

A N N U A L



RESEARCH REPORT

FISCAL YEAR 2021



WASHINGTON STATE
UNIVERSITY



Greetings!

As a public research university, research, scholarship, and creative activity is woven throughout the fabric of our mission to serve the public. Facing a global health crisis, the COVID-19 pandemic highlighted why new discovery and knowledge is critical to solving the most pressing issues today.

The pandemic upended every facet of public research universities' mission – from education to research and community engagement. But even as universities across the country took steps to limit on-campus research activities based on public health considerations and stay at home orders, our researchers at Washington State University transitioned research from on-campus to telework. Additionally, nearly 150 WSU scientists pivoted their work from existing projects to research contributing to our understanding of COVID-19 and its impact on society.

We are excited to share the exceptional breakthroughs and discoveries that made a significant impact during Fiscal Year 2021. Examples of research highlighted in this report include:

- ▶ First time evidence that human-made hexagonal diamonds are stiffer than the common cubic diamonds found in nature and often used in jewelry.
- ▶ A breakthrough in viable surrogate sires, or male animals that produce sperm carrying only the genetic traits of donor animals.
- ▶ The impact wildfire smoke has on Northwest vineyard's wine grapes.
- ▶ The role the pandemic played in increasing discrimination against Asians and Asian Americans.
- ▶ Evidence that social media used as a news source spread misinformation about the pandemic.
- ▶ Breastfeeding women who have COVID-19 transfer milk-borne antibodies to their babies without passing along the SARS-CoV-2 virus.

Additionally, we also celebrated the outstanding achievements of our entire research community, despite the challenges we faced. In FY2021, research and development (R&D) expenditures totaled \$357.6 million. WSU continued to set a record \$9,495,519 in royalty income, which includes continued licensing revenue from the successful launch of the Cosmic Crisp® apple.

We also celebrated milestones reached by our researchers, including the election of seven WSU faculty members to the Washington State Academy of Sciences (WSAS), as well as the election of three WSU faculty members to the WSAS Board. Other major achievements include the appointment of Xianming Shi as an American Society of Civil Engineers fellow, Tim Baszler receiving the 2020 American Association of Veterinary Laboratory Diagnosticians award, Juming Tang being elected to the National Academy of Engineering, and a Daytime Emmy nomination for Robert Franklin's research and on-air talent in "The Manhattan Project Electronic Field Trip."

To learn more about the life-changing research, scholarship, and creative activity unfolding at WSU, please read on – and stay up to date on all WSU research and services offered by the Office of Research by visiting research.wsu.edu.



Dr. Christopher J. Keane
Vice President for Research, WSU
Vice Chancellor for Research, WSU Pullman



Top Research Stories

Gene-edited livestock ‘surrogate sires’ successfully made fertile

For the first time, scientists have created pigs, goats and cattle that can serve as viable “surrogate sires,” male animals that produce sperm carrying only the genetic traits of donor animals.

The advance could speed the spread of desirable characteristics in livestock and improve food production for a growing global population. It also would enable breeders in remote regions better access to genetic material of elite animals from other parts of the world and allow more precision breeding in animals such as goats where use of reproductive technologies like artificial insemination is difficult.

A research team led by Jon Oatley, a reproductive biologist in the College of Veterinary Medicine, used the gene-editing tool, CRISPR-Cas9, to knock out a gene specific to male fertility in the animal embryos that would be raised to become surrogate sires. The male animals were then born sterile

but began producing sperm after researchers transplanted stem cells from donor animals into their testes. The sperm the surrogate sires produced held only the genetic material of the selected donor animals. The gene-editing process employed in this study seeks to bring about changes within an animal species that could occur naturally, such as infertility.

The study is the result of six years of collaborative work among researchers at WSU, Utah State University, University of Maryland, and the Roslin Institute at the University of Edinburgh in the U.K.

The researchers used CRISPR-Cas9 to produce mice, pigs, goats, and cattle that lacked a gene called NANOS2 which is specific to male fertility. The male animals grew up sterile but otherwise healthy, so when they received transplanted sperm-producing stem cells from other animals, they started producing sperm derived from the donor’s cells.

Before moving to large animals, Oatley’s team at WSU tested the surrogate sires concept with mice. In this model, they demonstrated that the infertile knockout males could father healthy offspring who carried the genes of the stem cell donor male. In pigs, goats and cattle, the team was able to demonstrate that sperm containing the stem cell donor’s genetics are produced in the infertile knockout surrogate male’s testicles. In cattle, they have refined the approach to establish natural fertility and are working towards the same goal in pigs and goats.

This technology has great potential to help food supply in places in the developing world, where herders still rely on selective breeding to improve their stock.

The surrogate sires technology could also open up a new option for genetic conservation of endangered species, whose dwindling numbers leave animal communities isolated from each other, limiting their genetic diversity.





WSU to study Washington grapes exposed to wildfires

WSU grape and wine chemistry researcher Tom Collins is working to minimize the effects of smoke exposure on wine grapes.

When vineyard grapes are exposed to smoke, they can absorb smoke particles into their fruit. Once inside, smoke compounds can bind with the sugars in the grapes. The grapes can develop unsavory aromas and flavors, causing wine to taste ashy or burned.

The wildfire smoke enveloping Washington state in September 2020 gave Collins, an assistant professor at the Ste. Michelle Wine Estates WSU Wine Science Center, a chance to measure the smoke particulates in the vineyard air. He sampled fruit from several vineyards, both WSU research and commercial vineyards, and made wine from the fruit to further his research to develop mitigation techniques.

Sampling a grape is not enough to test if wildfire smoke will alter the taste of the final wine. Through the winemaking and aging

process, sugar bonds chemically break, releasing the smoke related compounds that create the ashy flavors.

Collins' research on smoke exposure started in 2016, initially funded by the Washington Wine and Grape Research program administered by the Washington Wine Commission.

The project looks at different aspects each year. In a year with actual fires, Collins can compare the real-world exposure with that of the vineyard trials to see if both show similar wildfire smoke exposure. He also wants to understand if the timing of smoke exposure affects grape growth. Collins has also evaluated the use of barrier spray materials that could be applied in the vineyard prior to a smoke event to reduce the uptake of smoke related compounds into the fruit.

As the second largest premium wine producer in the United States, Washington is home to over 1,000 wineries, producing over

17 million cases a year. The impact of smoke on the Washington wine industry could run into the millions of dollars. Severe wildfires have increased in frequency in the west since 2011.

In April 2020, the U.S. Congress allocated \$2 million to the USDA to fund research on smoke exposure, of which \$900,000 was split evenly between WSU, the University of California-Davis, and Oregon State University.

The remaining amount retained by the USDA will be used to establish a smoke research program within the USDA's Agricultural Research Service.

Industry leaders from winegrowing associations in all three coastal states formed the West Coast Smoke Exposure Task Force, of which Tom Collins is a member. The task force works on everything from research and contracts to risk management and crop insurance.

Top Research Stories

Researchers advance 3D printing to aid tissue replacement

Arda Gozen looks to a future someday in which doctors can hit a button to print out a scaffold on their 3D printers and create custom-made replacement skin, cartilage, or other tissue for their patients.

Gozen, George and Joan Berry Associate Professor in the School of Mechanical and Materials Engineering, and a team of researchers have developed a unique scaffolding material for engineered tissues that can be fine-tuned for growing natural tissue. The team also includes researchers from WSU's Gene and Linda Voiland School of Chemical Engineering and Bioengineering, as well as from the University of Texas-San Antonio (UTSA), Morehouse College, and University of Rochester. The lead author is Mahmoud Amr, who received his doctorate at UTSA.

To create biological structures, biological materials known as "bioinks" are dispensed out of a nozzle and deposited layer-by-layer,

creating complex "scaffolds" for real biological material, and providing a place for cells to grow.

Real biological cells like to grow on a scaffold that approaches their own properties. For instance, a skin cell wants to grow on a scaffold that feels like skin while a muscle cell will only develop on a scaffold that feels like muscle.

The way that researchers have traditionally varied their scaffolds was to simply remove trusses to make them softer or stiffer – a method that is too simple to address all the needed complexity in tissue engineering.

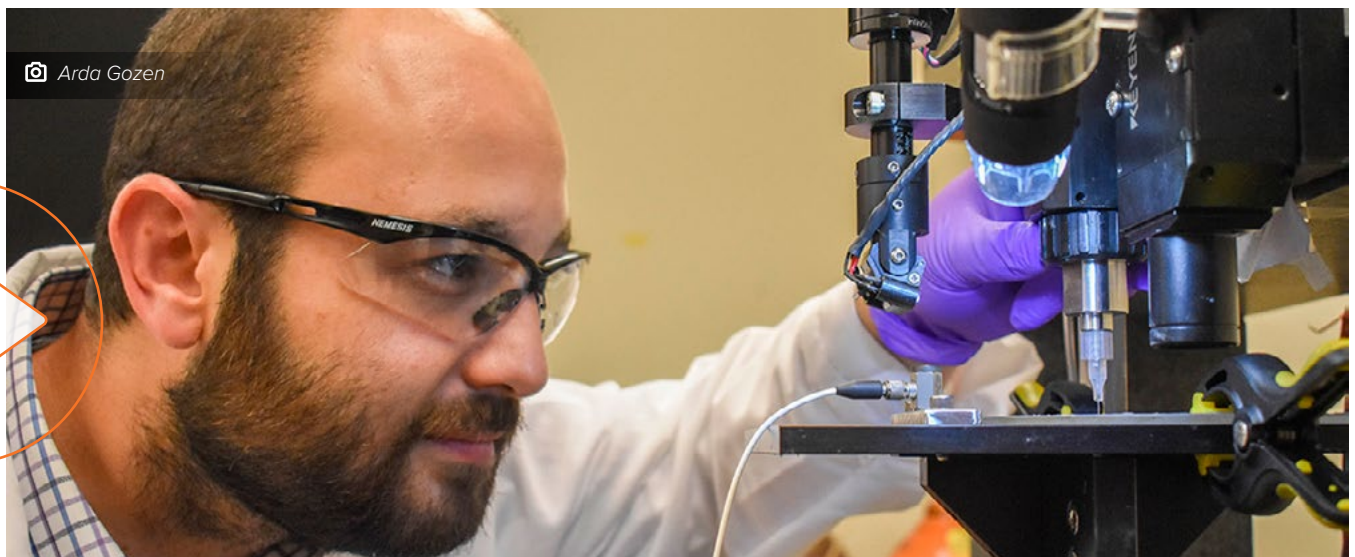
The team of researchers developed a new bioink material that allows for customizing properties to closer approach what cells might need. The ingredients for their scaffold include gelatin, gum Arabic, and sodium alginate, which are all common thickening agents used in many processed foods.

Similar to a thick rope of braided strands, the researchers used three separate chemical processes to tie their three ingredients together into one scaffold material for printing.

Playing with the separate chemical processes then provides a way to finely tune the mechanical properties of the material, allowing them to make a softer or stiffer final scaffold.

By adjusting the chemical bonds between the rope strands, they didn't change the material significantly, and it was amenable for growing cartilage cells.

The work is still in its early stages. Researchers would like to figure out how to tune the process and final material more precisely. They might look at varying the composition of their three materials or printing at different temperatures.



Rural areas have fewer mental health services for young people, but great need

Rural areas in the United States have relatively fewer mental health services for young people, yet that's where the help is needed the most, says a study led by Janessa Graves, associate professor in the College of Nursing.

Previous studies have shown that the suicide rate among young people in rural areas is higher than for urban youth and is also growing faster.

Yet by one measure, using ZIP Codes, only 3.9% of rural areas have a mental health facility that serves young people the study found, compared with 12.1% of urban (metropolitan) and 15% of small-town ZIP Code Tabulation Areas.

Measured by county type, 63.7% of all counties had a mental health facility serving young people, while only 29.8% of "highly rural" counties did.

While Graves' study focused on suicide prevention services offered in mental health facilities, even less intensive services like school mental health providers are lacking in rural areas.

The study concluded that given the higher rates of suicide deaths among rural youth, it is imperative that the distribution of and access to mental health services correspond to community needs.



Top Research Stories

Lab-made hexagonal diamonds stiffer than natural diamonds

For the first time, researchers have hard evidence that human-made hexagonal diamonds are stiffer than the common cubic diamonds found in nature and often used in jewelry.

Named for their six-sided crystal structure, hexagonal diamonds have been found at some meteorite impact sites, and others have been made briefly in labs, but these were either too small or had too short of an existence to be measured.

Now scientists at WSU's Institute for Shock Physics created hexagonal diamonds large enough to measure their stiffness using sound waves.

Researchers have long wanted to create a material stronger than natural diamonds, which could have a variety of uses in industry. While many theorized that hexagonal diamonds would be stronger, the study provides the first experimental evidence that they are.

Lead author Travis Volz, scientist at Lawrence Livermore National Laboratory, focused his dissertation work at WSU on the creation of hexagonal diamonds from graphite. For this study, Volz and Yogendra Gupta, director of the WSU Institute of Shock Physics and corresponding author on the study, used gunpowder and compressed gas to propel small graphite disks about the size of a dime at a speed of around 15,000 miles per hour onto a transparent material. The impact produced shockwaves in the disks that very rapidly transformed them into hexagonal diamonds.

Immediately after impact the researchers produced a small sound wave and used lasers to measure its movement through the diamond. Sound moves faster through stiffer material. Previously, sound moved fastest through cubic diamond; in the lab-created hexagonal diamonds it moved faster.


Each process happened in several billionths of a second, or nanoseconds, but the

researchers were able to make the stiffness measurements before the high velocity impact destroyed the diamond.

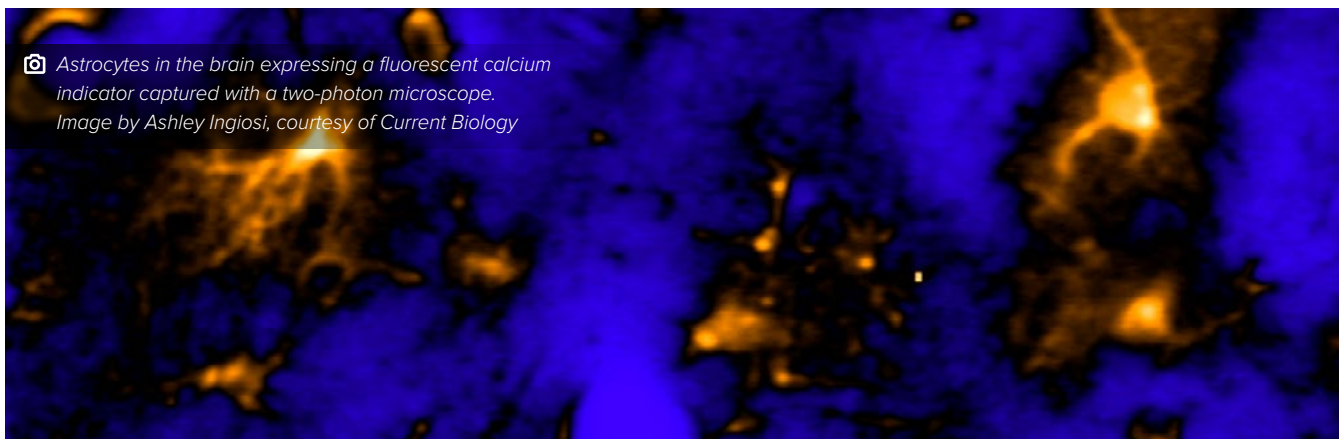
Stiffness is the ability of a material to resist deformation under a force or pressure. Generally stiffer materials are also harder. While the researchers couldn't scratch the diamonds to test hardness directly, by measuring the diamonds' stiffness, they can make inferences about their hardness.

If the science advances to the point where lab-made hexagonal diamonds can be created and recovered, they could have a range of uses.

While the industrial advantages are clear, it is still possible hexagonal diamonds could one day be used on engagement rings. Currently, lab-made cubic diamonds have less value compared to their natural peers, but hexagonal diamonds would likely be more novel.

 Photo of cubic diamonds by Edgar Soto





📷 *Astrocytes in the brain expressing a fluorescent calcium indicator captured with a two-photon microscope.*

Image by Ashley Ingiosi, courtesy of Current Biology

Star-shaped brain cells may hold the key to why, how we sleep

A study led by researchers at WSU's Elson S. Floyd College of Medicine suggests that star-shaped brain cells known as astrocytes could be as important to the regulation of sleep as neurons, the brain's nerve cells.

The study builds new momentum toward ultimately solving the mystery of why we sleep and how sleep works in the brain. The discovery may also set the stage for potential future treatment strategies for sleep disorders and neurological diseases and other conditions associated with troubled sleep, such as PTSD, depression, Alzheimer's disease, and autism spectrum disorder.

What scientists know about sleep has been based largely on neurons, which communicate through electrical signals that can be readily captured through electroencephalography (EEG). Astrocytes—a type of glial (or "glue") cell that interacts with neurons—do not use electrical signals and instead use a process known as calcium signaling to control their activity. It was long thought that astrocytes merely supported neurons, but a few studies have hinted that they may play a direct role in sleep.

To delve deeper into astrocytes' role in sleep, postdoctoral research associate Ashley Ingiosi and others in the Marcos Frank laboratory used a rodent model to record astrocytes' calcium activity throughout sleep and wake, as well as after sleep deprivation. They used a fluorescent calcium indicator that was imaged via tiny head-mounted microscopes that looked directly into the brains of mice as they moved around and behaved as they normally would. This indicator allowed the team to see calcium-driven fluorescent activity twinkling on and off in astrocytes during sleep and waking behaviors.

Looking at astrocytes in the frontal cortex, an area of the brain associated with measurable EEG changes in sleep need, researchers found that astrocytes' activity changes dynamically across the sleep-wake cycle, as is true for neurons. They also observed the most calcium activity at the beginning of the rest phase—when sleep need is greatest—and the least calcium activity at the end of the rest phase, when the need for sleep has dissipated.

Next, they kept mice awake for the first six hours of their normal rest phase and watched calcium activity change in parallel with EEG slow wave activity in sleep, a key indicator of sleep need. This suggests that sleep deprivation caused an increase in astrocyte calcium activity that decreased after mice were allowed to sleep.

They then studied mice that lacked a protein known as STIM1 selectively in astrocytes, which reduced the amount of available calcium. After being sleep deprived, these mice did not sleep as long or get as sleepy as normal mice once allowed to sleep.

Finally, they found that astrocyte calcium activity becomes less synchronized in non-REM sleep and after sleep deprivation, while the opposite is true for the electrical activity of neurons. This suggested to the researchers that astrocytes are not just passively following the lead of neurons and, together with the study's other findings, implicates a more direct role for astrocytes in regulating sleep and sleep need.

Top Research Stories

Soft X-ray method promises nanocarrier breakthroughs for smart medicine

Brian Collins, a WSU physicist, and a team of researchers developed a new technique to look at nanocarrier internal structure, chemistry, and environmental behavior without any labeling at all. In a study published by Nature Communications, this new technique will allow researchers to look inside these nanocarriers, analyze their chemical identities and concentrations – and do this all in their fully natural state, including their water environment.

This technique should allow researchers to assess behavior of certain nanostructures in different environments. For instance, for smart drug delivery, there can be different temperatures, pH levels and stimuli in the body, and researchers want to know if the nanostructures stay together until the conditions are right to apply the drug. If they can determine this early in the development process, they can be more certain the nanocarriers will work before investing in time-intensive medical studies.

Organic nanocarriers used for drug delivery are often created out of carbon-based molecules, which either love or loathe water. These so-called hydrophilic and hydrophobic molecules are bonded together and will self-assemble in water with the water-hating part hiding inside a shell of the water-loving segments. Hydrophobic drugs will also insert themselves into the structure, which is designed to open and release the drug only in the diseased environment.

The technique Collins and his colleagues have developed uses soft resonant X-rays to analyze the nanocarriers. Soft X-rays are a special type of light that lies between ultraviolet light and hard X-rays, which are the kind used by doctors to view a broken bone. These special X-rays are absorbed by almost everything, including the air, so the new technique requires a high vacuum environment.

Collins' team adapted a soft X-ray method to investigate printable, carbon-based, plastic electronics, so that it would work on

these water-based organic nanocarriers – penetrating a thin slice of water to do it.

Each chemical bond absorbs a different wavelength or color of soft X-rays. For this study, researchers selected X-ray colors to illuminate different parts of a smart medicine nanocarrier through their unique bonds. This allowed them to evaluate how much and what type of material was in its inner core, the size and water-content in the surrounding nano-shell, and how the nanocarrier responded to a changing environment.

They also used the soft X-ray technique to investigate a polysoap nanocarrier that was developed to capture crude oil spilled in the ocean. Polysoaps can create a nanocarrier from a single molecule, maximizing their surface area for capturing hydrocarbons such as those found in an oil spill. Using the new technique, the researchers discovered that the open sponge-like structure of a polysoap can persist from high to low concentrations, which will make it more effective in real-world applications.


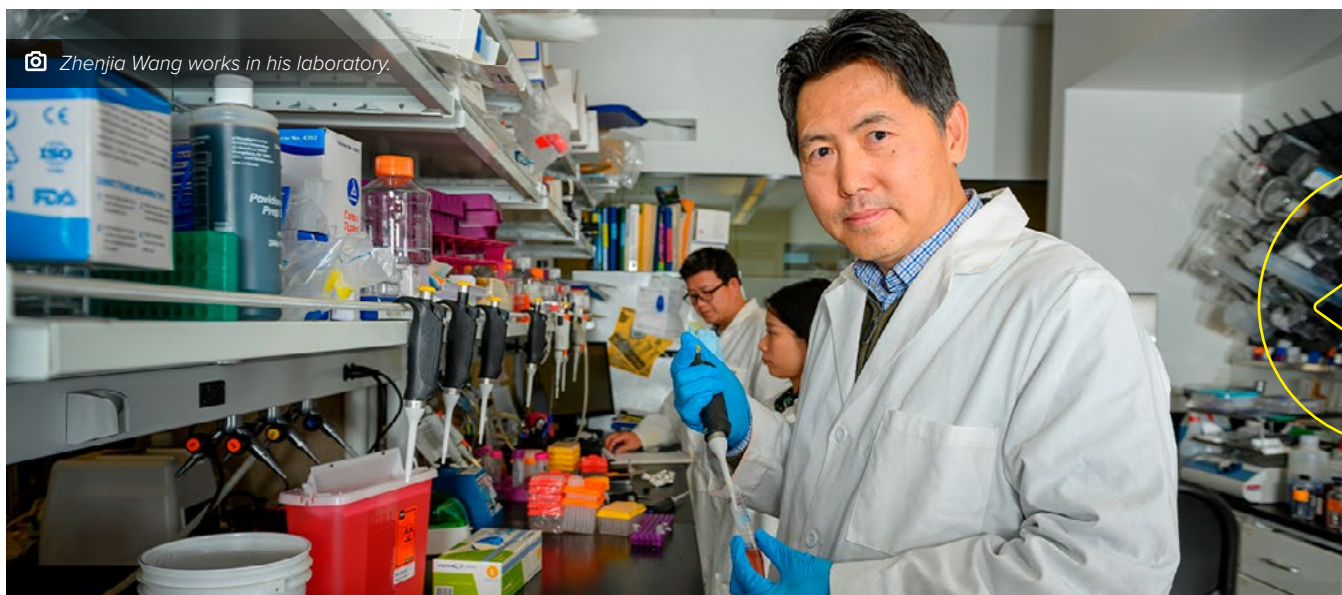
 Special X-ray colors resonate with bonds in molecules – methyl is pictured in this illustration. This enables scientists to selectively probe chemically distinct parts of micelle nanocarriers--in development for smart medicine and hydrocarbon sequestration related to oil spill clean-up.

Image created by Ryan Allen of Second Bay Studios for Washington State University.





📷 Zhenjia Wang works in his laboratory.

Medicine-carriers made from human cells can cure lung infections

Scientists at the College of Pharmacy and Pharmaceutical Sciences used human white blood cell membranes to carry two drugs, an antibiotic, and an anti-inflammatory, directly to infected lungs in mice.

The nano-sized drug delivery method developed by Zhenjia Wang, associate professor in Department of Pharmaceutical Sciences, successfully treated both the bacterial growth and inflammation in the mice's lungs. The study shows a potential new strategy for treating infectious diseases, including COVID-19.

According to Wang, if a doctor simply gives two drugs to a patient, they don't go directly to the lungs. They circulate in the whole body, so potentially there's a lot of toxicity. Instead, researchers can load the two types of drugs into single vesicles that specifically target the infected lung.

Wang and his research team have developed a method to essentially peel the membrane from neutrophils, the most common type of white blood cells that lead the body's immune system response.

Once emptied, these membranes can be used as nanovesicles, tiny empty sacks only 100 to 200 nanometers in diameter, which scientists can then fill with medicine.

These nanovesicles retain some of the properties of the original white blood cells, so when they are injected into a patient, they travel directly to the inflamed area just as the cells would normally, but these nanovesicles carry the medicines that the scientists implanted to attack the infection.

In this study, first author Jin Gao, a WSU research associate, loaded the nanovesicles

with an antibiotic and resolvinD1, an anti-inflammatory derived from Omega 3 fatty acids, to treat lungs infected by *P. aeruginosa*, a common potentially fatal pathogen patients can catch in hospital settings. The researchers used two drugs because lung infections often create two problems, the infection itself and inflammation created by a strong immune system response.

Toxicity studies and clinical trials would have to be conducted before this method could be used in human patients, but this study provides evidence that the innovation works for lung inflammation. If the method is ultimately proven safe and effective for humans, Wang said the nanovesicles could be loaded with any type of drug to treat a range of infectious diseases.

Top Research Stories

Social-belonging exercise improves ESL student success



Canning

A study conducted at 19 universities found that a brief social-belonging exercise boosts the performance and persistence of students who speak English as a second language in science, technology, engineering, and math (STEM) disciplines. The study utilized data collected from more than 12,000 STEM students by the College Transition Collaborative, which was founded in 2014 by researchers, staff, and advisors across the U.S. and Canada to create higher education learning environments that foster equitable student outcomes by bridging research and practice.

Elizabeth Canning, assistant professor of psychology in WSU's College of Arts and Sciences and co-author of the study, and the team of researchers found that the brief intervention which involves reading stories from older students and doing a writing exercise had lasting effects throughout the first year of college for ESL students.

The research demonstrates that the exercise increases ESL students' perception that a sense of belonging on campus will grow over time. It also increases the number of STEM credits ESL students successfully completed as well as their GPAs in those subjects.

ESL students are greatly underrepresented in U.S. colleges, particularly within STEM fields. Results of the study suggest that one way to increase the representation and academic success of ESL students in STEM is to target their sense of belonging.

Students who speak English as a second language often report concerns about not fitting in with native English-speaking students and a lack of social connections. In addition, many are required to pass language proficiency tests or enroll in special ESL courses during their first few years of college.

Students in the study, who were randomly assigned to receive the social belonging treatment, read short stories attributed to juniors and seniors describing the challenges

they faced in their transition to college. The students in the stories initially questioned the degree to which they belonged in college; and yet, with time they ultimately developed a greater sense of belonging. Study participants followed the readings with a writing exercise about their own experiences.

Results of the study revealed that both ESL and non-ESL students who received the social-belonging exercise anticipated greater growth in their sense of belonging than students who received the control treatment. However, these psychological gains in belonging only bolstered the academic persistence and performance of ESL students. Specifically, STEM-interested ESL students who received the social-belonging exercise (vs. the control group, which did not) completed more of the STEM courses that they began in their first term in college—and this effect persisted through the first year. ESL students who completed the social belonging exercise also earned higher STEM GPAs in term one than did their ESL peers who did not.





Restaurant customers frown on automatic gratuities

Automatic gratuities leave restaurant patrons with a bad taste, even when the meal and the service were excellent, research from WSU indicates.

The study hypothesized that if the service quality was high, people wouldn't care if an automatic service charge was added to their bill.

But whether customers had a good experience or bad one, they reacted negatively when their bill came with a mandatory tip, preventing them from leaving the gratuity themselves. Surprisingly, customers with the best dining experiences expressed the most dissatisfaction with automatic gratuities.

The study's lead author was Ismail Karabas, assistant professor of marketing at Murray State University, who worked on the research as part of his doctoral dissertation at WSU. Jeff Joireman, professor of marketing at the Carson College of Business, was the study's co-author.

People think non-voluntary tipping systems are unpopular because customers can't punish servers for poor quality service. But when the service was high, researchers found that customers were equally frustrated by non-voluntary tipping – this time because they couldn't reward their servers.

When customers lose control of the tip, their ability to show their gratitude has been blocked, researchers said. They have fewer positive feelings about the restaurant experience, and they're less likely to eat there again.

North American customers spend about \$66 billion annually on tips at restaurants and other establishments. Although voluntary tipping is still standard practice, a growing number of restaurants are moving toward automatic gratuities.

For restaurant owners, the switch to automatic gratuities is often about fairness. They want to

divide tips between servers and the kitchen staff, rewarding the entire team and equalizing pay.

The person who cooks your meal may be working harder than the server, but servers end up making quite a bit more money when you add in the tips. That's led to turnover of kitchen staff, which is a concern in the restaurant industry.

While the intent of using automatic gratuities to equalize pay and retain employees is laudable, restaurant owners and managers should be aware of the drawbacks, the researchers said.

Restaurants that switch to automatic tipping could explore other ways to help customers reward their servers through other means, such as providing feedback on comment cards, voting for a server of the month, or even adding a separate line on the bill for an extra tip.

Top Research Stories

Cannabis ads and store location influence youth cannabis use

Advertising and location of cannabis retailers influence adolescents' intentions to use cannabis, according to a study in the *Journal of Health Communication* by WSU researchers.

Stacey J.T. Hust, associate dean in the Murrow College of Communication, and Jessica Fitts Willoughby, associate professor of communication, conducted a survey of 13- to 17-year-olds in Washington state to find out how cannabis advertising and the location of cannabis retailers influence adolescents' intentions to use the drug. The researchers also asked participants about their outcome beliefs—whether or not they thought using cannabis would be good for them personally and/or socially.

Their research shows regular exposure to cannabis advertising on storefronts, billboards, retailer websites and other locations increased the likelihood of adolescents using cannabis. Location of retail stores also played a role, but the results of the survey were mixed.

While the actual density of cannabis retailers in an area was not associated with adolescents' intentions to use, study participants who said they lived within five miles of a cannabis shop were more likely to report intentions to use the drug than those who perceived they lived farther away.

The results of the research team's study could have significant policy implications as states that have legalized recreational cannabis use grapple with ways to adhere to the drug's legal status while trying to prevent adolescent marijuana use.


For instance, most states with legalized cannabis restrict placing retailers and advertisements next to schools. But other locations, where adolescents live and spend a lot of their time, remain largely unregulated.

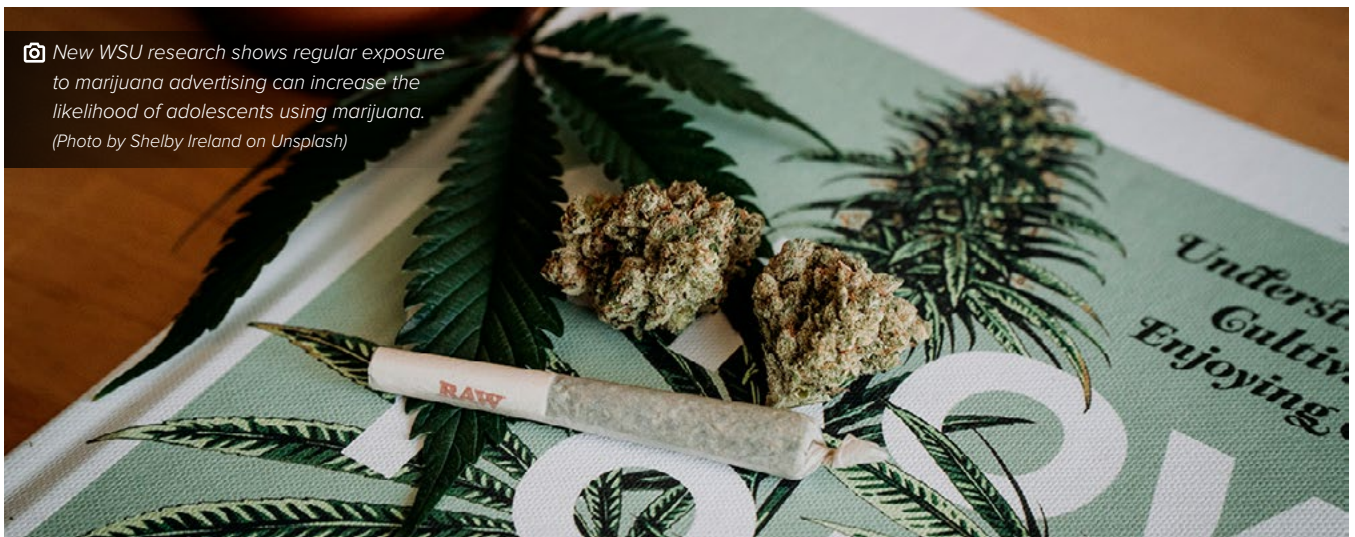
The findings are particularly relevant given that most states that have legalized recreational cannabis have not restricted their proximity

to neighborhoods or living areas, which may be particularly challenging in large metropolitan areas. States may want to consider using census data to identify the proportion of teens living in particular areas as they identify the location for cannabis retailers.

The researchers are currently in the process of conducting a new experiment where they are testing different types of advertisements to see how young people interpret and respond to them.

One of the things this research and other studies suggest is that these advertisements are prolific in certain areas. Researchers want to see what type of appeals are used in the advertisements and how those appeals affect viewers. The long-term goal is really to develop a better understanding of how adolescents can make healthy and informed decisions in an environment in which cannabis is legal.

 *New WSU research shows regular exposure to marijuana advertising can increase the likelihood of adolescents using marijuana. (Photo by Shelby Ireland on Unsplash)*





Study finds increasing discrimination against Asians and Asian Americans

Reports of racial discrimination against Asians and Asian Americans have increased since the start of the COVID-19 pandemic hit the United States, coinciding with an increase in reported negative health symptoms.

To investigate the scope of those anecdotes, Sara Waters, an associate professor in the Department of Human Development on the WSU Vancouver campus, and her graduate student, Suyeon Lee, a Ph.D. candidate in WSU's Prevention Science program, created a survey. Over 400 people responded, with almost 30% saying they experienced more discrimination since the pandemic started and 40% experienced more health impacts.

Researchers expected that people who experience racism would report more health issues. But they were surprised by just how much that increased. The racial

discrimination was above and beyond the increased stress levels experienced by the general public.

The survey contained questions about four mental and physical health outcomes: anxiety, depressive and physical symptoms, and sleep difficulties. It also asked people to provide specific examples of racial discrimination they faced. Responses ranged from microaggressions, like people glaring or changing lines at a supermarket, to more direct actions.

One person described walking past a group of children who told her to go back to her country and called her 'Coronavirus.' Another was threatened with a knife. Terms like 'kung flu' and 'China virus' were very common in responses. Words used often by people in leadership positions in the country were filtering down.

Experiencing those kinds of abuse impacts a person's mental and physical health in a variety of ways. For physical health, Lee and Waters asked people to rate any increases in symptoms like headaches, backaches, nausea, and other general physical maladies. For sleep difficulties, they used the established Pittsburgh Sleep Quality Index.

One way the survey results showed people can buffer the impact that discrimination has on health is by having social support.

Respondents who reported increased discrimination, but also reported having more social support, had fewer health symptoms, especially depression.

The researchers conducted their survey over a few weeks in May and June 2020, starting roughly two months after the pandemic hit the U.S.

Leading COVID-19 Research

Bracing for the next pandemic

Michael Letko, assistant professor in the Paul G. Allen School for Global Health, is working on expanding the ever-growing database of the world's coronaviruses with new data he is acquiring through some unique experimental approaches developed in his lab.

In January 2020, he published his findings on all known variants of the sarbecoviruses – the sub-branch of the coronavirus family tree that includes SARS-CoV-1 and SARS-CoV-2. This work has allowed researchers developing vaccines to rank the order in which these viruses circulating in nature poses the greatest risk of transmitting to humans. In fall 2022, Letko's team published a follow-up study showing how sarbecoviruses recently discovered near Sochi, Russia was capable of infecting human cells like SARS-CoV-2 but were resistant to the current COVID-19 vaccines. These latest findings have helped inform efforts to develop "universal" sarbecovirus vaccines, which aim to prevent future sarbecovirus outbreaks.

This work is made possible by some clever molecular biology that allowed Letko to up-scale the number of viruses he was able to

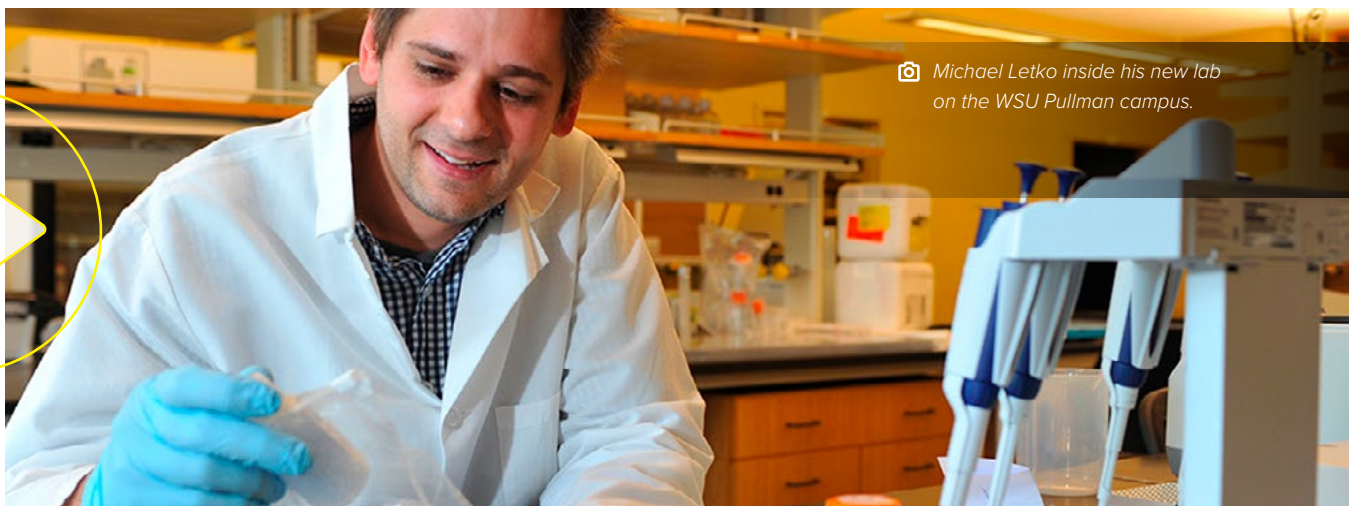
test in the lab. Before now, researchers had to either isolate a virus from a field sample or they had to rely on expensive genetic synthesis to try to recover the virus synthetically.


Letko's lab has developed methods to test only the smallest fragment of the virus that is responsible for allowing the virus to infect cells: the receptor binding domain. This piece of the virus is less than 2% of the viral genome but is essential to how the virus infects cells. Letko then uses various molecular biology techniques to test these small fragments by producing safe, virus-like particles that make cells glow when infected. If the virus fragment is compatible, then the cells glow bright green, indicating his virus-like particles have made their way into the cells. Importantly, his work does not require a whole virus, so Letko is able to safely test small pieces of viruses without risk of accidental infection.

There is a bigger goal though: Letko is working to develop a database that can help assess the potential for novel animal viruses to be transmitted to humans. After years of collecting laboratory data on how so many of these viruses can infect cells, newly discovered

viral sequences can automatically be ranked based off similarity to known viruses and how those viruses performed in his lab's various experiments. This type of database will be instrumental in the development of broadly protective vaccines and help inform researchers on the natural zoonotic origins of coronaviruses. Letko's lab also published a study in collaboration with WSU's Department of Computer Science showing a proof of this concept and identified genetic signatures in sarbecoviruses that can allow researchers to predict how certain viruses can infect human cells.

Eventually the database will be expanded to include other types of viruses. Letko's team is hard at work developing new laboratory tools to study the merbecoviruses, which are a distant relative of the sarbecoviruses that includes the Middle East Respiratory Coronavirus (MERS-CoV) – a highly pathogenic respiratory coronavirus that is endemic to the middle east. While predicting the next viral outbreak is still a major challenge, databases like the one Letko is working on will hopefully make outbreaks a thing of the past.



 *Michael Letko inside his new lab on the WSU Pullman campus.*



Breastfeeding mothers pass COVID-19 antibodies to babies

Breastfeeding women who have COVID-19 transfer milk-borne antibodies to their babies but do not pass SARS-CoV-2 to their infants via human milk, according to several new papers.

An initial study published in *MBio* analyzed 37 milk samples provided by 18 women diagnosed with COVID-19. None of the milk samples were found to contain the virus, but nearly two-thirds of the samples contained two antibodies specific to the virus. A follow-up longitudinal study published in *Frontiers in Immunology* on 316 milk samples provided by 64 women diagnosed with COVID-19 confirmed that SARS-CoV-2 was not detected in milk samples and found that milk-borne antibodies persisted in more than three quarters of women for at least two months.

Courtney Meehan, a WSU anthropology professor and co-author on the study, and WSU graduate student Beatrice Caffé were part of the multi-institutional research team led by University of Idaho (UI) nutrition researcher Michelle McGuire on the project. The team also includes scientists from the University of Rochester's Medical Center and School of Medicine and Dentistry, as well as Brigham and Women's Hospital and Harvard Medical School.

Combined results indicate that it is safe for moms to continue to breastfeed during a COVID-19 infection with proper precautions and that human milk may provide lasting passive immunity.

Earlier, McGuire, Meehan and their colleagues published a related review of scientific studies focused on coronaviruses in human milk in *Maternal & Child Nutrition* and found that scant evidence exists about their presence or absence.

The dearth of knowledge spurred this multi-university effort, which has since informed national and global guidance related to COVID-19 and breastfeeding.

This research was supported by the National Science Foundation, Bill and Melinda Gates Foundation, Medela and Milk Stork, the National Institutes of Health, WSU's Health Equity Research Center, UI's Agricultural Experiment Station.

Leading COVID-19 Research

Study measures food insecurity in Washington families

According to the first Washington State Food Security Survey, 30% of Washington households have experienced food insecurity since the implementation of the state's Stay Home, Stay Healthy order in March 2020. Of those households, 59% had children living in the home.

The research team wanted to understand how access to food and economic security for Washington residents has changed amid the COVID-19 pandemic.

The team was formed from professors and researchers associated with the WSU Food Systems Program, the University of Washington, and Tacoma Community College. Calling themselves the WAFOOD Survey Team, they deployed the first ever statewide survey about food security in Washington.

When Washington implemented the Stay Home, Stay Healthy order, it sent ripple effects through

the state's food system in the form of supply shortages, food production bottlenecks and distribution challenges.

The estimated average for food insecurity in Washington prior to the global pandemic was in the 10-15% range.

In April 2020, the WAFOOD Survey Team estimated 1.6 million food insecure Washington residents.

The Washington State Food Security Survey was deployed from June to July of 2020, with over 2,200 residents in 38 counties responding.

One of the major changes in food distribution amid the COVID-19 pandemic was that most food banks and pantries were drive-through only. Prior to the pandemic, people could shop and pick out their own food. But during the pandemic, people were getting less diversity in

their food products, and on average, less food.

Another issue is many food banks have consolidated to one main site, rather than multiple locations, meaning people must travel further for their food.

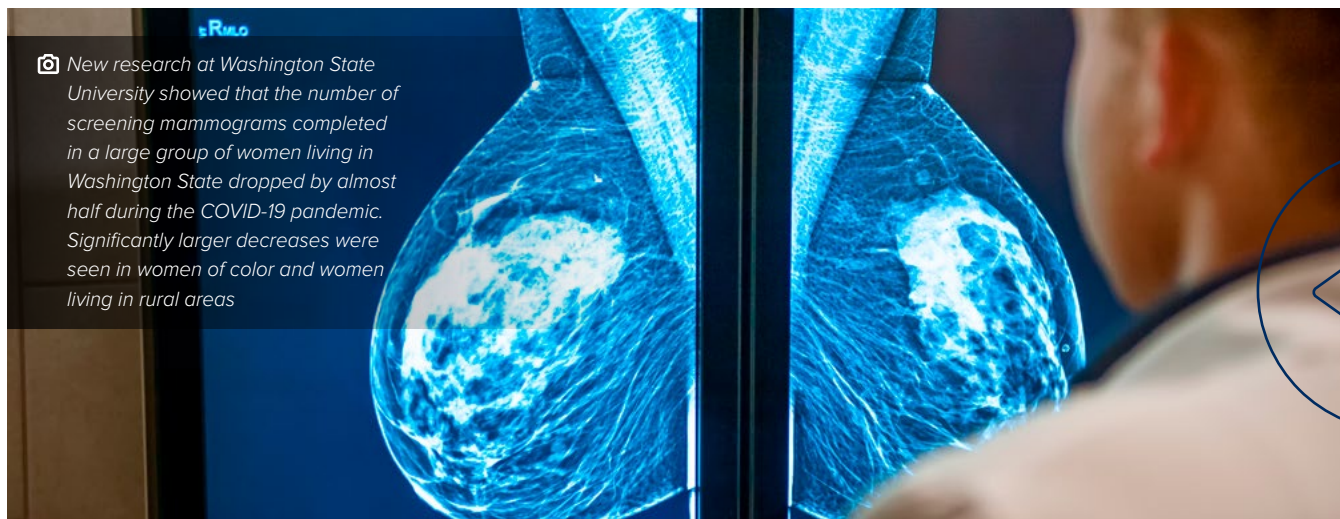
According to the survey, meals from food banks, pantries, summer school meals programs, and grocery vouchers increased, but recipients of the Supplemental Nutrition Assistance Program (SNAP) and the Women, Infants, and Children (WIC) program slightly decreased.


Researchers partnered with SNAP-Ed, so that Extension educators can modify their food and nutrition programs based on the data.

The WSDA can now utilize this data to help establish a baseline for pre-COVID food insecurity in Washington and forecast food insecurity into the future.



Faculty Achievements and Recognition



 *New research at Washington State University showed that the number of screening mammograms completed in a large group of women living in Washington State dropped by almost half during the COVID-19 pandemic. Significantly larger decreases were seen in women of color and women living in rural areas*

Women of color, rural women most impacted by missed breast cancer screenings during pandemic

Breast cancer screening took a sizeable hit during the COVID-19 pandemic, suggests new research that showed that the number of screening mammograms completed in a large group of women living in Washington state plummeted by nearly half. The study found the steepest drop-offs among women of color and those living in rural communities.

Detecting breast cancer at an early stage dramatically increases the chances that treatment will be successful. The study findings suggest that health care providers need to double down on efforts to maintain prevention services and reach out to these underserved populations, who faced considerable health disparities even before the pandemic.

Led by Ofer Amram, assistant professor in the Elson S. Floyd College of Medicine, the study was conducted by researchers at WSU Health Sciences Spokane in partnership with MultiCare, a not-for-profit health care system that encompasses 230 clinics and eight hospitals across Washington state.

The research team used medical record data from MultiCare patients who had screening mammograms completed between April and December of 2019 and during the same months in 2020, after the World Health Organization declared COVID-19 a global pandemic in March 2020.

The researchers saw the number of completed screening mammograms across Washington state fall from 55,678 in 2019 to 27,522 in 2020, a 49% decrease. When they analyzed the data by race, they saw a similar decrease in screening of 49% for white women but observed significantly larger decreases in non-white women. For example, breast cancer screening declined by 64% in Hispanic women and 61% in American Indian and Alaska Native women. The researchers also looked at geographical location and found that screening mammograms in rural women were reduced by almost 59%, whereas the number of mammograms completed in urban women fell by about 50%.

Additionally, the research team analyzed the data by insurance type and found that compared to women who were on commercial or government-run health insurance plans, screening reductions were greater in women using Medicaid or who self-paid for treatment, which are indicators of lower socioeconomic status.

While previous studies have looked at missed cancer screening during the pandemic, this study is the first to examine racial and socioeconomic differences, specifically. The research team's goal is to find ways to eliminate barriers to cancer screening, which would help reduce cancer-related health disparities.

In addition to Amram, authors on the paper included Pablo Monsivais, Solmaz Amiri and John Roll at the WSU Elson S. Floyd College of Medicine and Bethann Pflugeisen and Jeanne Robinson with the MultiCare Institute for Research & Innovation.

Leading COVID-19 Research

Arthritis researcher applies his expertise to COVID-19

When WSU College of Pharmacy and Pharmaceutical Sciences assistant professor Anil Singh was invited to give a talk about inflammation at the start of the pandemic, he could not have known it would lead to new COVID-19 research.

While reading about the disease mechanism of COVID-19 in preparation for his talk, Singh noticed that many treatments used for COVID-19 are medications used to treat rheumatoid arthritis. When he dug a little deeper, Singh learned that the inflammation of the lungs during COVID-19 is clinically similar to the inflammation of synovial joints in rheumatoid arthritis.

Singh assembled a team of researchers from Regeneron, Cornell University and Amity University to help him further investigate the connection and how it may lead to future COVID-19 therapeutics.

The team evaluated epigallocatechin-3-gallate (EGCG), a catechin found in green

tea. Green tea has been widely researched in various pathologies and EGCG has previously been shown to have anti-inflammatory and antioxidant properties. One of the key strengths of catechins is their power to bind multiple proteins that may suppress the immune system response.

When a virus enters the human body, cells release interferon to tell the body to react and inhibit the viral replication. However, when the COVID-19 virus enters the human body, it dampens the body's initial immune response.

Once the virus is inside the cells, viral papain-like protease protein (PLPro) programs cells to interfere with the interferon response and prevent the body from mounting an antiviral response.

The researchers used computer simulated experiments to evaluate various catechins and observed that EGCG showed a stronger binding affinity to PLPro, making

it more effective in inhibiting PLPro protein activity. Their discovery was published as a peer-reviewed paper in the special issue of *Catechins in Human Health 2020* of the journal *Molecules* of MDPI group, in February 2021. This proof of concept is a vital step in the development of clinical trials, several of which are now underway, paving the way to make EGCG a possible therapeutic option for COVID-19 prevention and treatment.

With the emergence and rapid spread of new and potent variants of the virus and ongoing challenges in the availability of vaccines worldwide, the development of additional therapeutics to combat the virus remains of the utmost importance to Singh.

While vaccines are the best way to prevent serious risk of COVID-19, this study provides the rationale for development of small molecule inhibitors which could work as adjunct therapy along with vaccination to treat COVID-19.

WSU's Lonnie Nelson evaluating COVID vaccines for impact on indigenous populations



Nelson

of potential COVID-19 vaccines by Native American and Indigenous populations.

Lonnie Nelson, an associate professor for the WSU College of Nursing and co-director of Partnerships for Native Health at WSU, was selected to serve on an expert panel of Native researchers to evaluate the perception

While conducting his study, he was invited to sit on a panel of a dozen scientific experts by the National Institute of Allergy and Infectious Diseases. Similar panels were convened for other populations disproportionately affected by COVID-19.

The panel reviewed a handful of vaccines. The group's most common feedback: the vaccine should be one dose rather than two. If it's two doses, it makes access a nightmare for people who are under-resourced. Additionally,

the study revealed that the delivery of a vaccine should be done in collaboration with members of Native communities.

Nelson's research shows that when trying to develop any kind of intervention, it's important to work with people in the community where it's going to be implemented, or it's very likely not going to be successful.

Social media use increases belief in COVID-19 misinformation

The more people rely on social media as their main news source the more likely they are to believe misinformation about the pandemic, according to a survey analysis by WSU researcher Yan Su, a doctoral student in the Murrow College of Communication.

The study, published in the journal *Telematics and Informatics*, also found that levels of worry about COVID-19 increased the strength of people's belief in misinformation. Two factors weakened beliefs in false information: having faith in scientists and a preference for "discussion heterogeneity," meaning people liked talking with others who held different views.

The findings point to possible practical solutions to disrupt the spread of misinformation.

Fact checkers are important for social media platforms to implement. When there is no fact checker, people just choose to believe what is consistent with their pre-existing beliefs.

It's also important for people to try to get out of their comfort zones and echo chambers by talking with people who have different points of view and political ideologies. When people are exposed to different ideas, they have a chance to do some self-reflection and self-correction, which is particularly beneficial for deliberation.

Su compared this data to the participants' other responses on the survey related to social media use, levels of worry and trust in scientists as well as how much the respondents valued discussions with people of differing viewpoints.

He found an amplification effect from social media users who were particularly worried about the coronavirus.

It seems that the more people use social media, the more likely they are to become worried about COVID-19, perhaps because there is a lot of unfounded and conspiracy theories on social media. Then this in turn can trigger a higher level of worry which leads to further belief in misinformation.

The survey data was collected during the beginning of the pandemic. Around the same time, the Pew Research Center found that nationally three in 10 Americans believed that the coronavirus was created in a lab, despite there being no evidence for this statement, and a third believed there was already a vaccine.



Leading COVID-19 Research

Pacific Northwest businesses show resilience during COVID-19

The 2020 Business in the Northwest report, published by WSU's Carson College of Business, found that although most businesses experienced significant hardships due to the novel coronavirus pandemic, Pacific Northwest business leaders were confident they had the necessary skills and resources to navigate the crisis.

The annual Business in the Northwest report specifically focuses on how business leaders have been navigating the unprecedented challenges brought forward by the pandemic. Businesses across the Pacific Northwest have stepped up to support both their employees and communities during this time and, despite facing setbacks, business leaders remain optimistic about the region's future.

Key findings from the 2020 report include:

- ▶ Businesses felt the negative impacts of the pandemic: The majority of business leaders (64%) reported feeling a negative impact on their business, resulting in a third of businesses having to close their doors. More than 1 in 10 (12%) businesses had to close permanently, while almost a quarter (24%) closed temporarily.
- ▶ Adapting in the face of challenge: Refining or re-strategizing product and service offerings helped 76% of business during this time.
- ▶ Business leaders supported stay-at-home policies: More than half of business leaders (66%) felt their state governments did either an "excellent" or a "good" job responding to the COVID-19 crisis. More than two-thirds (79%) say stay-at-home orders were the correct response to slowing the spread of the virus.
- ▶ In this together: The vast majority (87%) of business leaders felt a larger responsibility to help their communities during this time, and 95% felt an increased sense of responsibility to support their employees.
- ▶ Teleworking is here to stay: More than half (56%) of business leaders said they would continue allowing employees to work from home, and 74% would continue with virtual meetings.
- ▶ Optimism remains: Despite facing unprecedented challenges, 80% of business leaders were optimistic about the business climate in the region. Additionally, 92% felt their company was equipped with the tools needed to withstand changes over the next three years.

The report surveyed a total of 301 Pacific Northwest business leaders from June 16–25, 2020.



University Achievements



WSU Global Health Kenya team in Marsabit, Kenya.

WSU launches new Center for Research in Emerging Infectious Diseases in Nairobi, Kenya

WSU's Paul G. Allen School for Global Health is launching a new Center for Research in Emerging Infectious Diseases (CREID) that will be based in Nairobi, Kenya.

The new research center, part of WSU's Global Health – Kenya program, will have the capacity to address infectious disease outbreaks in eastern and central Africa (ECA) and have an immediate impact to save lives.

The center is made possible by \$7.6 million in funding over five years from the United States' National Institute of Allergy and Infectious Diseases (NIAID), part of the National Institutes of Health (NIH).

As the regional hub for communication and international partnerships, Kenya is an excellent location for the new Center.

East and central Africa are global hotspots for emerging infectious diseases, as demonstrated by the recurrent outbreaks of viral hemorrhagic fevers such as Ebola, Marburg, and Rift Valley fever. In addition to detecting these diseases,

the center will look for viruses festering at low levels among animals and the environment in the region, and work to rapidly detect diseases emerging elsewhere such as highly pathogenic influenza, Zika and Middle East respiratory syndrome (MERS).

In partnership with Emory University, Washington University at St. Louis, Charité-Universitätsmedizin in Berlin, Germany, and the Institute of Tropical Medicine-Antwerp, Belgium, the CREID will address significant knowledge gaps in current research regarding what drives disease emergence, while considering high human density, diversity of wildlife species, and forest vegetation as key factors in occurrence of EIDs.

Over 80% of the land in the region is remote with poor physical and public health infrastructure. Greater than 35% of human illnesses go undetected, making it particularly ideal for new pathogens to emerge and spread undetected for long periods. Partnering in the ECA region with the Kenya Medical Research Institute, Uganda Virus Research Institute in

Uganda, Sokoine University in Tanzania, and Institut National de Recherche Biomédicale (Democratic Republic of Congo), the CREID will maintain study sites in strategic locations designed to detect possible emerging viruses before they spread and cause widespread infections.

WSU Global Health – Kenya will build upon its long-established partnerships with agencies that coordinate human and animal outbreak responses in the region, such as the World Health Organization (WHO), Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE). These partnerships are critically important to addressing infectious diseases like COVID-19.

Multidisciplinary teams of investigators in the program will conduct pathogen/host surveillance, study pathogen transmission, pathogenesis, and immunologic responses in the host, and will develop reagents and diagnostic assays for improved detection for important emerging pathogens and their vectors.

University Achievements



📷 A high-speed broadband router is ready for installation at the Clarkston Heights Library in Clarkston, Wash., one of the early sites to launch the WSU-created Drive-In Wi-Fi Hotspots Project.

Drive-in Wi-Fi team earns inaugural FCC digital access award

The Federal Communications Commission honored a WSU-initiated partnership's work to create drive-up broadband access at hundreds of locations statewide, among nationwide efforts to close the digital divide.

FCC Commissioner Geoffrey Starks recognized the Drive-In Wi-Fi Hotspots Project team among 22 inaugural Digital Opportunity Equity Recognition (DOER) Program awardees. DOER acknowledges efforts to provide communities nationwide with access to affordable, reliable broadband.

Monica Babine, formerly senior associate for WSU Extension's Program for Digital Initiatives; Mike Gaffney, director of Extension's

Community and Economic Development Program Unit; Cindy Aden, formerly of the Washington State Library, a division of the Washington Secretary of State; and Russ Elliott, formerly director of the Washington State Broadband Office, part of the state's Department of Commerce, co-led the project.

During the COVID-19 pandemic, the team coordinated multiple companies and nonprofits to add more than 320 free broadband access locations across the state, bringing the total number of drive-in hotspots to more than 600.

What started with a vision to use WSU Extension sites as gateways to help students

access their courses, led to more than 600 Wi-Fi access points at schools, libraries, and offices across the state. With help from several partners, WSU's land-grant presence was used as a launch pad to increase essential connections for education, health, and livelihood.

In addition to in-kind support from many partners, the Drive-In Wi-Fi Hotspots Project received funding from the Microsoft Corporation, Avista Foundation, and the State of Washington, and was launched at WSU by the College of Agricultural, Human, and Natural Resource Sciences, the Provost's Office, and the Office of External Affairs and Government Relations.

WSU's Veterinary Teaching Hospital a top-rated emergency facility in the West



A dog receives an ultrasound inside the Intensive Care Unit at WSU's Veterinary Teaching Hospital. On average, the hospital sees 10-12 emergency cases daily, or about 4,000 to 5,000 per year.

WSU's Veterinary Teaching Hospital is now the only veterinary teaching facility in the west and one of just a handful in the country to be certified as a Level I facility by the Veterinary Emergency and Critical Care Society (VECCS).

According to the VECCS, a Level I emergency and critical care facility provides small animal emergency care to patients 24-hours a day, 365 days a year, and always has a Diplomate of

the American College of Veterinary Emergency and Critical Care employed full-time and available for consultation on-site or by phone.

WSU's Veterinary Teaching Hospital is the largest veterinary referral center in the Pacific Northwest. On average, 10-12 emergency cases are brought to WSU daily, adding up to about 4,000 to 5,000 emergency cases each year. The Veterinary Teaching Hospital has offered

uninterrupted 24-hour care to animals in need of emergency care every day since opening its doors in 1996.

In total, and prolonged by the ongoing pandemic, the certification took three years. It involved taking pictures of equipment, making videos to display the level of care, writing protocols, and recording team education and qualifications.

WSU School of Hospitality Business Management advances to No. 2 nationally



WSU's School of Hospitality Business Management was ranked No. 2 in the nation by a global ranking organization.

The school was also ranked seventh in the world by the Academic Ranking of World Universities in hospitality and tourism management.

The 2021 ranking, reported by the Shanghai Ranking Consultancy, focuses on the strength of academic research in the fields of tourism and hospitality management, including international influence and recognition.

In 2020, the school was ranked No. 4 in the United States and 11th in the world.

Food Safety researcher elected to National Academy of Engineering



Tang

Junming, Regents Professor in the Department of Biological Systems Engineering, was elected to the National Academy of Engineering.

Tang joined WSU in 1995 and has spent his entire career conducting pioneering research on application of microwave and radio frequency heating in food dehydration, post-harvest control of pests in agriculture produce, and inactivation of bacterial and viral pathogens in prepared foods and low moisture foods. Tang educated over 50 PhD students, trained more than 30 postdoctoral fellows and research associates, and published over 400 peer-reviewed scientific papers.

Tang's research has not only generated new knowledge but also created intellectual properties through dozens of U.S. and international patents. Tang's laboratory has developed two commercially viable technologies based on 915 MHz microwaves for production of high quality ready-to-eat meals with extended shelf-life under different storage conditions. The unique engineering designs allow predictable and rapid heating of pre-packaged food that eliminates food pathogens, replacing the long-time industrial method of canning foods.

Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature and to the pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing and implementing innovative approaches to engineering education.

Tang was also elected as Fellow of National Academy of Inventors in 2021.

Three WSU faculty named Fellows of the American Academy of Nursing

College of Nursing faculty Roschelle (Shelly) Fritz, Renee Hoeksel and Kawkab Shishani were inducted as Fellows of the American Academy of Nursing.

They were among 230 people worldwide being recognized for their contributions to health and health care. The three WSU faculty members' work includes using smart-health technology to monitor health changes in older adults; creating new pathways from an associate degree to a bachelor's degree; and waterpipe tobacco addiction.

Fritz's research uses sensor-based smart-health technologies in the home to monitor health changes. She developed the Fritz Method, a consistent way for clinicians to provide real-world context to big data – information that's used to develop machine-learning models that can recognize and predict significant health changes in older adults. Her work has been highlighted by computer science, nursing, and methods journal. She is a fellow of the National Science Foundation's Integrative Graduate Education Research and Training program, as well as an advisor to multiple health technology startups nationally and internationally.

Hoeksel's 30-year career at WSU has focused on developing programs and policies to enhance academic progression for working registered nurses. Through collaboration with other educational institutions, she led the transformation of RN-to-BSN education across Washington. She also helped create accessible, affordable, high-quality educational programs to promote academic progression across seven western states. Hoeksel has also played an important role as a college administrator, enlarging nursing faculty capacity through grants and mentorship of future nurse educators, especially those from diverse and under-represented backgrounds.

Shishani is an international leader in the study of waterpipe tobacco smoking, having begun her research career with epidemiological studies on tobacco use in Jordan. She completed the first U.S. study about treating waterpipe tobacco addiction. She has trained hundreds of nursing students, nurses, physicians, and pharmacists around the world on smoking cessation counseling. Globally and locally, she mentors international prospective students and makes regular presentations about Islamophobia.

Fine arts professor wins two national awards



Meredith

Hallie Meredith, assistant professor of fine arts, has been honored with two major awards for her research into ancient Roman art processes.

Meredith received the William R. Levin Award for Research in the History of Art before 1750 from SECAC, a leading national arts education and research organization, for her project “Fragmentary and Unfinished Art: Documenting Undocumented Late Roman Art and Process.” She was also selected to receive a 2021 Clark Fellowship for her related project, “Workshops, Process, and Anonymity: The Roots of Contemporary Craft in Ancient Roman Art.”

Both the Levin Award and the Clark Fellowship are distinctions held by eminent art historians, critics, and museum professionals worldwide.

Meredith’s SECAC project highlights the unfinished work of anonymous Roman artists who often deliberately concealed their techniques. Focused on the 3rd–7th centuries CE, it seeks to illuminate the processes of production which occurred during a rich period in late Roman carving but were not passed down in written texts.

Founded in 1942, SECAC provides support for arts professionals and fosters opportunities for the exchange of scholarship and creative activities. Initially an organization of artists, scholars, and arts professionals from southeastern states, it is now the second largest national group of its kind, with members from across the United States and beyond.

Meredith and a scholar from the University of Hong Kong were chosen to receive the annual Levin Award for 2020, which provides a minimum of \$5,000 to recognize and encourage research in art history.

The Clark is among only a few institutions globally with the dual mission of an art museum and a distinguished center for research and higher education, dedicated to advancing public understanding of art and art history.

For her Clark award, Meredith is taking a comparative, interdisciplinary research approach that will have a wide-ranging impact on Roman and contemporary craft and on the history of art as a discipline, with the potential to redefine the history of making.

Xianming Shi named American Society of Civil Engineers fellow



Shi

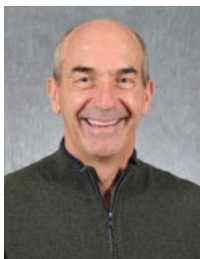
Xianming Shi, director of the National Center for Transportation Infrastructure Durability and Life-Extension and professor in the Department of Civil and Environmental Engineering, has been elected a fellow of the American Society of Civil Engineers (ASCE).

ASCE fellows make up only three percent of the approximately 150,000 members of the organization, which is the oldest engineering society in the U.S. Fellows are recognized for their contributions and solutions that change lives around the world.

Shi has been recognized for his significant contributions to civil engineering research, teaching, and professional service. He directs the Laboratory for Advanced and Sustainable Cementitious Materials and the Laboratory of Corrosion Science and Electrochemical Engineering at WSU. His research contributions include more than 140 scholarly journal articles, several books, one international patent and numerous other publications, with more than 6,000 citations by peers. His research has resulted in mechanistic understanding of how both nanoscience and nanoengineering can benefit infrastructure durability.

He has provided vision and leadership on three university transportation centers, and he has served as a control member for the ASCE Construction Institute Bituminous Materials Committee since 2016.

Washington Animal Disease Diagnostic Lab executive receives AAVLD Distinguished Service Award



Baszler

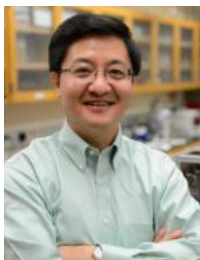
The American Association of Veterinary Laboratory Diagnosticians (AAVLD) awarded the 2020 AAVLD Distinguished Service Award to Tim Baszler, executive director of the Washington Animal Disease Diagnostic Lab (WADDL) and head of Global Health Surveillance Programs at the WSU Paul G. Allen School for Global Health.

The award recognizes a member who volunteers their time, energy, and professionalism to substantially enrich and advance the organizations mission and constituents. During the last 30 years, Baszler has chaired multiple committees and served as the president of AAVLD in 2012. Baszler's service has elevated WADDL's reputation with peers and strengthened WADDL's engagement with the USDA National Animal Health Laboratory Network and FDA Veterinary Laboratory Investigation and Response Network, both critical for maintaining animal health.

Baszler's commitment to move the AAVLD forward was also recognized when he served as chair of the accreditation committee overseeing the review and accreditation status of 59 publicly supported laboratories in the United States and Canada. As chair, he played an essential role aligning the AAVLD's essential requirements with international standards, which in turn expanded the recognition of AAVLD accredited laboratories for trade and export testing.

In addition to serving AAVLD, Baszler has published nearly 100 publications and mentored more than 50 residents and graduate students.

Yong Wang receives national American Chemical Society award



Wang

Yong Wang, Regents Professor and Voiland Distinguished Professor in WSU's Gene and Linda Voiland School of Chemical Engineering and Bioengineering, received the 2021 American Chemical Society's (ACS) E.V. Murphree Award in Industrial and Engineering Chemistry sponsored by ExxonMobil Research & Engineering Company. The annual award is given for outstanding theoretical or experimental research in industrial chemistry or chemical engineering.

A WSU alumnus who joined WSU in 2009, Wang is known for his work in developing novel catalytic materials and for research in fossil and biomass feedstocks conversion to fuels and other chemicals. He holds a joint appointment with the U.S. Department of Energy's Pacific Northwest National Laboratory where he is a Laboratory Fellow and associate director of the Institute for Integrated Catalysis.

Wang has published 400 articles in peer-reviewed journals, including in *Science*, *Nature*, *Angewandte Chemie*, and the *Journal of the American Chemical Society*. He holds 290 issued patents, including 110 issued U.S. patents (>90% licensed to industries), and has won numerous awards including the 2019 American Institute of Chemical Engineers' Catalysis and Reaction Engineering Practice Award.

He is a fellow of the American Association for the Advancement of Science (AAAS), the American Chemical Society, American Institute of Chemical Engineers, Royal Society of Chemistry, National Academy of Inventors, and a member of the Washington State Academy of Sciences. He currently serves as Executive Editor of *Chemical Engineering Journal* and co-Editor-in-Chief of *Applied Catalysis B*, the top two journals in chemical engineering and catalysis.

WSU veterinarian recognized for service in prevention medicine



Moore

Dale Moore, Emeritus Professor, was honored with the American College of Veterinary Preventive Medicine 2020 Helwig-Jennings Award.

The award, established in 1980, recognizes contributions of veterinarians John F. Helwig and William E. Jennings to veterinary preventive medicine.

Moore received the award after more than three decades of service to the organization, of which she has been a diplomate since 1988. She is the 38th recipient of the award and just the seventh female to receive the honor in 40 years.

Moore came to WSU in 2007. She was the former director of Veterinary Medicine Extension and the former director of the Continuing Veterinary Medical Education at WSU's College of Veterinary Medicine.

Her service to her board specialty included the continuing education, residency approval, and examinations committees as well as mentoring and sponsoring other veterinarians to become board certified.

Moore received her Doctor of Veterinary Medicine degree from the University of California, Davis in 1983. She later received her master's degree in preventive veterinary medicine from UC Davis in 1988. She served as officer for the Centers for Disease Control and Prevention Epidemic Intelligence Service from 1988 to 1990. She also received a doctorate degree from Pennsylvania State University in behavioral health and epidemiology in 1998.

WSU Tri-Cities history professor part of Manhattan Project film nominated for Daytime Emmy



Franklin

A WSU Tri-Cities history professor is part of a history film focusing on the Manhattan Project that was nominated for a Daytime Emmy Award in the category of Outstanding Daytime Non-Fiction Special.

Robert Franklin, assistant director of the WSU Tri-Cities Hanford History Project and teaching assistant professor of history, was one of a handful of talent that starred in *The Manhattan Project Electronic Field Trip* produced by The National WWII Museum based in New Orleans. The project focuses on the three major sites that were instrumental in the Manhattan Project, which developed the technology and produced the plutonium and uranium for the world's first atomic bombs: Hanford, Washington; Los Alamos, New Mexico; and Oak Ridge, Tennessee.

The 70-minute film has been shown to students in middle schools and high schools across the country and explores the science, sites, and stories of the creation of the atomic bomb.

Franklin, with his role and expertise on Hanford, was approached about participating in the film project in 2019. That summer, a crew from the National WWII Museum traveled to all three sites, using a local high school student as the host for each site and referencing local experts in the region about its history. Franklin had the opportunity to voice his expertise on the site as part of the film and provided input to the script.

Sara Cassin, a student from Delta High School in Pasco, Wash., and Franklin, led filmmakers through Hanford's B Reactor, the world's first large-scale nuclear reactor and other historical landmarks and buildings on the site.

Two WSU faculty win Society of Professors of Education's outstanding book award

Two WSU professors have won the Society of Professors of Education's outstanding book award for 2020.

Sola Adesope, a Boeing Distinguished professor of STEM Education, and A.G. Rud, a Distinguished Professor of cultural studies and social thought in education, released *Contemporary Technologies Education: Maximizing Student Engagement, Motivation, and Learning*, published by Palgrave Macmillan.

The book aims to outline various technologies and how they are used in education including the flipped classroom, social media, Massive Open Online Course, Serious Educational Games, and wikis, along with other subject areas. The book also provides an overview of the current state of learning analytics as an emerging technology in education and discusses the central theoretical, methodological, and practical issues in the field.

The Society of Professors of Education has a stated purpose "to provide a forum for consideration of major issues, tasks, problems, and challenges confronting professional educators."

The topics in Adesope and Rud's book aligned well with SPE's purpose. These included identifying common areas of research and then building on them to advance the use of technologies for facilitating student engagement, motivation, and learning.

Dan Dolan recognized with public safety leadership award



Dan Dolan, Emeritus Professor in the Department of Civil and Environmental Engineering, has received the National Institute of Building Sciences (NIBS) Building Seismic Safety Council's Excellence Award.

The excellence award recognizes individuals who have made a significant difference in advancing seismic design and construction and in improving the safety and economic viability of building systems.

The Building Seismic Safety Council works to enhance public safety by providing a national forum that fosters improved seismic planning, design, construction, and regulation in the building community. The council has developed the National Earthquake Hazards Reduction Program Recommended Seismic Provisions, which have served as the foundation of the nation's seismic standards and model building codes.

Dolan

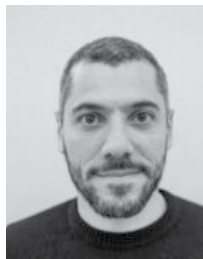
With WSU since 2002, Dolan has pursued efforts to improve building codes to make the built environment safer for earthquakes and hurricanes.

He developed two FEMA publications, the *Homebuilders' Guide to Earthquake – Resistant Design and Construction* and the *Home Builders' Guide to Coastal Construction*. He served as chair of the International Code Council committee to address wall sheathing requirements of the International Residential Code (IRC). This committee's work helps to define the safety level of single-family houses in the United States.

He was a member of the International Code Council IRC Building and Energy Committee, which evaluates proposals for the IRC pertaining to structural performance and energy conservation to determine if the change is beneficial to the public's safety. He has also served on the International Building Code Technical Update Committee to evaluate changes proposed for the structural safety portion of the building code governing large buildings.

In his research, Dolan studies dynamic load on low-rise buildings, dynamic response of light-frame buildings, response of dowel connections, dynamic testing of structural assemblies, and numerical modeling of structural and material response.

Al-Hassawi receives national teaching award



Al-Hassawi

Omar Al-Hassawi received the American Institute of Architecture Students and Association of Collegiate Schools of Architecture (ACSA) New Faculty Teaching Award.

The award honors early career, architecture faculty members who demonstrate excellence in teaching performance. ACSA is an international association of architecture schools and represents about 7,000 faculty who teach more than 40,000 students in the U.S. and Canada.

Al-Hassawi, assistant professor in the School of Design and Construction, teaches graduate design studios and a passive environmental control systems course. He is the first WSU recipient of the annual teaching award since its inception in 1990.

In Al-Hassawi's courses, students have designed projects ranging from affordable homeless shelters and a mixed-use development using mass timber to a memorial for a WSU alumnus who died during Operation Desert Storm. In 2018, Al-Hassawi and professor Ayad Rahmani led students on a trip to Jordan as part of the School of Design and Construction course, Global Engagement in Design and Construction. A team of his students won a national prize for their design of a waste to energy power plant, and another student received an honorable mention in an international competition for his project to transform cities through sustainability and use of renewable resources.

Al-Hassawi's research has focused on passive cooling systems that can be applied to building design by architects. He practiced architecture across the Middle East and was involved in the design of key projects in the region such as the Capital Market Authority Tower in Riyadh, Saudi Arabia and the Saudi Arabian Embassy in Amman, Jordan.

He recently won a \$750,000 grant to develop new certificate and degree programs at the undergraduate and graduate levels in high-performing energy-efficient residential design and construction. The new Energy Conscious Construction (ECC) programs are launching in spring 2023.

Criminologist Faith Lutze internationally honored for her work



Lutze

The international Academy of Criminal Justice Sciences (ACJS) has selected Faith Lutze, a WSU professor and expert in criminal justice, to receive the group's prestigious Founder's Award in recognition of a career of providing substantial contributions to the Academy and to the discipline of criminal justice through education and research.

Established in 1963, ACJS provides a forum for disseminating information and ideas about critical issues in crime and criminal and social justice research, policy, education, and practice. In her 33 years of membership, Lutze has served on several committees and in a number of leadership roles, including as president (2018-19), second vice president (2016-17), and Executive Board member.

In 2020, she received the Keeper of the Flame Award from ACJS for her distinguished service to the Minorities and Women Section (MWS) in advancing the principles of social justice and human rights. In 2010, she was honored with the Coramae Richey Mann Leadership Award from MWS and the ACJS Corrections Section's Outstanding Member Award.

She regularly enters prison facilities to work with staff and inmates and provides essential research and evaluations for national and state prison programs. Her major publications include *The Professional Lives of Community Corrections Officers: The Invisible Side of Reentry* (2014), based upon her decades of evaluating programs in the Washington State Department of Corrections. The book is among the first to contextualize the work of contemporary probation and parole officers.

She pioneered research on rehabilitation and reentry services and has provided expert analysis of drug courts, boot camps, and criminal justice and prison culture. Her current research and teaching interests include gender violence, justice, and strategies for reducing harm and oppression in the criminal justice system.

Education faculty receives awards for multilingual learner research



Ardasheva

Yuliya Ardasheva, a faculty member at WSU Tri-Cities, has received one of two national 2021 Mid-Career Awards from the American Educational Research Association's Second Language Research Special Interest Group.

Ardasheva is an associate professor within the College of Education, where she focuses her research on multilingual learners' language and academic development and teacher preparation. The award committee were impressed with Ardasheva's robust and coherent research portfolio.

It's research that, for Ardasheva, hits close to home. She came to the United States at 27 years-old, not speaking a single word of English, having already earned bachelor's and master's degrees in her native language. She earned her doctorate degree in the United States.

This line of research began with Ardasheva's dissertation and her first externally funded project as a postdoctoral student at the University of Louisville. Her role was to develop literacy supports at a portable planetarium for middle and high school students, all part of a Newcomer Academy in Louisville.

Newcomer Academy students spoke 25 primary languages and most of them were refugees from war or conflict zones. As a result, most had interrupted schooling.

Ardasheva's focus was on developing pre- and post-instructional literacy activities aligned with the planetarium experiences. This was to improve students' science vocabulary knowledge, learning strategy use, oral and reading comprehension. Ultimately, this would allow for building science background knowledge and science concept elaboration.

To date, Ardasheva has published 45 peer-reviewed articles and six book chapters on this and other topics and presented her work at more than 70 national and international conferences.

John Roll named 2021 American Psychological Association Fellow



Roll

John Roll, professor and vice dean for research for the Elson S. Floyd College of Medicine, was named a 2021 American Psychological Association Division of Behavior Analysis Fellow.

He was one of eight individuals from across the country to be elected to Fellow status in 2021, which was the first time since 2017 that new Fellows were elected. This honor was bestowed in recognition of his significant contributions to the science of behavior analysis.

Roll was previously elected as a Fellow in the American Psychological Associations' Division of Psychopharmacology and Substance Abuse and its Division of Addiction Psychology. Roll also serves as a Fellow in the American Association for the Advancement of Science, the Association of Behavior Analysis International and the Association for Psychological Science.

Gebremedhin receives prestigious international applied mathematics prize



Gebremedhin

Assefaw Gebremedhin, associate professor in the School of Electrical Engineering and Computer Science, is recipient of the 2021 George Pólya Prize in Applied Combinatorics.

Administered by the Society for Industrial and Applied Mathematics (SIAM), the international prize is awarded every four years for a notable application in an area of mathematics called combinatorial theory. The field of research is primarily concerned with counting and has a broad range of applications in computer science and a wide variety of problems that it can address.

Gebremedhin and his colleagues, Fredrik Manne from the University of Bergen, Norway, and Alex Pothén from Purdue University, were chosen for their work to develop efficient graph coloring algorithms and codes with applications to Jacobian and Hessian matrix computations. Computation of Jacobian and Hessian matrices is central to many science and engineering applications and is used under the hood by machine learning algorithms. In the approach Gebremedhin

and his colleagues take, these derivative matrices are evaluated using a powerful scientific computing technique called algorithmic or automatic differentiation.

With WSU since 2014, Gebremedhin leads the Scalable Algorithms for Data Science (SCADS) Lab, which conducts research at the intersection of algorithms, data analytics, and computational science and engineering. His research interests include data science and artificial intelligence, network science, high-performance computing, and applications in cyber security, energy systems, and bioinformatics. In 2016, he received a National Science Foundation CAREER Award for work on fast and scalable combinatorial algorithms for data analytics.

Steve Hines receives 2020 AAVMC Distinguished Veterinary Teacher award



Hines

WSU professor and veterinarian Steve Hines was recognized as the 2020 American Association of Veterinary Medical Colleges' Distinguished Veterinary Teacher.

The award is the most prestigious teaching award in veterinary medicine and is presented by Zoetis, the largest global animal health company. It highlights those who have dedicated their life and career to improving veterinary medical education.

To date, Hines is the only national recipient to receive the student-nominated award twice. He was also honored with the award in 1996 and has received the award at the college level three different times.

In addition to students, Hines was also nominated by Bryan Slinker, former dean of the College of Veterinary Medicine, and Bob Mealey, Veterinary Clinical Sciences Chair.

Hines was recognized for his role in the Diagnostic Challenges, a multidisciplinary case-based exercise he started in 1991 that provides second-year veterinary students a simulated "real-world" exercise that runs a full week.

The award also recognized Hines for founding the College of Veterinary Medicine Teaching Academy in 2010. The Teaching Academy supports faculty dedicated to teaching and learning and brings educators together to learn, grow, and collaborate. In 2013, the program became the model for a regional teaching academy that includes six veterinary schools throughout the West. Hines was a founding Fellow and the first Steering Committee chair.

Faculty named leaders, new members of Washington State Academy of Sciences

The Washington State Academy of Sciences (WSAS) has named WSU faculty to hold the positions of incoming board president and three seats on the board. It also announced seven WSU faculty as new members of its 2021 class.

John Roll, professor and vice dean for research in the WSU Elson S. Floyd College of Medicine, was selected as the president-elect of the WSAS Board of Directors.

Roll is joined by three new board members from WSU: Celestina Barbosa-Leiker, professor and vice chancellor for research and administration, WSU Health Sciences; Douglas Call, Regents Professor, Paul G. Allen School for Global Health; and John Stark, director of the Washington Stormwater Center and professor of entomology.

The WSAS Board is responsible for the governance of the academy in support of its mission, “science in the service of Washington state.”

In addition, seven WSU faculty will join WSAS as new members:



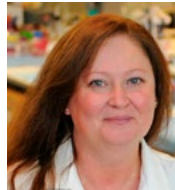
Duncan

Glen Duncan, professor and chair, Department of Nutrition and Exercise Physiology—For meritorious work in the fields of exercise and nutrition science, with a focus on epidemiology and the built environment.



French

Brian French, Berry Family Distinguished Professor in Educational Psychology—For contributions to advancing the development and application of psychometric methods for validation of test scores, for ensuring accuracy and fairness in decisions about individuals with test score use, and the use of simulation to strengthen statistical models for test development.



Lokensgard,

Rita Fuchs Lokensgard, professor and director, Alcohol Drug Abuse Research Program—For elucidating the neuroanatomical, pharmacological, and cellular mechanism of drug-seeking behavior and drug memory reconsolidation in non-human animals. For identifying areas of the amygdala associated with drug-related memories and developing methods for determining how memory reconsolidation is related to drug relapse and for leading state-wide efforts to promote addiction research.



Hulbert

Scot Hulbert, associate dean and director, College of Agricultural, Human, and Natural Sciences Office of Research—For discoveries revealing the molecular mechanisms by which pathogens defeat plant defense responses to infection, facilitating development of durable resistance to historically devastating diseases of grain crop plants.



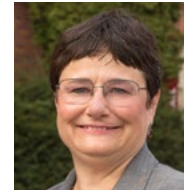
Meier

Kathryn Meier, professor and associate dean for faculty and student development, interim chair for the Department of Pharmaceutical Sciences—For leadership in cancer research. For advancing STEM education as associate dean at WSU and major international research impact as Editor-in-Chief of Molecular Pharmacology, and as a member of advisory boards of multiple scientific societies, including the American Society for Pharmacology and Experimental Therapeutics, the American Physiological Society, and the American Association for Cancer Research.



Peters

John Peters, professor and director, Institute of Biological Chemistry—For generating widely acclaimed fundamental research that has immediate impacts on biotechnological developments ranging from production of biofuels to greener agricultural practices. For a history of deep strategic thinking and a track record for engaging policy makers and the public to advance education and sustainable economic development in Washington state. Peters is now at the University of Oklahoma.

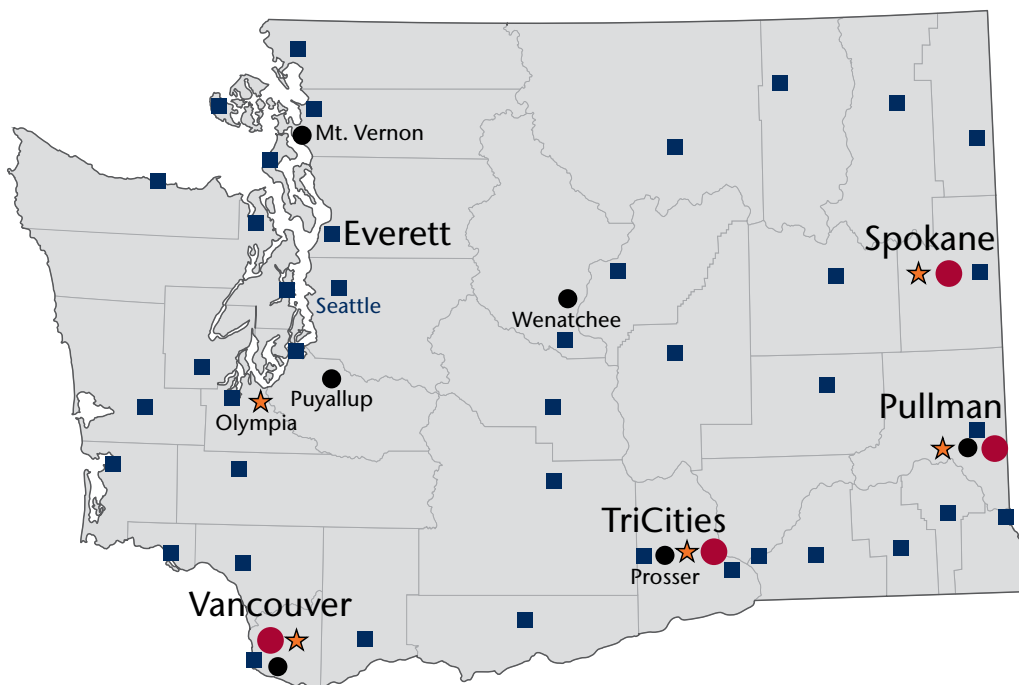


Schulz

Noel Schulz, Edmund O. Schweitzer III Chair in Power Apparatus and Systems, director of PNNL-WSU Advanced Grid Institute—For contributions to advancing modeling and simulation methods and tools for electric power distribution systems including shipboard power systems, renewable energy, storage, microgrids, and artificial intelligence applications, and leadership for advancing recruitment, retention, and advocacy for women in STEM worldwide.

Advancing research statewide

Washington State University faculty conduct research at campuses across the state. Extension offices in each of Washington's 39 counties turn research into action for local industry and communities.



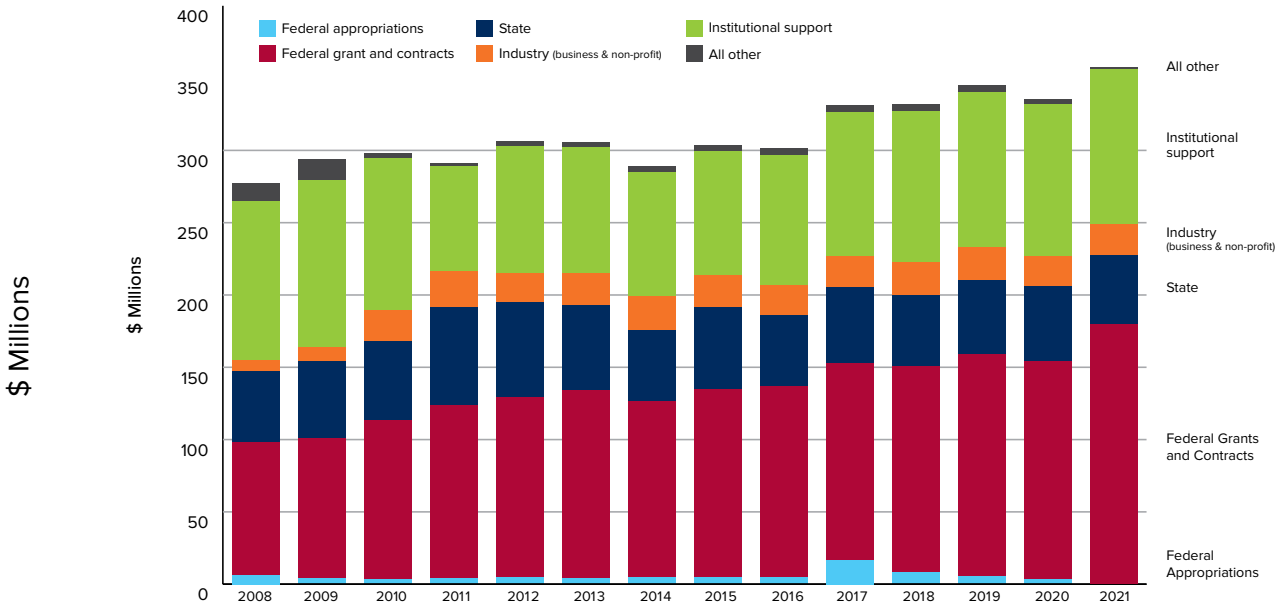
- **Research centers, institutes, and core facilities** - More than 30 research centers and institutes bridge disciplines to answer difficult questions. Core facilities support investigations with instrumentation and services.
- **Research and extension centers** - Agricultural and natural resource research at four strategically located centers is supported largely by state and federal research grants and contracts. Public investment in these centers yields enormous returns in land productivity, disease-resistant crops, and the conservation and safer use of natural resources.
- ★ **Libraries** - WSU serves the state with eight libraries at five locations: Pullman, Spokane, Tri-Cities, Vancouver, and Olympia.
- **Extension offices** - WSU Extension leverages research to find solutions to local issues.

Facts & Figures

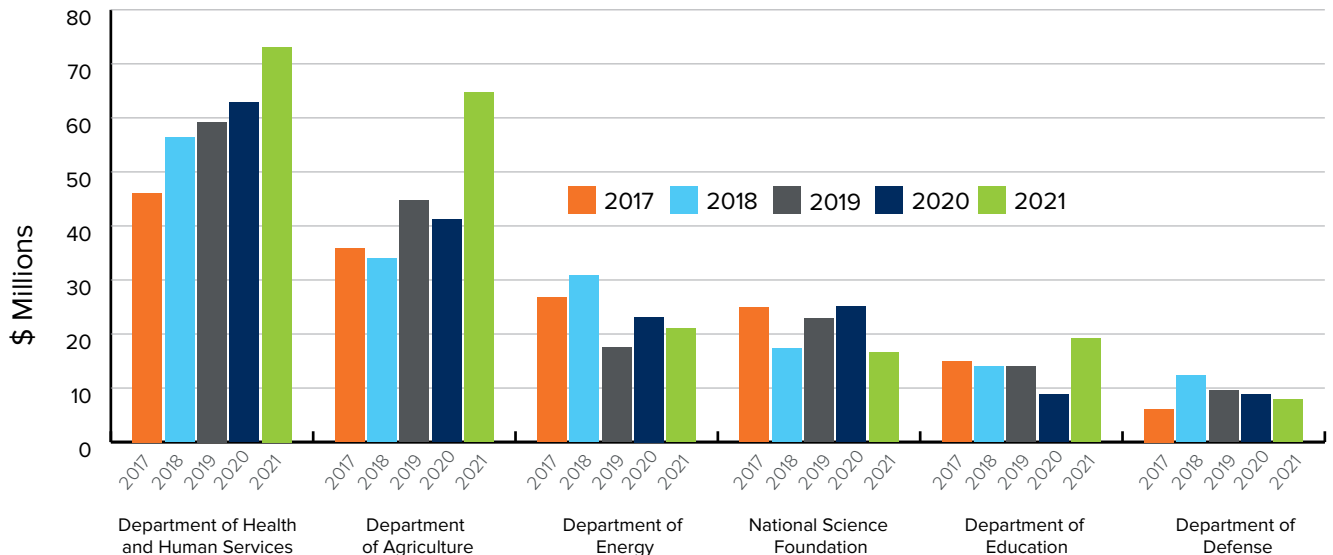
Facts & figures

Total Research and Development Expenditures
\$357.6 million total for FY2021

Please note: Figures in this graph differ from the NSF HERD Report to reflect recent corrections with data calculations within WSU. Not all corrections are reflected in the NSF HERD report online.

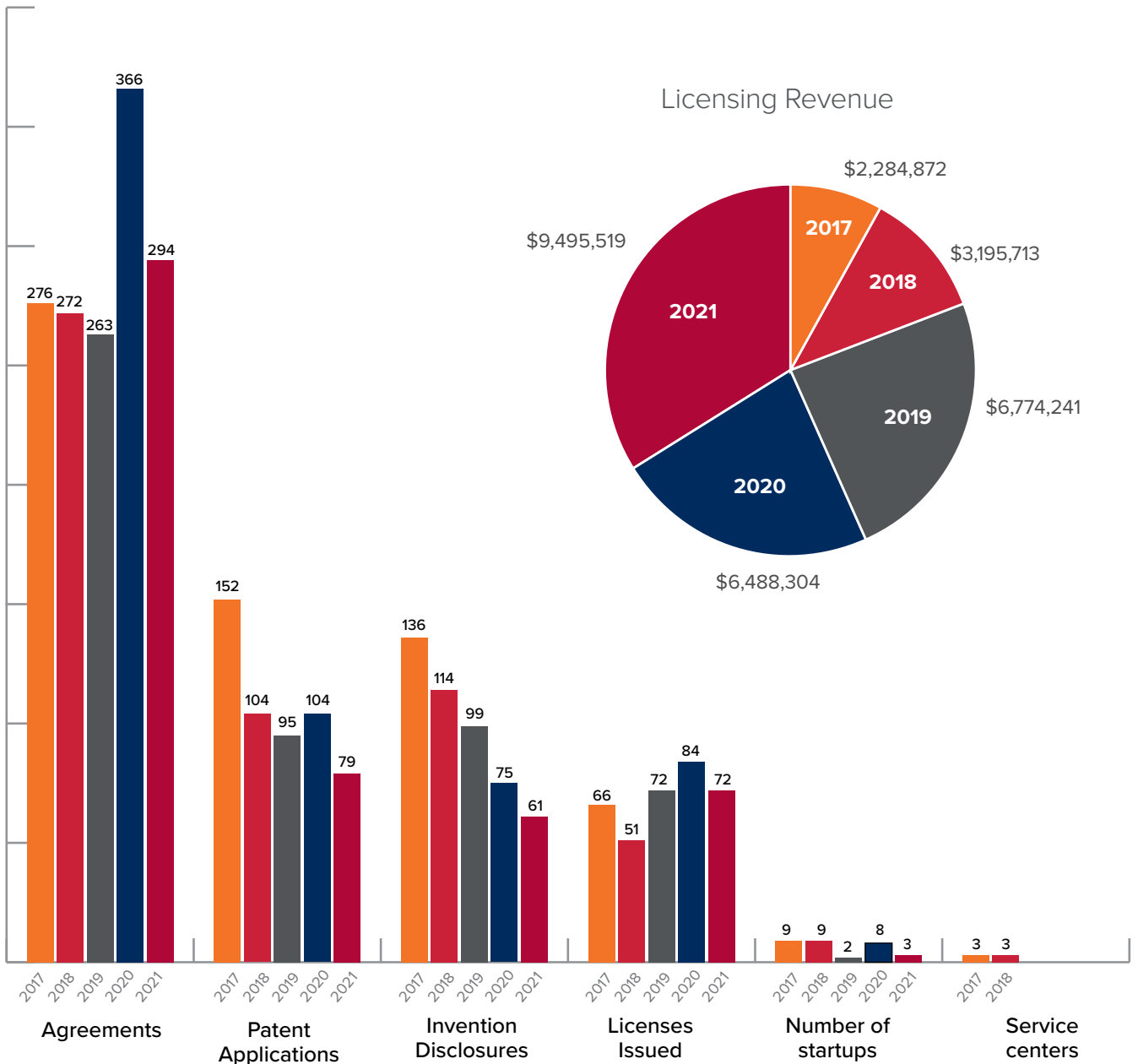


Trends in Federal Awards



Facts & figures

Commercialization on the Rise FY17–FY21





Everett | Extension | Global | Pullman | Spokane | Tri-Cities | Vancouver



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