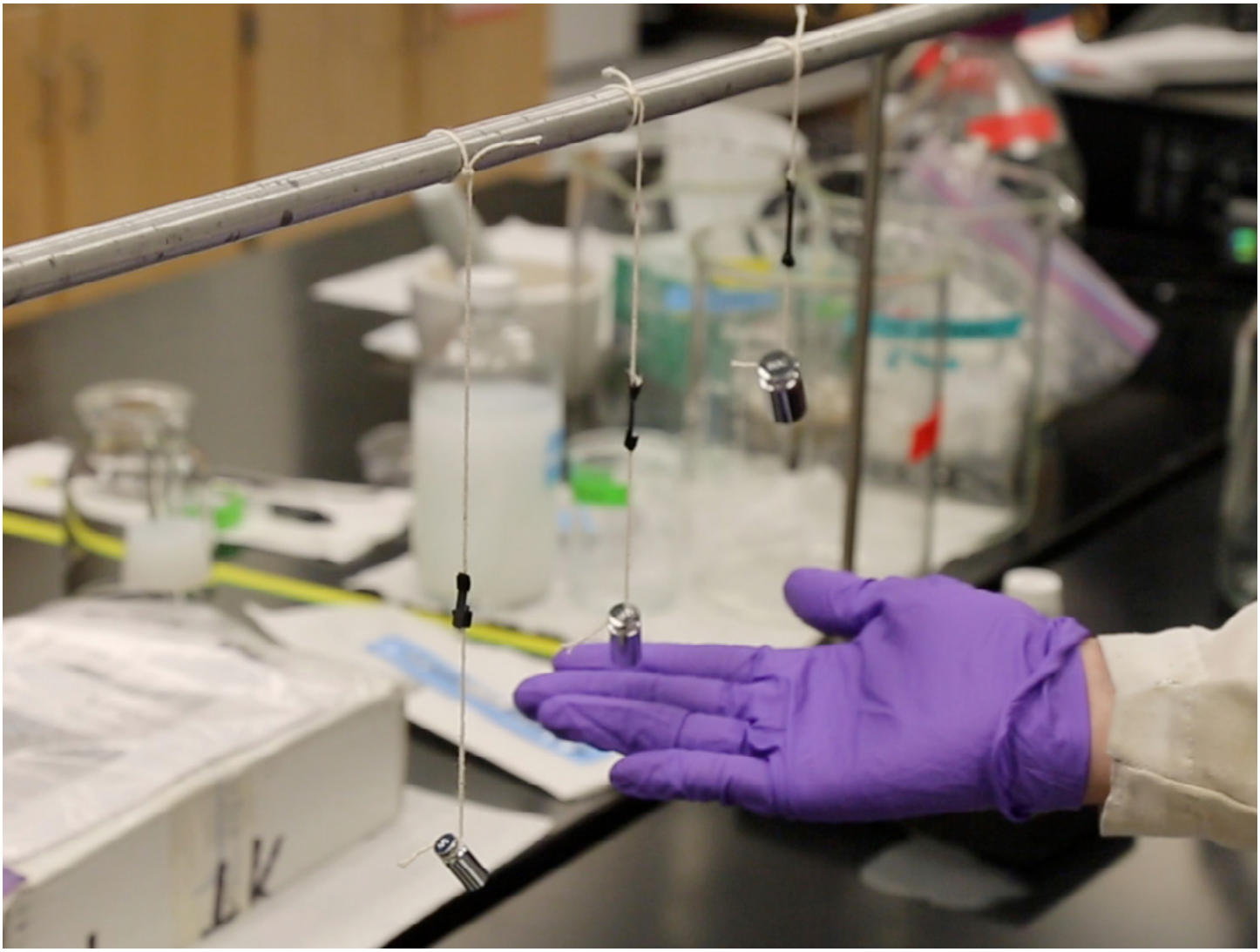
15 M.S. Chemical Engineering

3 MBIOT (Biotechnology)

6 M.S. Safety Engineering

27 Ph.D. Chemical Engineering

NEW ELECTRODES **INCREASE EFFICIENCY**



One of the most significant challenges facing the widespread adoption of electric vehicles and aircraft is mass, as even the most current electric vehicle batteries and supercapacitors are incredibly heavy.

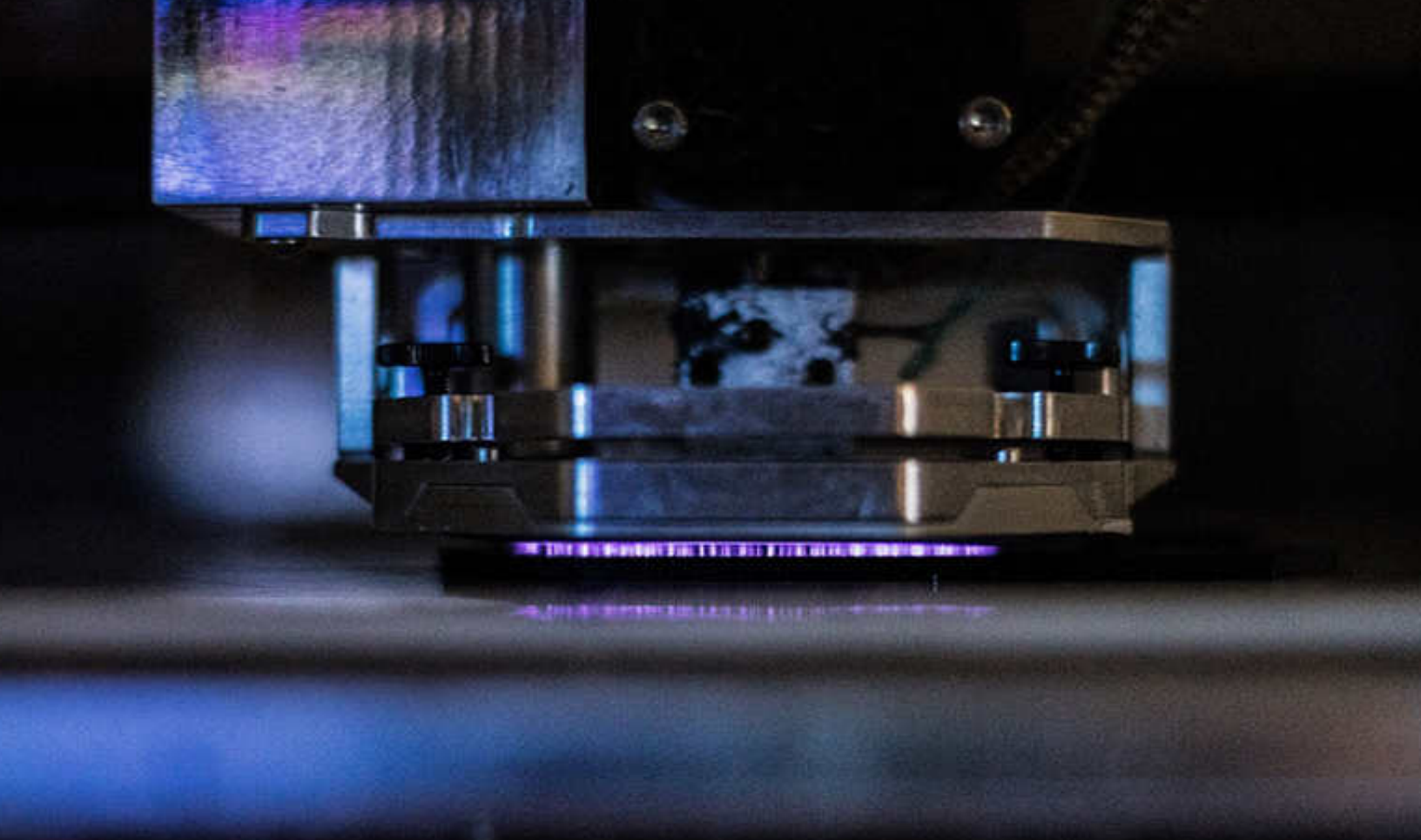
Most of the research aimed at lowering the mass of electric vehicles focuses on increasing the energy density, thus reducing the weight of the battery or supercapacitor itself. However, a team led by Dr. Jodie Lutkenhaus believes that lighter electric vehicles and aircraft can be achieved by storing energy within the structural body panels. In an article published in *Matter*, the research team described the process of creating new supercapacitor electrodes that have drastically improved mechanical properties. The team created strong and stiff electrodes based on dopamine functionalized graphene and Kevlar nanofibers. Dopamine, a neurotransmitter, is a highly adhesive molecule that, when paired with calcium ions, leads to a significant improvement in mechanical performance.

Researchers also reported supercapacitor electrodes with the highest multifunctional efficiency to date for graphene-based electrodes, opening the door to lighter electric vehicles and aircraft.

FEATURED RESEARCHER

Dr. Jodie Lutkenhaus

Professor; Presidential Impact Fellow,
Axalta Coating Systems Chair,
Holder of William and Ruth Neely Faculty Fellowship



TECHNOLOGY INVENTED TO FULLY **REMEDY 3D PRINTING'S 'WEAK SPOT'**

Plastic 3D-printed parts are mechanically weak — a flaw caused by the imperfect bonding between the individual printed layers that make up the 3D part.

Researchers at Texas A&M University, in collaboration with scientists in the company Essentium, Inc., have now developed the technology needed to overcome 3D printing's "weak spot." By integrating plasma science and carbon nanotube technology into standard 3D printing, the team welded adjacent printed layers more effectively, increasing the overall reliability of the final part.

"Finding a way to remedy the inadequate bonding between printed layers has been an ongoing quest in the 3D-printing field," Dr. Micah Green said. "We have now developed a sophisticated technology that can bolster welding between these layers all while printing the 3D part."

To promote inter-layer bonding, the team turned to carbon nanotubes. Since these carbon particles heat in response to electrical currents, the researchers coated the surface of each printed layer with these nanomaterials. Similar to the heating effect of microwaves on food, these carbon nanotube coatings can be heated using electric currents, allowing the printed layers to bond together.

The team collaborated with Dr. David Staack to generate a beam of charged air particles, or plasma, that could carry an electrical charge to the surface of the printed part, allowing electric currents to pass through the printed part, heating the nanotubes and welding the layers together.

With the plasma technology and the carbon nanotube-coated thermoplastic material in place, Texas A&M and Essentium researchers added both these components to conventional 3D printers. When the researchers tested the strength of 3D-printed parts using their new technology, they found that the strength was comparable to injection-molded parts.

FEATURED RESEARCHERS

Dr. Micah Green
Professor
Nancy and Dan Zivney '73 Faculty Fellow
Director of the Graduate Program

Dr. David Staack
Associate Professor (Mechanical Engineering)
Sallie and Don Davis '61 Career Development Professor
Director, Engineering Laboratory Instruction

RESPONSE TO ‘TWO-FACED’ BACTERIA

The gut microbiome, which is a collection of numerous beneficial bacteria species, is essential to our overall well-being, good health and warding off pathogen infections.

Major cues for the pathogens are the molecules (or metabolites) produced in the gut.

The metabolite indole is an example of a microbiome-produced small molecule that is abundant in the gut and is a powerful repellent for bacteria.

According to Dr. Pushkar Lele, this led to a simple question: “Why does indole, which is produced by many of our beneficial bacterial species, not repel the good gut bacteria along with the bad ones?”

To answer this question, researchers studied the response of the beneficial gut bacteria, E. coli, to indole. In an article in the *Proceedings of the National Academy of Sciences*, they describe the discovery of a previously unknown response to indole, where the molecule seems to both repel and attract bacteria. This Janus response — named after the Roman god Janus who had two faces, one looking into the future and one looking into the past — has to do with the way indole is interpreted by the bacterial chemo-receptors.

“We found that there are two receptors in E. coli that sense indole,” Lele said. “One senses indole as a repellent, and one senses indole as an attractant. Sustained exposure to high concentrations of indole desensitizes the receptor that interprets it as a repellent. This leads to indole being sensed only as an attractant.”

According to Dr. Arul Jayaraman, the Janus response displays a large amount of sophistication, and the discovery could lead to a better understanding of the complexities of the gut microbiome.

“Beneficial bacteria aggregate on the surfaces within the gut based on some common feature,” Jayaraman said. “We propose that one such feature is the ability to produce or sense indole. Bacteria that produce indole could group together and be attracted to niches where indole concentrations are high.”

FEATURED RESEARCHERS

Dr. Arul Jayaraman
Professor; Department Head
Presidential Impact Fellow
Holder of the Ray B. Nesbitt Endowed Chair

Dr. Pushkar Lele
Assistant Professor

AGGIE RING
RECEIVED 53 YEARS LATER

Dilipkumar Patel '66, center, celebrates receiving his Aggie ring with family and friends at the Clayton W. Williams, Jr. Alumni Center.

For former student Dilipkumar Patel '66, what started out as a surprise visit to his alma mater this last summer became a day he would never forget.

Patel's daughter Bela Jain had made plans to spend the day with her parents in College Station but wouldn't give any details about where they were going. Accompanied by his wife Devayani, the family arrived at Texas A&M University and stopped by The Association of Former Students, where Jain suggested they park to take pictures of the Haynes Aggie ring replica.

There, The Association's vice president, Kathryn Greenwade '88, greeted the family and, under the guise of giving them a tour, invited them inside the Clayton W. Williams, Jr. Alumni Center. She led them to a group of staff, friends and Dr. Arul Jayaraman, head of the chemical engineering department, who were waiting to give Patel his Aggie ring.

The ring was a surprise gift for his 80th birthday. Jain said the idea came to her about five years ago, when he turned 75 and her first son graduated college. Jain and her brother both graduated from The University of Texas at Austin, and their father bought them college rings, each time mentioning he wished he would have bought his own.

Patel came to Texas A&M from India in 1963 and when he graduated, he didn't have the money to buy his Aggie ring. He worked in Houston for many companies throughout his career and retired 10 years ago.

"All my success in life goes to becoming an Aggie, the 12th Man," Patel said. "This was one of the happiest moments in my life, which I will always treasure. I am proud to wear this ring and honor the university."

TEXAS A&M UNIVERSITY

Artie McFerrin Department of Chemical Engineering

engineering.tamu.edu/chemical

ARTIE MCFERRIN DEPARTMENT OF CHEMICAL ENGINEERING

AREAS OF FOCUS

- Biomedicine | Biomolecules
- Biofuels | Biotechnology
- Catalysis
- Complex Fluids | Microfluidics | Soft Matter
- Computational Chemical Engineering
- Energy
- Environmental | Sustainability
- Materials | Microelectronics
- Multiscale Systems Engineering
- Nanotechnology
- Process Control and Process Safety
- Process Systems Engineering
- Reaction Engineering