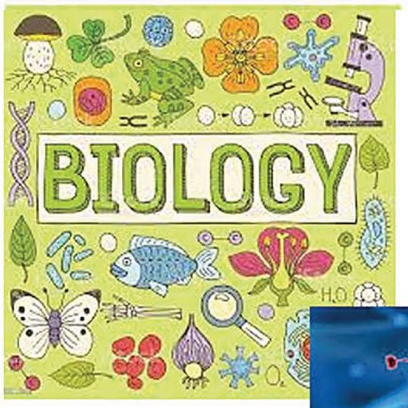

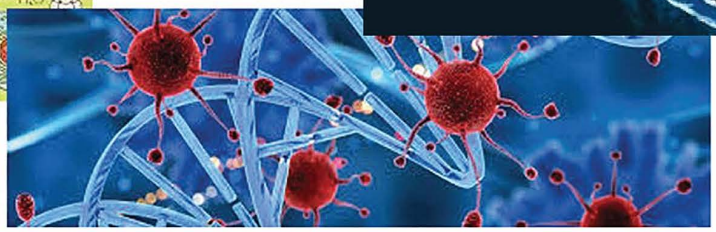

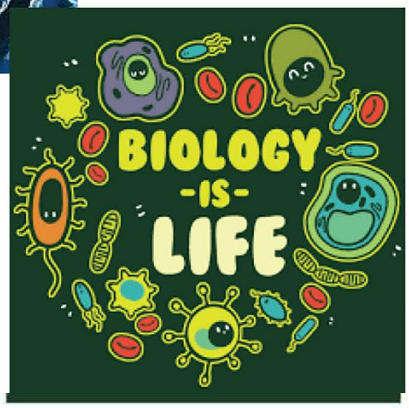

CP Biology 2021-2022 Horlick HS Racine, WI

Final Essay Compilation

Biochemistry, B.S.

Mr. Klema with son Griffin during Graduation from Miami School of Law

Intellectual Property J.D. (Patent Law)

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Click on the name below to jump to their essay.
Click on the researcher's name to go to the respective website resource

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Xuejun pan

Institution:

WARF

Summarize the subject or area of research that is being conducted below: He turns plant materials like woodchips into sugars.He also studies the enzymes in his sugars .His method is one of the best methods in the business.He also believes that that biomass is going to be the hard currency in biocurrency.The work has the potential to yield 1 billion tons of sugar equivalent to up to 150 billion gallons of ethanol.It is edible but pan doesn't recommend consuming it.

Cut and paste the text from the source website page below A vial of white sugar sits on Xuejun Pan's desk beside a box of wood chips.

"It's pretty pure and sweet," he says, pointing to the sugar. "I'm not encouraging you. But it's edible."

With a new method being honed in Pan's laboratory, the process of transforming tough plant material into powder-soft sugar takes only hours. The reaction is mild, fast and groundbreaking. No harsh pretreatment or enzymes are required. Low costs and sky-high sugar yields – that may exceed 90 percent – make Pan's method one of the best in the business.

Standing in his lab in the Enzyme Institute, Pan swirls a test tube of syrupy extract. A murky layer of lignin settles at the bottom.

"Think about the future when we run out of oil. We may have solar energy, wind energy, nuclear energy and hydro. But what about the chemicals and materials currently derived from petroleum? Biomass likely is going to be the only option. Biomass-derived sugar will be the hard currency of the future bioeconomy."

The work going on here is exciting because it has been speculated that biomass holds the potential to yield 1 billion tons of sugar per year in the U.S., equivalent to 80-150 billion gallons of ethanol. However, current methods to produce bioethanol from cornstarch or sugarcane are inadequate and unsustainable to meet the global demand for renewable fuels.

To be sustainable, biofuel production should instead rely on abundant, inedible lignocellulose like switchgrass, corn stover, wheat straw, wood chips and waste paper.

The problem, Pan explains, is that lignocellulose is a complex material made of cellulose wrapped in tough hemicellulose and lignin. For this reason, lignocellulose is more difficult than starch to break down and convert (hydrolyze) into fermentable sugars. Harsh acids, blazing heat and other pre¬treatments traditionally have been required before introducing pricey enzymes.

Needed is a cost-effective, single-step approach to extract the sugar.

“We’re reducing process time from days to hours,” Pan says.

“At the very beginning when we were presenting, there were doubts. Could it really be true?”

Key to his approach is the use of inorganic bromine salt (lithium bromide or calcium bromide) to break down lignocellulose and unleash fermentable sugars. Other labs have investigated other salts, but poor performance and byproducts dog the results.

Pan’s reaction method works on raw biomass at stovetop temperatures, hydrolyzing cellulose and hemicellulose and releasing monosaccharides for subsequent biofuel or chemical production. Lignin separates from the product sugars and can be filtered out for use in coproducts. The bromine salt can be recovered and reused.

“Success of this technology could be game changing,” Pan says. “If you can get easy, low-cost sugar, you’ll be a winner in the game.”

Support from the Accelerator Program is now being used to scale up the process to the point that it will be practical for industry. Demonstrating that the salts can be cheaply separated and recycled will be crucial.

Pan says that guidance from Accelerator Catalysts has helped him make technical modifications as well as polish an entirely new skill.

“I don’t have experience in marketing technology,” he says. “Catalysts helped me understand what industry is interested in.”

With several patents under his belt, Pan's biomass conversion methods are part of WARF's Clean Technology portfolio.

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Aditya Akella

Institution:

Wisconsin Alumni Research Foundation

Summarize the subject or area of research that is being conducted below:Akella's team is working on developing a softwarebased framework called Stratos that makes middlebox services as flexible and efficient as the applications they enhance. Stratos automatically determines how best to deploy middleboxes in the network architecture. Akella credits his experience with WARF's Accelerator Program for giving him the direction needed to push forward and complete a working prototype of his system.

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Aditya Akella considers himself a high tech plumber. And it likely won't be long until tech-savvy consumers everywhere are grateful for his efforts to keep data flowing smoothly through the virtual pipes and other fixtures that make cloud computing possible.

Akella, an associate professor of computer sciences at the University of Wisconsin-Madison, understands he has chosen an unexpected route to technological achievement. While accolades rain down on software developers responsible for the latest smartphone apps and social networking tools, the technological underpinnings and algorithms that speed, protect and direct the flow of data receive far less attention.

An expert on these linkages, Akella and his team find their calling in advancing the technology. To fully achieve the promise of cloud computing—accessing computing resources including storage and applications from the Internet rather than local servers—improved "middlebox" connections will be necessary.

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“Large companies and entrepreneurs alike have focused long and hard on advancing computation and storage technology,” Akella says. “By comparison, network infrastructure is still in the Stone Age. The traditional view has been that it’s akin to plumbing. The reality is, without faster and better networking tools, the advantages of cloud computing ultimately will be limited.” Among the keys to network advances are the “middleboxes,” devices that transform, filter, route or secure data. Examples of middleboxes include firewalls, which filter out dangerous or unwanted information; wide area network optimizers that coordinate to cache or compress data moving across the Internet; and load balancers that help route the movement of data to multiple access points. Akella’s team is developing a softwarebased framework called Stratos that makes these and other network middlebox services as flexible and efficient as the applications they enhance. Stratos automatically determines how best to deploy middleboxes in the network architecture, intelligently balances and directs traffic to avoid network congestion and scales the middleboxes to optimize performance and cost. The software allows users to run middleboxes developed by other vendors and seamlessly strings multiple technologies together. “Without Stratos, users have to determine how many middleboxes they need and manually configure traffic, a setup that is never optimal because the volume of traffic can change,” Akella says. “With our system, when traffic picks up, it automatically identifies the most beneficial configurations and employs the resources necessary to handle the load.” Thus, large cloud service providers could employ Stratos to enhance services to customers while increasing their own efficiency. What makes Stratos work? More than 10,000 lines of code created by Akella and student researchers Aaron Gember, Saul St. John, Anand Krishnamurthy, Robert Grandl and Xiaoyang Gao. Akella credits his experience with WARF’s Accelerator Program for giving him the direction needed to push forward and complete a working prototype of his system. “The Catalysts told me to go ahead and bring on some students to get it written, rather than continue trying to do it all myself,” Akella says. “This was really critical because without the added support, I would still be balancing this project against other responsibilities and progress would have been much more limited.” Instead, Akella’s working prototype already has caught the attention of several major potential industry partners. He has provided live demonstrations to Cisco Systems and Dell and estimates he needs just a few more months to fully scale up and debug the team’s work. “Industry is just now coming to grips with the expanding needs in this area,” Akella says. “We see the potential to create value for society in a number of ways. Our research group has a tradition of releasing free, limited versions of new software to other academic groups for research purposes. We also intend to create a version with more user-friendly interfaces for commercial purposes and license to industry or form our own startup company.”

Massachusetts Institute of Technology

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CP Biology Final Essay

Name: [redacted]

Scientist(s):

Denise Ney

Institution:

Warf Wisconsin Alumni Research Foundation

Summarize the subject or area of research that is being conducted below:

Denise Ney is researching about a rare condition called Phenylketonuria (PKU) which the inherited disorder occurs in about 1 in 13,000 newborns in the United States. All of this started about a half century ago with a mother of two kid who would've been diagnosed with PKU. Patients diagnosed with this disorder must adhere to a lifelong draconian diet or the phenylalanine accumulates in their bodies and high levels can wreak mental impairment and physical breakdown. Her research focuses on developing safer, more palatable medical foods based on a protein called glycomacropeptide (GMP) found in cheese. They found out that GMP helps female mice burn fat and build stronger bones and are working in their research to see if GMP can work the same way to humans. Which can help give new to womans trying to lose weight or suffering from osteoporosis. But Ney and her team are still halfway with this research and still learning and investigating new things.

Cut and paste the text from the source website page below

Denise Ney is working with a company to dish up new options to people living with a rare metabolic disorder. And the next big thing in weight loss may be lunch for her lab mice.

One mother's determination can shape the course of science. It can launch decades of research, discovery and a breakthrough at long last – a test that is saving children around the world, though it came too late to save her own.

In the cool Norwegian spring of 1934, Borgny Egeland was armed with a hypothesis. Dismissed by the leading medical centers of Europe, she marched undaunted into Oslo University Hospital, her two young children in tow.

She had watched as her daughter, born bright and healthy, slipped deeper into mental retardation. The six-year-old spoke few words and limped. Tragedy struck twice. A son, age four, was succumbing even faster, unable to talk, walk or feed himself.

Why was this happening? And did it have something to do with the strange odor in the children's hair, sweat and urine? The scent was so powerful it aggravated their asthmatic father.

The physician examined the children out of courtesy. Like his colleagues he observed a hopeless case of 'feeblemindedness.'

But in his attic laboratory above the medical ward, he conducted one last test on the children's urine using a few drops of acid. It was supposed to turn the sample a reddish color. It turned green. He called for more samples.

In her sunlit office on the UW-Madison campus, Denise Ney finishes the story.

"The mother brought in 22 liters of urine over a period of months. Using old-fashioned organic chemistry, the physician isolated a phenylalanine compound and concluded it was building up in their blood."

Today, after half a century of research, the children would be screened soon after birth and diagnosed with a rare condition called phenylketonuria, or PKU. The inherited disorder occurs in about 1 in 13,000 newborns in the United States.

People with PKU lack an enzyme needed to process phenylalanine, an amino acid found in most common foods. PKU patients must adhere to a lifelong draconian diet – e.g., special synthetic formula, low-protein pasta, a cup of broccoli – or the phenylalanine accumulates in their bodies. High levels can wreak mental impairment and physical breakdown.

Ney, a professor of nutritional sciences and D2P advisory board member, is an internationally recognized PKU expert. She can tell stories about the patients she's come to know over the years: the young girl who wanted a PKU mouse for a pet; the man who strayed from his strict diet as a teenager and can't walk without a crutch; the Wisconsin woman who's lived a rich and interesting life because she was diagnosed early.

"Her brother was not diagnosed, and lives in an institution," Ney says. "That's when the meaning of this work really hits you."

Ney's research focuses on developing safer, more palatable medical foods based on a protein found in cheese whey called glycomacropeptide (GMP). GMP is ideal for patients because it is the only naturally occurring protein to contain so little of the dangerous amino acid.

A translational research home run.

Now, support from the Accelerator Program is helping Ney take the next step in GMP investigation. It turns out, the protein may have health benefits beyond the niche PKU market. It appears to help female mice burn fat and build stronger bones.

No diet product currently on the market combines these two benefits.

If GMP works the same way in humans, it could give new hope to women trying to lose weight or suffering from osteoporosis. Female athletes may stand to gain as well. The commercial potential is significant.

But it's too early to tell. Ney and her team are about halfway through a major rodent study trying to pin down the effects of a GMP diet in the general population.

A bluish X-ray image of a mouse skeleton flickers on Ney's computer screen. She explains how DXA scans measure bone mineral density, and what fatty acid oxidation assays reveal about metabolism.

So far the results are tantalizing. Even if GMP can't prevent the mice from gaining weight, it may help them lose it faster and develop bigger, stronger bones. "To my knowledge we're the only ones putting these two things together. That's special. That's the story of this Accelerator project."

What's the connection between less fat and stronger bones? Ney points to a recent study that suggests that early in their development, cellular precursors have a choice – become a bone cell or become a fat cell.

"The less fat you make, the more bone cells you make," says Ney. "We think this is being programmed by consuming GMP."

There's an interesting commercial angle to this research. Presently, no company in the United States produces GMP (Ney orders her supply from Denmark). If there were a larger market for GMP, a company closer to home may get involved, driving down the cost of PKU medical foods as a result.

And after all, GMP comes from making Wisconsin's favorite product. Cheese.

One company in North America has expressed interest in Ney's latest work and is waiting to learn more. But she'll need the rest of the year to work through her data and publish her findings.

In the meantime, Ney reflects on the many patients, food scientists, advocates and clinicians that have advanced GMP research to its current state.

"I don't think there are many campuses in the world that could pull this off. We have all the pieces here. It's the Wisconsin Idea."

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Hector-Deluca

Institution:

National Institute of health.

Summarize the subject or area of research that is being conducted below:

The area of research conducted was synthetic Vitamin D, in Kidney failure patients. Hector discovered paricalcitol which suppresses the parathyroid gland and the overproduction of the parathyroid gland that occurs during kidney failure. Paricalcitol is one of the safer vitamin D therapies. Hector Deluca led the research to make Zemplar which is a synthetic vitamin d hormone to regulate calcium in the bloodstream. He has founded two companies to help develop drugs for diseases. His research has helped WARF return money to the universities through grants from his work.

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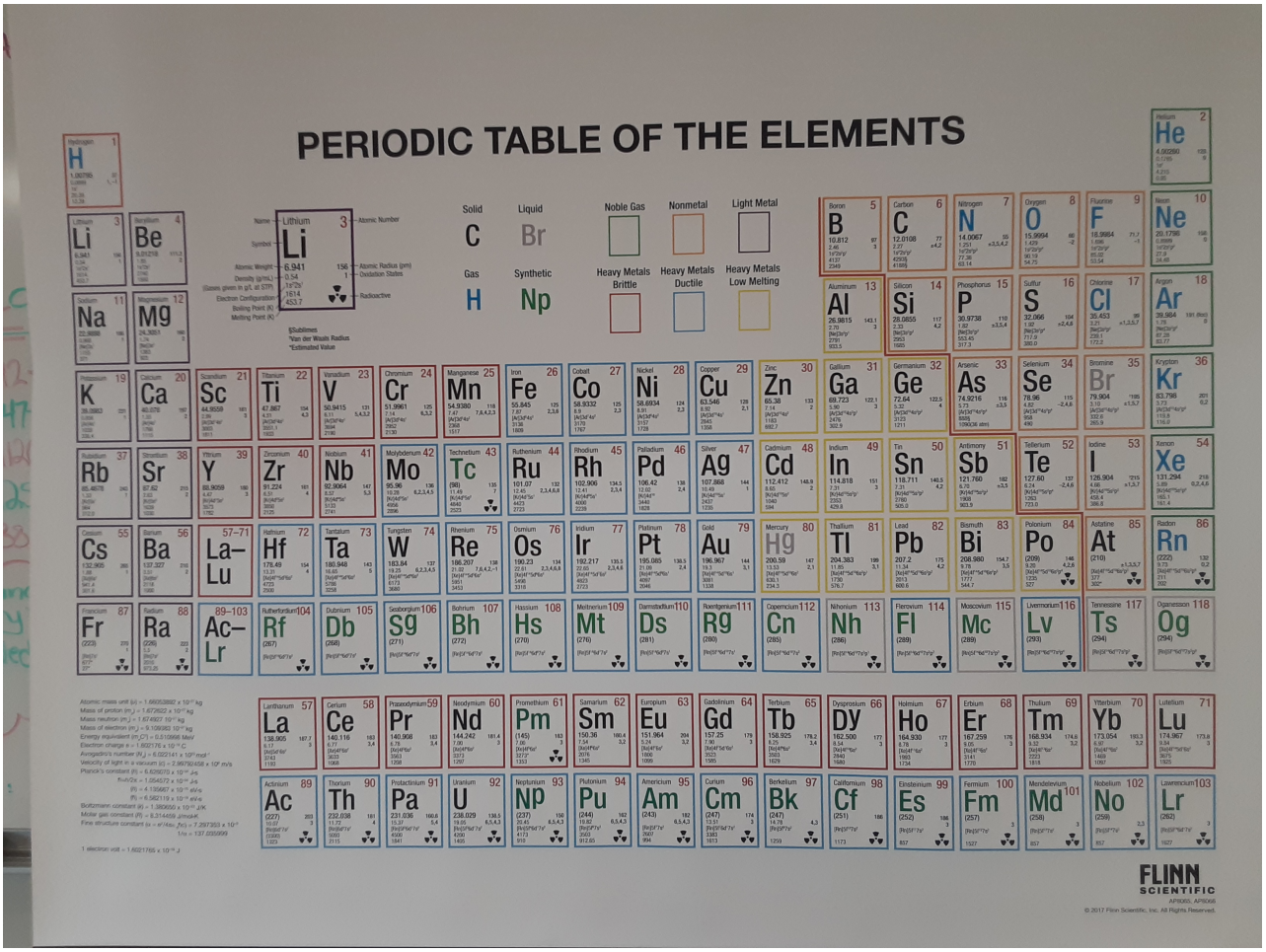
A teacher, entrepreneur and peerless scientist, Hector DeLuca has embodied the Wisconsin Idea for more than 50 years. His research into the metabolism and activity of vitamins D and A is transforming the lives of patients around the world. DeLuca has founded two companies and helped develop multiple drugs to treat bone diseases, chronic kidney failure and other afflictions. With nearly 2,000 patents to his name, the earnings from his innovative technologies have allowed WARF to return tens of millions of dollars to the university through annual grants. Three campus buildings are named in DeLuca's honor.

A serious side effect from kidney failure is the depletion of vitamin D hormone, which is manufactured by the kidneys and regulates calcium absorption from the intestines. Without adequate levels of vitamin D hormone in the bloodstream, the body cannot process enough calcium from digested food and instead must draw calcium into the blood from the skeleton. Over time this leads to weakened, brittle bones that break easily. To fi ght this condition, in the early 1990s, scientists at the University of Wisconsin-Madison invented paricalcitol, a synthetic form of vitamin D hormone that regulates

calcium in the bloodstream. Biochemistry professor Hector DeLuca, Ph.D., led the research team that discovered paricalcitol (now sold commercially as Zemplar™). Initial funding for the research was provided by the National Institutes of Health. When calcium levels in the blood are low, the parathyroid gland produces parathyroid hormones that trigger calcium release from the bones. During kidney failure the parathyroid gland is in a state of over-production known as secondary hyperparathyroidism. Paricalcitol suppresses the activity of the parathyroid gland and the overproduction of parathyroid hormone by increasing calcium levels in the blood. Paricalcitol is also safer than other vitamin D hormone therapies because it has lower risk for elevating blood calcium to dangerous levels. The use of vitamin D hormone therapy in chronic kidney disease patients has increased since paricalcitol was commercialized as Zemplar. Nearly 80 percent of patients on kidney dialysis now receive vitamin D hormone compared to approximately 60 percent in 1999. Paricalcitol generates more than $30 million each year in royalties for th



CP Biology Final Essay

Name: [redacted]

Scientist(s):

Paul Berg

Institution:

Stanford University

Summarize the subject or area of research that is being conducted below:

Paul Berg won a Nobel Prize in 1980 for Chemistry. Berg was born the 30th of June, 1926 in New York City, New York. At the time of the award he was affiliated with Stanford University. He was awarded this prize for his “fundamental studies of the biochemistry of nucleic acids, with particular regard to recombinant-DNA”.

Berg grew up in Brooklyn where a teacher of his awakened his interest in science when the teacher encouraged the students to conduct their own research projects. Berg was studying biochemistry at Pennsylvania State University up until WWII when he served on a submarine before he received his degree in1948. He then went to receive his Doctorate at Case Western Reserve University, after a period at Copenhagen, he worked with Arthur Kornberg in St. Louis, Missouri. Berg made his Nobel Prize awarded discovery at Stanford University. After that in 1947 he married Mildred Levy, and the couple had a son, John.

DNA carries organisms' genomes and also determines their vital processes. The ability to artificially manipulate DNA opens the way to creating organisms with new characteristics. In conjunction with his studies of the tumor virus SV40, in 1972, Berg succeeded in inserting DNA from a bacterium into the virus' DNA. Berg thereby created the first DNA molecule made of parts from different organisms. This type of molecule became known as hybrid DNA or recombinant DNA. Among other things, Berg's method opened the way to creating bacteria that produce substances used in medicines.

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Paul Berg The Nobel Prize in Chemistry 1980
Born: 30 June 1926, New York, NY, USA
Affiliation at the time of the award: Stanford University, Stanford, CA, USA
Prize motivation: “for his fundamental studies of the biochemistry of nucleic acids, with particular regard to recombinant-DNA”
Prize share: ½

Life: Paul Berg grew up in Brooklyn. A teacher awakened his scientific bent when she encouraged students to conduct their own research projects. Berg was studying biochemistry at Pennsylvania State University when World War II broke out. He served on a submarine before obtaining his degree in 1948. He received his doctorate at Case Western Reserve University, and after a period in Copenhagen, he worked with Arthur Kornberg in St. Louis, Missouri. Berg made his Nobel Prize-awarded discovery at Stanford University. In 1947 he married Mildred Levy, and the couple had a son, John.

Work: DNA carries organisms' genomes and also determines their vital processes. The ability to artificially manipulate DNA opens the way to creating organisms with new characteristics. In conjunction with his studies of the tumor virus SV40, in 1972, Paul Berg succeeded in inserting DNA from a bacterium into the virus' DNA. Berg thereby created the first DNA molecule made of parts from different organisms. This type of molecule became known as hybrid DNA or recombinant DNA. Among other things, Berg's method opened the way to creating bacteria that produce substances used in medicines.

CP Biology Final Essay

Name:

[redacted]

Scientist(s):

GLEN KWON & KEVIN KOZAK

Institution:

University of Wisconsin-Madison

For people that have metastatic lung or metastatic breast cancer, the chances for successful treatment are limited and even the best outcomes may result in a diminished quality of life. But at The University of Wisconsin-Madison they work to create things that can enhance the chance for a cure and treatment for people.

Driven by the knowledge that their unique combination of skills may save lives, pharmaceutical researcher Glen Kwon and radiation oncologist Dr. Kevin Kozak hope to make a difference. The two University of Wisconsin-Madison faculty members are developing a new drug combination and delivery method that promises to attack hard-to-treat solid tumors.

“Existing therapies are woefully inadequate for these kinds of tumors with four out of five lung cancer and three out of five metastatic breast cancer patients not responding to conventional treatments,” said Kozak, an assistant professor in the human oncology department with the School of Medicine and Public Health. “For patients and their families, these are devastating diagnosis. Yet when faced with these odds, the patients tend to be incredibly altruistic and often say they would like to be a part of something that could one day help others in the same situation. As a physician, I want to help expand the toolbox of options we have for them.”

With support from the Wisconsin Alumni Research Foundation’s Accelerator Program, Kwon and Kozak are working on a potent new combination of drugs and using nanoparticles called polymeric micelles to deliver the “drug cocktail.” Called Triolimus (tree-oh-LEE-miss), the three-in-one nanomedicine also serves as a possible focus of their startup company Co-D. Co-D’s efforts center on Kwon’s research into methods for improving drug delivery with new and existing drugs.

Kwon, a School of Pharmacy professor, hit on the concept for Triolimus after becoming convinced that three existing medicines weren't achieving their full potential to help patients due to drug delivery concerns. The medicines – paclitaxel, rapamycin and 17-AAG – possess varying levels of effectiveness and work against different molecular targets to interfere with tumor cell growth and proliferation.

"These medicines need to be injected or infused by the intravenous route and the challenge was to achieve a stable, safe and sterile IV vehicle for combination cancer treatment," Kwon said. "When you combine them and enable IV administration, they show a powerful synergistic effect with nonoverlapping side effects. That could mean a longer life and a better life for patients."

But bringing paclitaxel, rapamycin and 17-AAG together as a three-in-one nanomedicine was unprecedented. Kwon said key challenges included a lack of water solubility of the medicines, poor stability and toxicity associated with existing IV vehicles such as surfactants and ethanol. Getting the desired ratio right also required significant effort.

After several years of experimentation, Kwon discovered a surprisingly simple way to formulate the three drugs as a three-in-one nanomedicine for IV injection or infusion: the three drugs and polymer (PEG-PLA) are dissolved in acetonitrile and evaporation of the organic solvent by reduced pressure leaves behind a thin amorphous film of the combined medicine and polymer. When mixed with water, the thin film dissolves, assembling into drug-loaded PEG-PLA micelles—tiny spherical beads that enable sterile filtration, IV injection or infusion of Triolimus as well as drug delivery to the intended destination.

Beyond its effectiveness in halting the growth of tumors and limiting their spread, part of the beauty of Triolimus lies in its scalability. The fact that it does not require the introduction of more complicated chemical or mechanical processes ultimately makes it more appealing to potential industry partners looking to manufacture it in large quantities, Kwon said.

In the meantime, however, Kwon and Kozak acknowledged they have their work cut out for them. They launched the startup company Co-D after recognizing growing reluctance in the pharmaceutical industry to take on many early-stage risks related to drug development.

CP Biology Final Essay

Name:

[redacted]

Scientist(s):

WILLIAM L. MURPHY

Institution:

University of Wisconsin Stem Cell and Regenerative Medicine Center

Summarize the subject or area of research that is being conducted below:

How Murphy's studies are discovering a new way for bone building formula for surgical replacements. Last year there were a combined total of 500,000 knee and hip replacements, but from those the bone doesn't heal properly and leading to even more surgery to fully recover the hip or knee. More pain from the second surgery and thousands of dollars thrown down the drain because of the failed surgeries. Surgeons are coming up with a new way to make less pain for the patients and avoiding having to come back for more surgery. It is a bone building mixture that combines short amino acids that can combine the bones that are broken or need to be replaced. Murphy has come up with a replacement that involves strengthening the bond of the peptide molecule and hydroxyapatite coatings.

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More than half of all chronic conditions in adults over age 50 are related to bone and joint diseases.

As a result, joint replacement surgeries are on the rise — last year about 200,000 hip replacement and 300,000 knee replacement surgeries were performed. Unfortunately, these procedures may result in bone-implant connections that don't heal properly, ultimately leading to implant failure and revision surgery. This of course creates additional stress and pain for patients while driving up the cost of health care by billions of dollars.

Surgeons may soon be able to reverse these negative outcomes through use of a new modular peptide growth factor, a bone building mixture featuring short threads of amino acids that can bind to implants and locally stimulate new bone growth. Animal studies show the unique, biologically active molecule in the formula improves bonding between orthopedic implants and

bone and actually accelerates healing at the repair site, thereby reducing the serious side effects that often result in implant failure.

Researchers led by William L. Murphy, associate professor of biomedical engineering and orthopedics and associate director of the University of Wisconsin Stem Cell and Regenerative Medicine Center, inserted two key components into the modular peptide structure: a biologically active growth factor for stimulating bone growth and a binding factor for strengthening the bond between the peptide molecule and the hydroxyapatite coatings on the implants.

Murphy was surprised by how quickly and strongly the modular peptide molecules attached to implants and bone tissue stimulated new bone formation.

“The level of control that an orthopedic surgeon will have when using these biologically active molecules will be important,” says Murphy. “For example, the peptides can ‘activate’ a variety of implants, ranging from natural bone grafts to metal hip prosthetics. They can also be applied in the operating room by simply ‘dip-coating’ or ‘painting’ the surface of an implant with a peptide solution.”

“We will continue to work on demonstrating how these molecules can target, accelerate and improve implant-bone healing in scenarios that are especially challenging,” adds Murphy. “One particular focus will be on showing that these molecules are effective in helping particular bone defects that are known for not healing well. Examples include large bone defects that result from trauma, or fibrous tissue gaps that are similar to the aseptic loosening that can happen with total joint implants.”

CP Biology Final Essay

Name:

[redacted]

Scientist(s):

SUNDARAM GUNASEKARAN

Institution:

Wisconsin Alumni Research Foundation

Summarize the subject or area of research that is being conducted below:

The scientist I was given is an inspiration to us all. Helping people make better food. Better choices with the food we eat. He's trying to find bad chemicals in food and get rid of them.

Cut and paste the text from the source website page below

To see the world – or the supermarket aisle – through the eyes of a food engineer is an epiphany. Marshmallows become spring systems. Apples appear non-isotropic. A bag of Cheetos suddenly poses questions of viscosity, extrusion and tensile stress.

Fail to maintain proper mechanical strength and the Cheetos could turn to orange dust before they hit the shelves, says Sundaram Gunasekaran, a UW-Madison professor of biological systems engineering.

“The number of engineering problems that revolve around food, whether natural or manufactured, is as complicated as any other engineering problem,” he says.

Gunasekaran draws an analogy between two classical processes: making bricks and baking bread. Both involve ratios, heat and chemical reactions. So why do we take one for granted?

“Consumers don’t realize engineering is involved and the problems are actually more challenging because many foods are alive and changing,” he says. “Concrete is concrete. Steel is steel. But cheese today is different from the cheese yesterday or tomorrow.”

Food has proven a rich problem space for Gunasekaran over the years, yielding numerous disclosures and partnerships with major industry players including Tyson and Intel.

At first glance his WARF technologies seem wildly diverse: a quick and easy test for dangerous bacteria; biodegradable glue from animal byproducts; electrodes with low-cost replaceable tips, to name a few.

But follow the breadcrumbs and they all lead back to his fascination with food quality and safety.

In his quiet office in the Agricultural Engineering building it is easy to forget that a crisis is brewing. The latest Salmonella outbreak has killed two people and sickened 300.

The numbers are expected to rise because this time the culprit is cucumbers, which are often sold individually and not labeled. There is almost no way for consumers to know if they're eating a recalled variety, admits an FDA official.

The latest outbreak comes on the heels of several others linked to tainted ice cream, peanuts and cantaloupes.

And most incidents don't make headlines. Every year an estimated 48 million Americans (that's one in six of us) get sick from foodborne illness. Approximately 3,000 die.

The hazards are many. Gunasekaran knows that bacteria, toxins, allergens, pesticide residues and other pollutants pose a constant threat. He's working on new biosensors to detect many of these contaminants. The technology is based on nanomaterials.

"Nanotechnology is rather slow coming to the food industry," he says. "When we started working with these materials for quality and safety applications it was a major transition."

He wants to empower everyone along the food chain to make good decisions.

"We can all agree on the idea of making it simple for a wide variety of people, whether it is the inspector or the mom feeding her baby at home," he says. "They all care about safety and quality."

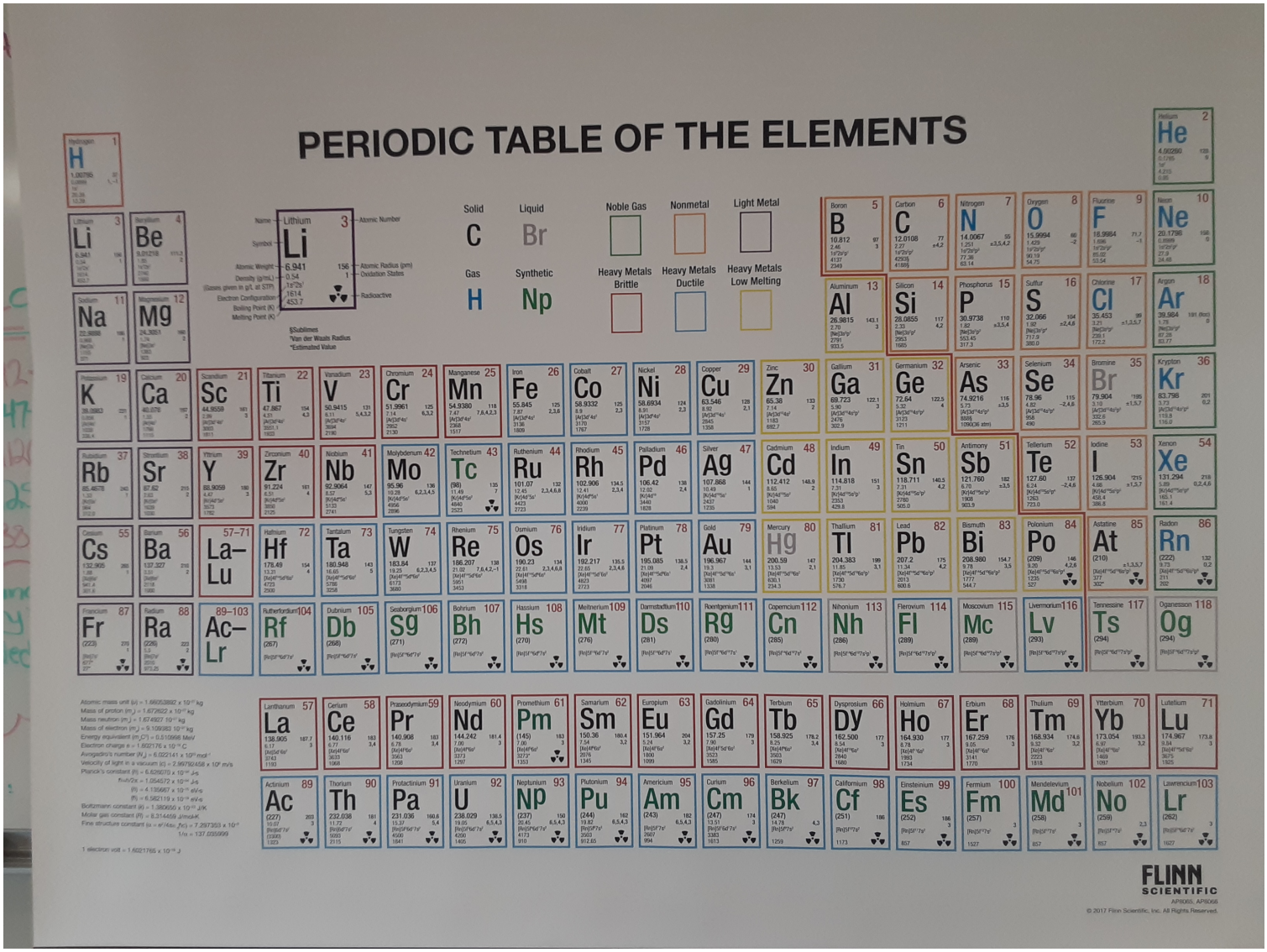
He offers a few examples of the kinds of advancements he hopes to see some day – food packages with indicators that change color as the due date approaches or quality degrades; an easy food allergen test that works like today's blood sugar monitors.

"Allergies are extremely dangerous, especially to children," he says. "If a diabetic patient can draw blood and test it at home, there is no reason someone couldn't put a food or juice sample on a test electrode to determine what is in it."

Of course, these consumer-level applications will take time to unfold. And Gunasekaran has his work cut out for him, teaching classes when he's not experimenting with new and improved nanosensors.

But is he a picky eater?

“I’m aware of what could go wrong,” he says. “So I tend to be careful. Not picky, but careful.”



CP Biology Final Essay

Name: [redacted]

Scientist(s):

Robert Thorne

Institution:

W.A.R.F

Summarize the subject or area of research that is being conducted below:

Robert Thorne is researching how to get to the brain and cure diseases that are in there. Robert's dad died of brain cancer which helps him with his research. The blood brain barrier is a very powerful barrier that can keep many substances out. Robert and his team want to bypass the barrier completely. Robert wants to use the nasal passway to get the drugs to the brain. Thorn and his team had a solution to spray the nasal to make them vulnerable.

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"There are lots of potential drugs we can use to treat brain disorders like cancer, Alzheimer's, Parkinson's, you name it. Most major universities have big science programs that will go on identifying fantastic drug candidates." "My father died of brain cancer about 25 years ago. I know through that experience with him where the limitations are." "The blood brain barrier is the gold standard of barriers," says Thorne. "It's tight. It has all sorts of mechanisms to keep substances out." Thorne and his team are pursuing an alternative strategy. Rather than trying to slip through the blood brain barrier, bypass it altogether. The neurons in our nasal passageways are surprisingly exposed to the outside world, Thorne explains. When you sniff a glass of wine, for example, scent-carrying particles called odorants drift into the nose and physically bind to receptors.
These easy-access neurons could serve as bridges to the brain for medicine. There's a catch.
The nasal epithelium is a barrier, and the larger drugs still have trouble penetrating. Thorne and his team offer a solution. They realized that exposed neurons are vulnerable neurons, perpetually dying and sprouting like seedlings. How? A protein factor naturally found in the nose, called matrix metalloproteinase-9 (MMP-9), loosens the nasal epithelium like a fresh rain.

Spray the nasal passageway with an extra dose of MMP-9 and what happens? Will it help the big drugs pass through? Will the epithelium seal back up? Is it toxic?

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Nadar Behdad

Institution:

Wisconsin Alumni Research Foundation

Summarize the subject or area of research that is being conducted below:

Nadar Behdad is an inventor studying a way to find and cook cancer cells. He is planning on using an antenna to track cancer cells and emit microwave radiation. However he was stuck because he could not beat the laws of physics. Behdad got inspiration from the Ormia ochracea. An Ormia ochracea is a small fly that has really accurate hearing called super resolving directional hearing. The fly inspired a small antenna GPS that triangulates positions. The GPS antenna is inserted into cancerous cells and raises the temperature to 60 degrees celsius to cook the cells. A breakthrough showed that when using higher frequencies the antenna could be created smaller so someday they might be able to be inserted into a vein or through catheters. Nader Behdad and his team's next step is making a company and commercializing.

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Nader Behdad's laboratory in Engineering Hall seems to buzz with a hundred ideas. Boxy power amplifiers line the back wall while copper clippings curl across the tabletop. A partition in the middle of the room – for firing electromagnetic waves – requires a little footwork.

An entrepreneur, inventor and father, Behdad is happy juggling a caseload of students and collaborations. He has been involved with the Accelerator Program on several different projects since joining UW-Madison in 2009.

Behdad's journey to Wisconsin crisscrosses continents. Originally from Iran, he graduated from Michigan and found himself turning down a job offer in the biomedical sector. After a stint in Florida he returned to the Midwest academic life.

Along the way he's learned that frustration can bear fruit. Behdad has devoted countless hours to studying electrically 'small' antennas (small relative to the electromagnetic wavelengths that

they receive and transmit). After eight years and a Ph.D., he felt he'd hit a wall of physical limitations.

"We can't beat the laws of physics," he says. "But the demand is out there."

From inconspicuous military communication systems to the innards of a cell phone, the demand to create ever smaller antennas continues to push the bounds of reality.

In a stroke of insight, Behdad has looked to nature for a solution. He points to Ormia ochracea, a small fly native to the southern United States. Despite its minute size (its ears are separated by a mere half millimeter), the bug can precisely identify where a sound is coming from down to a degree or two. This is called super resolving directional hearing.

"We looked at these insects and tried to figure out how they accomplish this," Behdad says. "We designed so-called biomimetic antennas based on the concept."

Support from the Accelerator Program is helping his team build a proof-of-concept prototype. Applications include military tracking and civilian navigation systems. For example, Behdad describes a kind of indoor GPS device for triangulating one's position within a building.

In upcoming field tests, the team will take the antennas outside and try to pinpoint various FM broadcast stations scattered across Madison.

Back in Engineering Hall, Behdad's conversation turns to another topic. He brandishes a handful of what resemble slender glass needles. Actually they are antennas, designed to be inserted into a cancer patient and emit microwave radiation.

"Think about your microwave oven," says Behdad. "It's exactly the same physical phenomenon. But instead of an oven, we have tiny antennas that we embed in cancerous tissue to cook it."

Raise the temperature of diseased tissue to about 60 degrees Celsius and cells begin dying within seconds.

But not all microwave ablation antennas are created equal, Behdad explains. One of the probes (stained with a recent liver sample) is slimmer than the others. This is because it isn't attached to a device called a balun, a kind of conductor that surrounds the main antenna and prevents electric currents from running along the shaft and burning surrounding tissue.

The attachments have been necessary for years, until a team consisting of Ph.D. student Hung Luyen and his advisers Nader Behdad and Susan Hagness designed a balun-free antenna that is safe and less invasive. Their design utilizes a natural chokepoint to stifle any stray current.

"It's the difference between inserting a thick needle into the body versus a very fine one," says Behdad.

But thinner antennas are only the beginning. The most remarkable improvement is invisible. Several years ago, discounting decades of precedent, Behdad and Hagness began investigating higher frequencies.

“Over the past 20 or 30 years almost all engineers ignored one interesting concept,” Behdad says. “Everybody was looking at relatively low frequencies, the same ones that your microwave oven works at.”

The field had long believed that this low frequency, long wavelength energy works best because it is able to penetrate deeply into tissue. Crank up the frequency and the energy fails to penetrate, said the consensus.

But Behdad and Hagness started looking at frequencies in the 10 gigahertz range (roughly 10 times higher than conventional wisdom). Intriguing computer simulations were followed by promising experiments and surprising blackboard physics.

“No one had done the comparison we had done,” Behdad says. “It was the first experiment that showed that using higher frequencies had merit.”

Merit, and one groundbreaking advantage.

“At higher frequencies the antennas can become smaller,” he says.

So small they may one day be routed through a vein or twined through catheters to reach tumors of the lung, liver or kidney.

The therapeutic potential for slimmer, smaller antennas is vast. But there is much work yet to be done and WARF is helping. So far the experiments have been ex vivo, using dead tissue. Behdad, Hagness and their team now want to run tests in blood perfused liver samples, then progress to studies in animals.

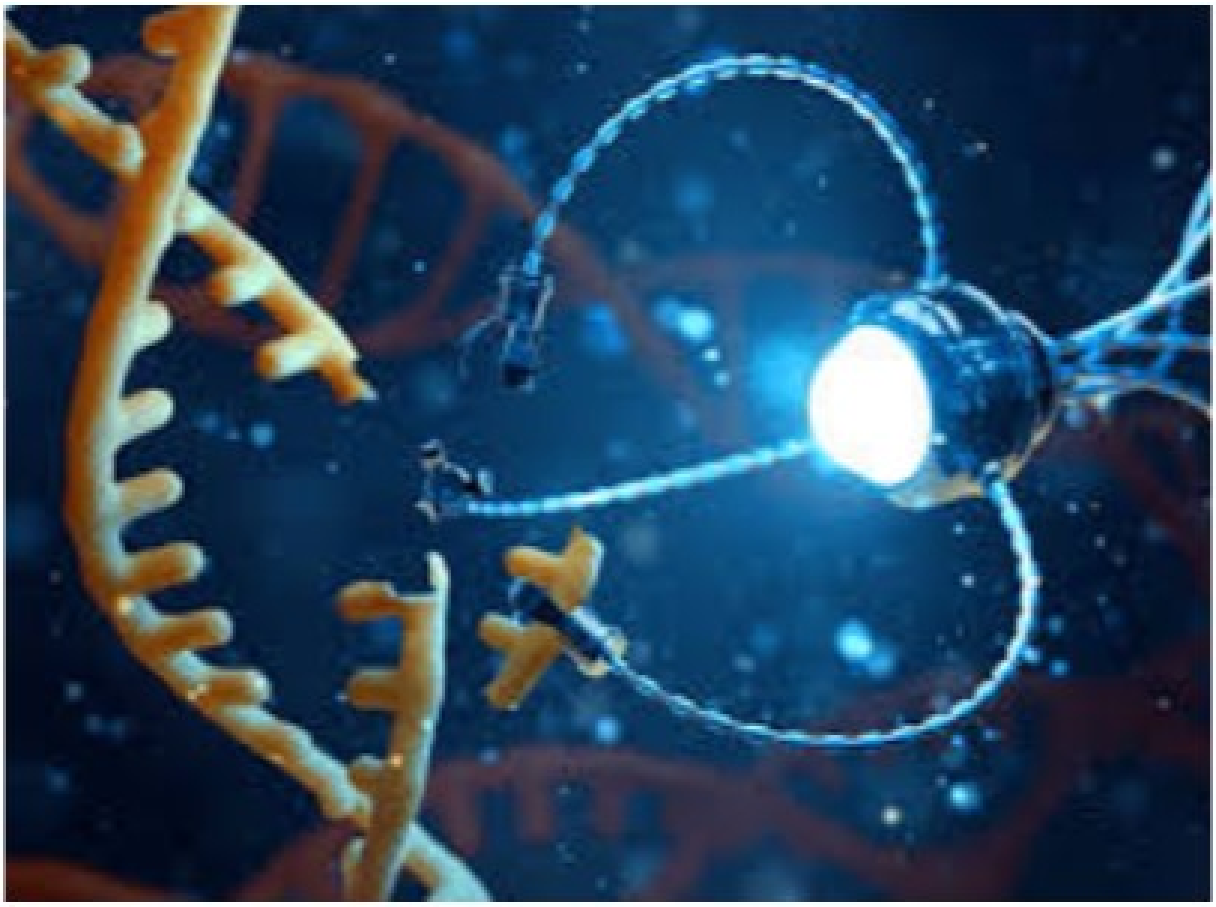
“Support from the Accelerator Program has been very helpful,” says Behdad. “Especially with some of the applied parts of the work that are really important for commercialization.”

The team recently completed a large-scale study comparing their new designs against antennas on the market. Behdad says his past experience in the Accelerator Program has taught him that a good technical solution may not be enough to attract interest from large industry players. He says he is actively interested in a startup.

“This is something we can design and build,” he says. “Our main focus is to set up a company and commercialize it ourselves.”

Does he find time to sleep?

“Part of the reason I’m working on so many different things is that after a while I get bored and need to find new things to do,” he laughs.



CP Biology Final Essay

Name: [redacted]

Scientist(s):

Yoshi Kawaoka

Institution:

The Wisconsin Alumni Research Foundation

Summarize the subject or area of research that is being conducted below:
The subject that they are studying is vaccines for the influenza virus.

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> The Wisconsin Alumni Research Foundation (WARF), the private, nonprofit patenting and licensing organization for the University of Wisconsin–Madison, and FluGen, a local startup company that develops influenza vaccines and treatments, have signed license agreements for a technology that has the potential to significantly improve the way influenza vaccines are manufactured.
>
> "Flu vaccines today are manufactured in embryonated chicken eggs," says Paul V. Radspinner, president and CEO of the company. "The current method is expensive and risky because it involves predicting in advance which flu virus will affect the population and then growing that specific virus in the eggs."
>
> Radspinner noted that the current technique can take up to nine months and may not work during an avian-based pandemic because the bird flu virus itself may prove lethal to the eggs.

FluGen is built on technology created by Yoshihiro Kawaoka, a professor in the UW–Madison School of Veterinary Medicine and one of the world's leading influenza experts, and Gabrielle Neumann, a virologist at UW–Madison. Earlier technologies from the Kawaoka laboratory already are changing the influenza vaccine industry by providing more cost-effective, flexible and speedier methods to manufacture vaccines.

"Dr. Kawaoka is an internationally regarded expert in avian influenza. The university, WARF and the state of Wisconsin recently collaborated to provide Dr. Kawaoka the means to create the Influenza Research Institute, which is part of the UW School of Veterinary Medicine," says Carl E. Gulbrandsen, managing director of WARF. "Dr. Kawaoka, his institute and his company FluGen are important ingredients in maintaining the UW–Madison's prowess as a major research powerhouse and our capital region as a nationally significant and growing hotbed of biotechnology. We're very pleased to be able to work with him."

Kawaoka co-founded FluGen last summer with Neumann and Radspinner, a former WARF licensing manager whose industry experience includes more than 15 years in leadership positions with Eli Lilly and Deltanoid Pharmaceuticals.

FluGen, based in Madison's University Research Park, initially will focus on improving the way flu vaccines are manufactured. All major influenza vaccine manufacturers are in the process of developing vaccines that will be produced within cells rather than the embryonated eggs, which will dramatically increase the speed and reduce the expense of making the vaccines, according to Radspinner.

FluGen's new technology makes this new manufacturing process faster and less expensive by increasing vaccine yield substantially. This could lead to the need for smaller facilities and less time to produce the appropriate vaccines, which could be critical in the event of a "bird flu" pandemic.

FluGen also intends to commercialize improved influenza vaccines and conduct research aimed at finding more effective ways to treat people infected with the virus.

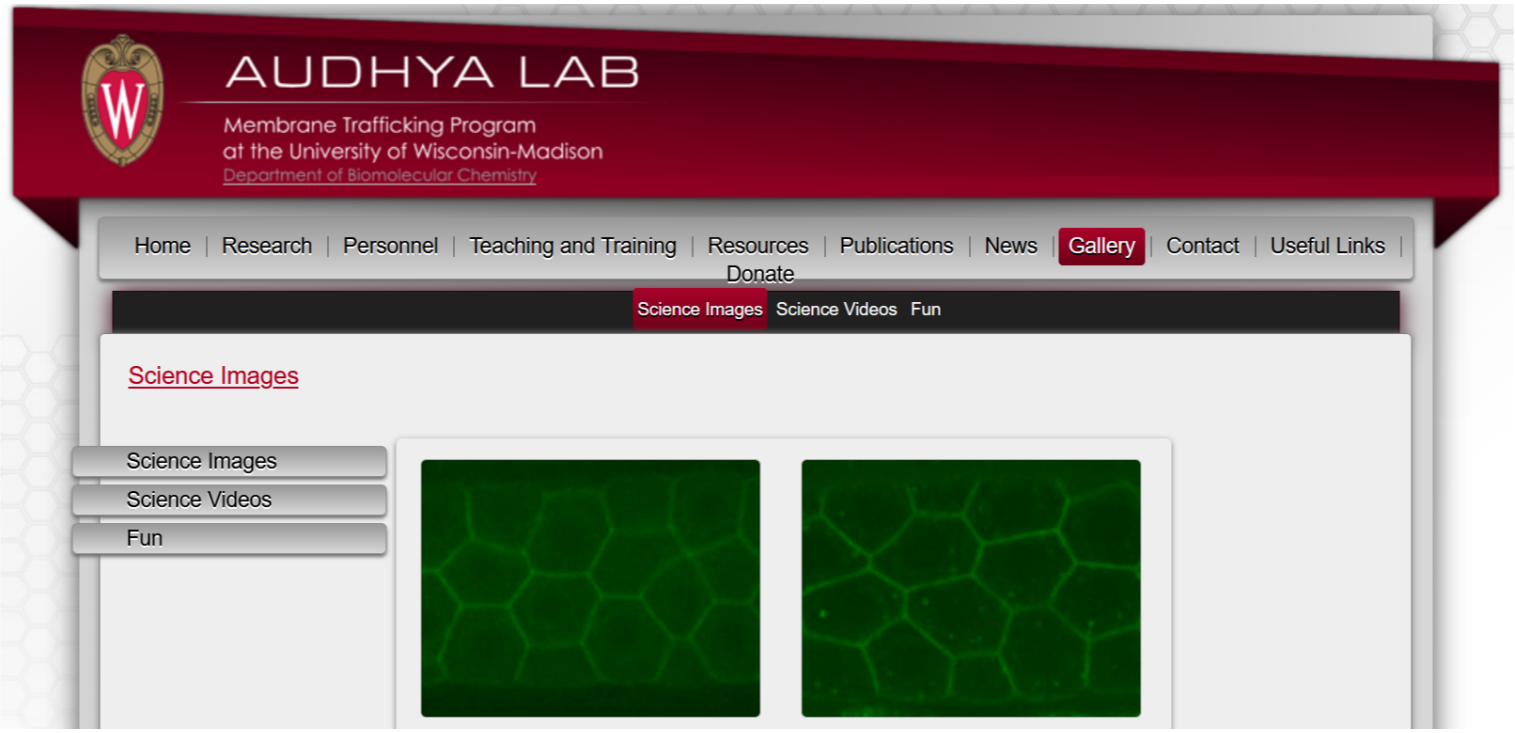
The company, which will collaborate with the new UW–Madison Influenza Research Institute led by Kawaoka, has received more than $2 million in angel investments thus far. It also recently was certified to receive investor tax credits from the state of Wisconsin.

"This is a great example of how UW, WARF, the local angel investment community and the state of Wisconsin are working together to spur economic development," says Radspinner. "This company, like other exciting new biotech ventures, will lead to higher-paying jobs that will help us keep more new UW graduates in Wisconsin."

FluGen is a Madison, Wis.-based company focused on the prevention and treatment of both seasonal and pandemic influenza worldwide. The company was founded in 2007 by Kawaoka, Neumann and Radspinner to address three specific areas: increasing vaccine virus yields in cell culture, developing better influenza vaccines and producing new ways to treat the disease.

WARF supports world-class research at UW–Madison by protecting the intellectual property of university faculty, staff and students, and licensing inventions resulting from their work. Through these efforts, university ideas benefit the public by bringing resources back to the

university to continue the cycle of investment, research and invention. WARF was established in 1925 as the world's first university-based technology transfer office.



Click the above photo to check this lab out at the U.W.Madison

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Jim Dumesic

Institution:

Summarize the subject or area of research that is being conducted below:
Dumesic works in breaking down biomass. He uses a method called gamma valerolactone, or GVL. The method was faster and cheaper than the competitors.

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THE SPARK

Having scaled up production by double digits, momentum builds behind new biomass process

For a world hooked on fossil carbons, the vials of amber syrup in Jim Dumesic's lab are full of sweet potential.

Dumesic's group caused a stir in research circles and the media in 2014 by publishing a paper in the journal Science describing a new scheme for breaking down biomass and unlocking its polysaccharides. Those sugars – candy for microbes – can be fermented to ethanol or upgraded into a host of high value chemicals currently made from petroleum.

The development of this new scheme was funded by Great Lakes Bioenergy, one of three Bioenergy Research Centers supported by the Department of Energy Office of Science.

At the crux of their method is a solvent derived from biomass itself, called gamma valerolactone (GVL). It's an elegant process. The GVL created in the reaction is recycled and used to drive it again.

The method appears to be faster and cheaper than its competitors. It doesn't rely on pricey enzyme cocktails that take days to work and must be tailored to the reactants.

“Our process can work in a matter of hours and on any biomass we have ever used such as corn stover, wood, leftovers from sugar cane and residues from paper mills,” says Dumesic, a professor of chemical and biological engineering.

But he knew that a process that works beautifully in 50 milliliter batches would have little practical value to a biorefinery operating on tens of tons.

With support from the WARF Accelerator Program and State of Wisconsin funding available to the Wisconsin Energy Institute, Dumesic and his team have spent the past 18 months proving their method can scale up.

Back in his office on campus, he says the funding partnership has been “essential to move the process ahead,” and shares the exciting results with an engineer’s sobriety.

And the results are exciting indeed. He reports that the team has bumped up production by 80-fold, with sugar yields topping 75 and 65 percent for xylose and glucose, respectively. Along the way they’ve learned to streamline steps and optimize factors like reaction temperature and acid concentration.

In addition to the sugars, they’re also producing strong streams of ‘native’ lignin that can be used for a variety of products from construction materials to paint. (‘Native’ means the lignin is not chemically altered by the process and therefore prized by researchers normally restricted to the byproducts of paper mills.)

Achieving these milestones took an unexpected collaboration.

Colleagues in the engineering department and at the Forest Products Laboratory helped Dumesic ‘cobble on’ to a reactor already in use, saving significant time and resources.

He credits the WARF Accelerator program for bringing the two camps together.

“The funding enabled us to work with the Forest Products Laboratory to modify their apparatus. Without that we never could have scaled up to the two liter level. No way.”

Now, those same colleagues are interested in taking things to the next level by designing an extruder system that operates in a continuous flow mode, like a real refinery. This would make the entire process more commercially viable – a point brought home by the Accelerator Program’s expert Catalysts.

“They tuned up our vision of where we want to take this,” says Dumesic. “That means we need a system that takes biomass, feeds it to a reactor and sends it through in a continuous process. No one has been able to do that yet.”

Dumesic, a faculty member at UW-Madison since 1976, has no illusions. He is the first to acknowledge the economic headwinds facing the biofuels movement. Cheap gasoline remains the biggest obstacle.

“If you only target biofuels you are going to lose,” he says.

His research takes a broader scope. Industrial chemicals, pharmaceuticals, polymers, even lubricants – many of these products can be made from sustainable resources and compete on price.

“Gasoline is very easy to make from petroleum. All you do is distill it. But you can make the case that other things like lubricants are harder to make from petroleum and rather easy to make from renewables,” he says. “So there is a market there.”

And Dumesic is no stranger to the private sector. With support from WARF he has helped found two startup companies in recent years, Virent Inc. and Glucan Biorenewables. He continues to serve as an advisor to the latter.

From experience, he knows that moving discoveries from the academic lab to the private sector often requires support from federal, state and local sources like WARF.

In both cases Dumesic provided the initial spark before passing the torch to younger researchers in his lab.

“It’s possible but very challenging to be a professor and stay with a startup,” he says. “Oftentimes it’s the graduate students and postdocs who want to run with it and get the technology out into the real world.”

Glucan Bio, with a location in the University Research Park in Madison, is taking the GVL method in several interesting directions. One of these relates to the production of a valuable chemical feedstock called furfural, found in agricultural formulations, herbicides and flavorants.

Furfural production has gone almost entirely to China, says Dumesic, because the process of making it is energy intensive and traditionally requires corn cobs.

“The way corn is harvested now, no one is saving the cobs,” he says. “So there is no domestic source of furfural currently available.”

Glucan Bio wants to be that source. If the technology they are developing specs out, the main importers of furfural are eager to talk.

In the meantime, Dumesic is busy teaching courses on chemical kinetics and keeping up with a dynamic biomass community stretching from Asia to the Iowa cornfields.

But he can still take a moment to reflect on the humor of his 40 years at UW-Madison.

“As part of my startup package I got an HP-45 calculator,” he smiles. “And all the figures in my thesis were drawn with India ink.”

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Matthew Porteus

Institution:

Stanford profiles

Summarize the subject or area of research that is being conducted below:

Dr. Portus studied Hematopoietic Stem Cell Transplantation. For Dr. Portus' fellowship and post-doctoral research he began his studies in developing homologous recombination as a strategy to correct disease causing mutations in stem cells as definitive and curative therapy for children with genetic blood diseases. This time of work has been the first to demonstrate that gene correction could be achieved in human cells at frequencies that were high enough to potentially cure patients; because of this, Dr. Portus is considered one of the founders and pioneers of the field of genome editing. His research program continues to focus on developing genome editing by homologous recombination as curative therapy for children with genetic diseases.

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Dr. Porteus was raised in California and was a local graduate of Gunn High School before completing A.B. degree in "History and Science" at Harvard University where he graduated Magna Cum Laude and wrote an thesis entitled "Safe or Dangerous Chimeras: The recombinant DNA controversy as a conflict between differing socially constructed interpretations of recombinant DNA technology." He then returned to the area and completed his combined MD, PhD at Stanford Medical School with his PhD focused on understanding the molecular basis of mammalian forebrain development with his PhD thesis entitled "Isolation and Characterization of TES-1/DLX-2: A Novel Homeobox Gene Expressed During Mammalian Forebrain Development." After completion of his dual degree program, he was an intern and resident in Pediatrics at Boston Children's Hospital and then completed his Pediatric Hematology/Oncology fellowship in the combined Boston Children's Hospital/Dana Farber Cancer Institute program. For his fellowship and post-doctoral research he worked with Dr. David Baltimore at MIT and CalTech where he began his studies in developing homologous recombination as a strategy to correct disease causing mutations in stem cells as definitive and curative therapy for children with genetic diseases of the blood, particularly sickle cell disease. Following his training with Dr. Baltimore, he took an independent faculty position at UT Southwestern in the Departments of Pediatrics and Biochemistry before again returning to Stanford in 2010 as an Associate Professor. During this time his work has been the first to demonstrate that gene correction could be achieved in human cells at frequencies that were high enough to potentially cure patients and is considered one of the pioneers and founders of the field of genome editing—a field that now encompasses thousands of labs and several new companies throughout the world. His research program continues to focus on developing genome editing by

homologous recombination as curative therapy for children with genetic diseases but also has interests in the clonal dynamics of heterogeneous populations and the use of genome editing to better understand diseases that affect children including infant leukemias and genetic diseases that affect the muscle. Clinically, Dr. Porteus attends at the Lucille Packard Children's Hospital where he takes care of pediatric patients undergoing hematopoietic stem cell transplantation.

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Mike Sussman & Melanie Ivancic

Institution:

UWM

Summarize the subject or area of research that is being conducted below: Cologuard is a noninvasive stool-based test that may very well be the best of its kind. Colorguard received a thumbs up by the government task force that evaluates and recommends screening tests for detecting hidden disease.

Cut and paste the text from the source website page below

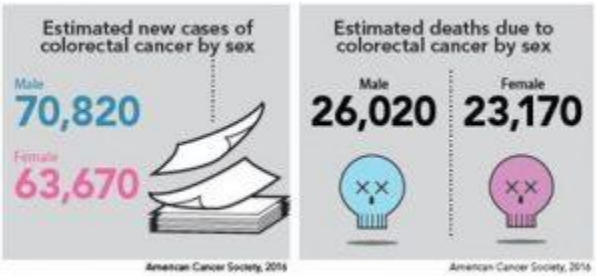
Local biotech company Exact Sciences made headlines in 2014 when it received FDA approval for a potentially transformative screening test for colorectal cancer. The noninvasive stool-based test, called Cologuard, just may be the best of its kind. This past June the company made news again when Cologuard received a thumbs up from a governmental task force that evaluates and recommends screening tests for detecting hidden disease.

In a lab a few miles away, UW biochemistry professor Mike Sussman likes what he sees. Sussman, along with postdoctoral researcher Melanie Ivancic, is busy taking a different and likely complementary approach.

Support from the Accelerator Program is helping their team develop a blood test for predicting colon cancer early and effectively. They recently achieved a major milestone – this summer they doubled the size of their pilot study and successfully collected serum samples from almost 300 patients.

“What makes our test significant is that it is looking at the final product (protein) and not the blueprint (DNA),” says Ivancic. “The test is done in blood rather than stool, which is likely to increase the compliance rate of testing.”

They plan to analyze each sample using mass spectrometry, searching for a small set of protein biomarkers they believe indicate pre-cancer or cancer. Preclinical results suggest their test could detect the disease at an early stage and may outperform or complement other diagnostic methods, including Cologuard.



The need is real. Colon cancer claims more than 600,000 lives worldwide every year. When detected early the five-year survival rate exceeds 90 percent but, tragically, about one-third of patients are not up to date on their screening. In part this is because colonoscopy is seen as invasive and inaccessible in many areas.

“Colonoscopy remains the gold standard but it’s not perfect,” says Ivancic. “It requires anesthesia, there are some risks associated with perforation, it’s expensive and compliance is low.”

Her team is not trying to replace the procedure. Rather, they envision their test as an inexpensive and easy first line of defense. Imagine it – a routine blood draw at the doctor’s office that gets more people screened than ever before, and identifies those at risk to undergo further testing.

The dream, of course, is premature. Immune to hype, Sussman and Ivancic are seasoned investigators committed to research as it should be. That means honest data, unimpeachable methods and a healthy perspective.

“This is not a slam dunk,” says Sussman, recognizing that mass spectrometry is a complex tool for mainstream blood work.

Still, his excitement breaks through.

“Melanie is not only detecting proteins but specific parts of proteins,” he says. “We went from thousands of possibilities to these few that we know are changing.”

Given their early success, the team now finds itself wrestling with research questions of a different nature.

“How would we manufacture this product? How do we do it on a large patient scale? Right now in the academic setting we don’t have the capabilities of running millions of samples,” says Ivancic. “How do we practically move this project forward?”

For help answering some of these questions the team applied and was recently admitted into the Discovery to Product (D2P) Igniter program on campus. Ivancic says D2P's expert mentors are working with them to assess several market-entry strategies.

She says that being in the two programs simultaneously – Accelerator and D2P – has been a great complement, helping them refine their technology while getting smart on business.

It's a long road on both fronts. But for Ivancic ("the heart and soul and brains and hands of this project," in Sussman's words), inspiration is personal.

"Of course the basic science is fun but in the end I'm driven by how this could help people," she says. "That's why I'm so invested in this project."

Post navigation

Weiping TangMark Cook

CP Biology Final Essay

Name: [redacted]

Scientist(s):

JIM STEELE

Institution:

WARF

Summarize the subject or area of research that is being conducted below:

Steele is a food scientist that has spent months creating a laboratory simulation of the human gastrointestinal tract as he works to develop a food additive that will protect against the ravages of clostridium difficile bacteria. 14,000 U.S. hospital patients die from C. difficile infection. C. difficile bacteria is notoriously difficult to eradicate from common surfaces and thrive in environments such as hospitals and nursing homes where residents often have compromised immune systems. Steele and his team are trying to understand how probiotics work; they've identified several strains of bacteria that stimulate a significant , protective response against clostridia. They are working to identify the right strain and right dosage to create the greatest benefit for patients.

Cut and paste the text from the source website page below TEELE STUDIES INFECTION-FIGHTING POWER OF A NEW PROBIOTIC BACTERIUM

UW-Madison Food Scientist Jim Steele holds a probiotic sample.

To an untrained eye, the bubbling beaker in Jim Steele's lab looks like a good idea gone bad.

As a lab assistant lifts the glass from its warm water bath, a turbid brown liquid swirls inside. It certainly won't win any beauty contests.

But it might save your life — at just 3 cents per serving.

Steele, a food scientist with the College of Agricultural and Life Sciences, has spent months creating a laboratory simulation of the human gastrointestinal tract and other test regimens as he works to develop a food additive that will protect against the ravages of Clostridium difficile bacteria. Each year, some 14,000 U.S. hospital patients die from C. difficile infection and thousands more develop serious complications from the bacteria, which causes severe diarrhea and other intestinal illnesses among patients whose natural gut microbiota has been altered by antibiotic treatment.

C. difficile bacteria are notoriously difficult to eradicate from common surfaces and thrive in environments such as hospitals and nursing homes where residents often have compromised immune systems. As a result, Steele says, his work promises important medical and scientific advances.

"From a broad scientific perspective, we're trying to understand how probiotics work," Steele says. "More specifically, we've identified several strains of bacteria that stimulate a significant, protective response against clostridia. Through the Accelerator Program, we're working to identify the right strain and right dosage to create the greatest benefit for patients."

By now, most consumers are familiar with the benefits of probiotics listed on the labels of some yogurt and other food products. Depending on the type of probiotic bacteria used, the health benefits may range from improved digestion to immune system support.

Until Steele's work, however, few understood the tremendous genetic variability of specific kinds of beneficial, probiotic bacteria. His team is focusing on Lactobacillus casei, an organism found in a wide range of environments, including the human mouth, ripening cheese and decomposing green plant material.

"The interesting thing about L. casei is the tremendous genetic variability, a large part of which arose about 8,000 to 10,000 years ago during the domestication of dairy cattle and advent of cheese production," Steele says. "Our work in genome sequencing indicates that on average, only about 60 percent of the genes are conserved while about 40 percent are variable. This means that L. casei strains differ from each other by hundreds of genes, and this variability opens up possibilities related to targeted strain-specific therapeutic benefits."

However, substantiating the benefits of a specific L. casei strain against dangerous C. difficile infections has meant thousands of hours of work for Steele, his graduate assistants and collaborators: Nasia Safdar from UW-Madison's School of Medicine and Public Health; Benjamin

Darien from the School of Veterinary Medicine; and Eric Johnson from the department of bacteriology.

Among the challenges has been creating a model system that replicates the harsh conditions present in the human gastrointestinal tract.

The system has been used to select L. casei strains that can survive passage to the small intestine, where it is hypothesized that they stimulate the host immune system to fight the C. difficile infection.

Other significant challenges have involved validating animal models of the disease. For example, certain breeds of laboratory mice don't display measurable symptoms of C. difficile infection while others succumb too quickly to the disease.

Steele's team also has been hard at work narrowing the potential strains of L. casei down to a few top performers. He started by isolating a promising group of samples drawn from wine isolates, corn silage, cheese and fecal samples. Now, with Accelerator Program funding, he is preparing to begin a final round of testing in mice. If the effort proceeds as expected, human clinical trials could be on the horizon.

Part of the beauty of L. casei is that this organism has been consumed safely by humans for thousands of years and hence the selected strain can be manufactured through routine processes similar to those already in place in the food industry. The relative ease of production and high volume processes also mean that an L. casei probiotic could be available at approximately 3 cents per serving, a commercially viable price.

"That's a very reasonable price given the tremendously high costs associated with treating C. difficile infections and the potential lifelong health implications," Steele says. "Given the public acceptance of probiotics and the ease of eating a cup of yogurt or smoothie every day during a hospital stay and for a time afterwards, the invention would have real potential to help people."

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Guri Sohi

Institution:

The Institute of Electrical and Electronic Engineers

Summarize the subject or area of research that is being conducted below:

The design of high-performance microprocessors.

Cut and paste the text from the source website page below

> University of Wisconsin–Madison computer sciences professor Gurindar "Guri" Sohi will be honored for techniques that contributed to the design of high-performance microprocessors.
> The Computer Society of the Institute of Electrical and Electronics Engineers and the Association for Computing Machinery named Sohi the recipient of the Eckert-Mauchly Award this month, citing his innovations in processor architecture and instruction-level parallel processing.
>
> Sohi will receive the 2011 Eckert-Mauchly Award, known as the computer architecture community's most prestigious award, at the International Symposium on Computer Architecture on June 7 in San Jose, Calif.
>
> A member of the UW–Madison computer sciences faculty since 1985, Sohi — now John P. Morgridge and E. David Cronon Professor of Computer Sciences — proposed new models for the design of microprocessors that can process multiple instructions of a computer program in parallel. His innovations are found today in almost every

microprocessor used from personal computers to powerful servers, and will soon be at work in smart phones and tablet computers.

Sohi's influence on leading-edge microprocessors includes the multiscalar paradigm — which guides the execution of a single, sequential program on multiple processing cores — and his research group's proposal of memory dependence prediction, which further improved microprocessor performance.

A fellow of the IEEE and ACM and member of the National Academy of Engineering, Sohi served as chair of UW–Madison's Computer Sciences Department from 2004 to 2008. He earned a bachelor's degree in engineering at Birla Institute of Technology and Science in Pilani, India, and master's and doctorate degrees in electrical and computer engineering from the University of Illinois.

The Eckert-Mauchly Award, initiated in 1979, recognizes contributions to computer and digital systems architecture and includes a $5,000 prize. The award was named for John Presper Eckert and John William Mauchly, who collaborated on the design and construction of the Electronic Numerical Integrator and Computer (ENIAC), the first large-scale electronic computing machine. Previous winners of the award include Wisconsin native Seymour Cray.

CP Biology Final Essay

Name: [redacted]

Scientist(s):

David Baltimore

Institution:

WARF

Summarize the subject or area of research that is being conducted below:

David Baltimore received a Nobel Prize in Physiology or Medicine. David Baltimore along with Howard Temin, discovered that viruses with genomes consisting of RNA can also be inserted into host cells' DNA. David went to Swarthmore college and majored in biology. He then switched to chemistry to carry out a research thesis. David went on to do much research and eventually won a Nobel Prize.

Cut and paste the text from the source website page below

David Baltimore
The Nobel Prize in Physiology or Medicine 1975
Born: 7 March 1938, New York, NY, USA
Affiliation at the time of the award: Massachusetts Institute of Technology (MIT), Cambridge, MA, USA
Prize motivation: "for their discoveries concerning the interaction between tumour viruses and the genetic material of the cell"
Prize share: ⅓

After Renato Dulbecco discovered that tumor viruses operate by incorporating their DNA into the DNA of host cells, David Baltimore and Howard Temin –independently of one another–discovered that viruses with genomes consisting of RNA can also be inserted into host cells' DNA. This takes place through an enzyme known as reverse transcriptase. The discovery that the information in RNA can be transferred to DNA meant that the generally

accepted rule that genetic information was only transferred in one direction–from DNA to RNA, to protein–had to be modified.

My interest in Biology began when I was a high school student and spent a summer at the Jackson Memorial Laboratory in Bar Harbor, Maine. There I first experienced research biology and saw research biologists at work; this experience led me to become a biology major in college.
I went on to Swarthmore College where I began as a major in biology but switched to chemistry later so that I could carry out a research thesis. Between my last two years at Swarthmore I spent a summer at the Cold Spring Harbor Laboratories working with Dr. George Streisinger, and the experience of working with and watching that great teacher led me to molecular biology.
I started graduate school at Massachusetts Institute of Technology in biophysics, but when I decided to work on animal viruses I left M.I.T. to study for a summer with Dr. Philip Marcus at the Albert Einstein Medical College and to take the animal virus course at Cold Spring Harbor, then taught by Dr. Richard Franklin and Dr. Edward Simon. I joined Dr. Franklin at the Rockefeller Institute to do my thesis work and then continued in animal virology as a postdoctoral fellow with Dr. James Darnell. I had already found that much could be learned by studying virus-specific enzymes, so I studied for a while with Dr. Jerard Hurwitz at the Albert Einstein College of Medicine to learn from someone who knew enzymology as a professional. My first independent position was at the Salk Institute in La Jolla, California where I had the rare opportunity to work in association with Dr. Renato Dulbecco. After 2 1/2 years away from a university setting, I returned to M.I.T. in 1968 and have remained there. In 1974, I joined the staff of the M.I.T. Center for Cancer Research under the directorship of Dr. Salvador Luria because I had found that my research interests, that previously had involved mainly the non-oncogenic RNA viruses, were more and more focused on the problems of cancer.

In 1975, when I received the Nobel Prize, I was already in New York on sabbatical, investigating the possibility of moving from virology into immunology. When I returned to MIT, I did reorient my laboratory and from then on I have pursued a mix of immunology and virology. Today that takes the form of an interest in using retrovirus vectors to modify the immune system.

Our most significant discovery in immunology was probably the identification of the protein pair that rearranges immunoglobulin genes, the so-called RAG proteins. This was actually done by two graduate students, David Schatz and Margie Oettinger. We turned to examining the transcription factors that modulate the development of B lymphocytes and discovered the key transcription factor, NF-κB.

We studied B lymphocyte development mainly using cells immortalized by the Abelson mouse leukemia virus. While examining the ability of this virus to cause cell transformation and cancer, we discovered that its oncoprotein was a tyrosine-specific protein kinase. This was a unique enzymatic activity at the time, also discovered by Tony Hunter. This observation led to the development of Gleevec, one of the most successful anti-cancer drugs and the first small molecule to target the activity of an oncoprotein.

While carrying out an active research program, I found myself drawn to administration of scientific institutions and I have maintained both interests to this day. My first foray into administration came about through an encounter with Mr. Jack Whitehead. He offered me the opportunity to start a small research institute, which he would fund. We founded the Whitehead Institute for Biomedical Research as an independent entity allied with MIT, devoted mainly to developmental biology. I was able to attract an amazing faculty and the Whitehead has continued as a great institution. One of its faculty, Eric Lander, was the driving force for the sequencing of the human genome and he has now generated an offspring of Whitehead, the Broad Institute.

I went from MIT and Whitehead to New York in 1990 to be President of the Rockefeller Institute, my graduate alma mater. I only stayed in that position through 1991 because a misconduct case against a collaborator of mine became a drag on my effectiveness. I returned to MIT in 1994 but was again taken away in 1997 to be President of the California Institute of Technology (Caltech). For the last eight years I have had the honor and challenge of running this great institution, described by my wife as the last ivory tower. As a student, I had learned about the physical sciences but as a biological research scientist I had had little interaction with the great advances in the field; coming to Caltech greatly broadened my appreciation for the remarkable advances being made across the board in science and technology.

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Aurelie Rakotondrafara

Institution:

WARF

Aurelie Rakotondrafara says instead of typically finding that one RNA equals one protein, she instead explains that's not the case here and says we are able to express several proteins from the same RNA.

ASSISTANT PROFESSOR TURNS THE TABLES ON PLANT VIRUSES

Aurelie Rakotondrafara had packed for the tropics. So when a clerk at the Fulbright fellowship office asked if she was ready for winter, her face fell. She thought she was heading to a Ph.D. program in Hawaii.

"Not Hawaii," corrected the clerk. "Iowa."

Rakotondrafara can laugh about it now. After a few years globetrotting, the young plant virologist is making Madison home. Her journey here crisscrossed four hemispheres, from a childhood in Madagascar to the cornfields of Ames to postdoctoral research in a cutting-edge European laboratory.

Her work has already made a splash. In 2014 she and a collaborator won a WARF Innovation Award for discovering a unique sequence in a wheat virus that allows it to leapfrog genetic dogma.

"We typically say that one mRNA equals one protein," she explains. "That's not the case here. We will be able to express several proteins from the same RNA."

That is because Triticum mosaic virus contains a special genetic sequence called an internal ribosome entry site (IRES) that enables it to express its single large polyprotein much more efficiently. An IRES allows translation to jump to the middle of an mRNA strand and initiate at any internal position. In most organisms the process usually starts at the front.

Rakotondrafara says viruses developed this strategy to outwit a host cell's defense mechanisms.

“Viruses are so smart at making protein,” she says. “The question is how do we use their strategy to our advantage?”

IRESes obtained from animal viruses are in widespread use for commercial and experimental protein production. However, this one is the first to function well in plant systems and may be a hundred times more potent than its competitors.

The power to express multiple genes at the same time, or stack traits, may yield new and improved biofuel crops and chemicals. The discovery could change how biopharmaceuticals are made, such as the antibody cocktail currently produced in tobacco plants to treat Ebola patients.

While Rakotondrafara admits this work is her favorite (“translation regulation is what I love”), she’s taking on applied projects aimed at crop health and productivity.

She describes a dilemma: the majority of the potato cultivars favored by farmers in Wisconsin and elsewhere are highly susceptible to a virus called PVY that can sometimes cause ugly dark rings. When leaves begin to show an off-color ‘mosaic’ pattern, farmers know the virus has invaded their field and can take action.

But a recent strain is more insidious – infected plants don’t exhibit symptoms until it’s too late.

“The crop may look healthy aboveground,” says Rakotondrafara. “But when it comes to harvest time, all of the tubers are dead.”

There is hope. Rakotondrafara and her colleagues are looking to genetically engineer potatoes that resist the virus. The new potatoes won’t contain any foreign DNA but rather will overexpress a naturally occurring gene with several amino acid mutations.

The project is funded by the Wisconsin Potato and Vegetable Growers Association.

“What’s cool is that we’re being supported by the farmers,” she says. “No, it’s not big money. But they see the potential. Even if it is years down the road.”

She says the new potatoes wouldn’t have to be sold commercially. Rather, they could be used as a buffer to surround and protect the non-modified crop from disease-carrying aphids.

“The first transgenic potato that hit the market several years ago went down the drain,” she says.

“I understand the growers’ concerns about so-called Frankenstein genes and public rejection.”

She understands history too. Rakotondrafara admits feeling intimidated when a position opened up in the UW-Madison plant pathology department four years ago. She was working in a lab in Germany at the time and hesitated to apply.

After all, Madison researchers were the first in the world to successfully transfer plant DNA; the first to grow tobacco from a single cell; the first to discover the cause of maple blight, oak wilt and cranberry black rot. The department helped transform alfalfa into a billion dollar crop and make Wisconsin cabbage a global staple.

“It was here the first resistance gene against *Phytophthora infestans* was discovered,” notes Rakotondrafara. “That is the pathogen that caused the Irish potato famine in the 1840s that killed a million people and resulted in a massive migration to the U.S.”

Legacy is a heavy mantle. Was she ready for the challenge?

No doubt about it. Standing in her lab overlooking Lake Mendota, Rakotondrafara recalls a childhood of big dreams, of hearing about locust outbreaks and starving people.

“I wanted to save the world,” she smiles.

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Rolf Reitz

Institution:

Wisconsin Alumni Research Foundation

Summarize the subject or area of research that is being conducted below:

-Over the years, there have been many forms of diesel engines that have polluted the environment and air. There are more regulations that are being passed in order to greatly reduce the amount of emissions put into the air. A compression diesel engine was invented to reduce the emission levels. Rolf Reitz said "We then did follow-up testing on the best-performing models in the laboratory to verify the results we were seeing in the modeling. We confirmed that by using two fuels of different reactivity and multiple injections, we can control in-cylinder fuel reactivity to optimize combustion phasing, duration and magnitude." This engine has been worked on and developed to try and help.

Cut and paste the text from the source website page below

One of the most exciting things about being a research scientist is finding a solution to a long-standing problem that makes the world a better place.

That's exactly what UW-Madison mechanical engineering professor Rolf Reitz has done with his new clean compression diesel engine technology. By increasing fuel efficiency and reducing toxic emissions, this advanced process conserves precious natural resources, improves human health and reduces environmental damage.

Previous efforts within the industry to design a "clean" diesel engine have had limited success reducing emissions of nitrogen oxides and particulate "soot," which pollute the air and water and are harmful to the human body. Although "after-treatment" systems can be installed on vehicles to trap these pollutants, they reduce fuel efficiency and are costly to retrofit—two major drawbacks.

State and national governments are passing more stringent regulations to restrict the amount of emissions that can be released from diesel-powered vehicles. To meet this important challenge, Reitz and his students have developed a compression diesel engine combustion process that utilizes in-cylinder fuel blending to successfully reduce emission levels.

“Computer modeling and simulations were used to test the combustion of various fuel models for diesel and gas in the combustion chamber,” says Reitz, who has worked on engine technologies for more than 30 years (the last 21 years with UW-Madison’s Mechanical Engineering Department). “We then did follow-up testing on the best-performing models in the laboratory to verify the results we were seeing in the modeling. We confirmed that by using two fuels of different reactivity and multiple injections, we can control in-cylinder fuel reactivity to optimize combustion phasing, duration and magnitude.”

The first step in the process is the introduction of a low-reactivity fuel into the cylinder (e.g., using port fuel injection) to create a well-mixed charge of low-reactivity fuel, air and re-circulated exhaust gases.

“The level of re-circulated exhaust gas and the closure of the intake valve are controlled so that a high-reactivity fuel can be injected directly into the combustion chamber before ignition of the premixed fuel occurs,” says Reitz.

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Weiping Tang

Institution:

WARF

Summarize the subject or area of research that is being conducted below:

Cardiovascular diseases are the leading cause of death globally, and statin therapy is not always effective. Tang studies how cholesterol regulates in our bodies to help with this deadly disease.. “LDL cholesterol travels through the bloodstream, receptors on the surface of liver cells catch the particles, haul them inside and degrade them.” When it’s done well, the receptors then return to the surface of the cell to look for more interlopers.

Cut and paste the text from the source website page below

DISCOVERY TO PROMISE

Chemist “tuning up” potential new therapeutic for world’s deadliest disease

The 2003 discovery of PCSK9 – a protein with a clunky name and unknown function – would solve a genetic mystery on two continents.

In Paris, a group of researchers was tracking families suffering from abnormally high cholesterol. Around the same time in Dallas, scientists were astounded by a handful of cases registering extraordinarily low levels. In both instances, genetic sequencing quickly homed in on PCSK9.

The correlation sparked a gold rush in the pharmaceutical world.

Within nine years the first antibodies entered clinical trials. By 2015, two new drugs for treating cardiovascular disease were on the market.

It was translational medicine at warp speed, a discovery-to-product surge perhaps unmatched in the modern genomic era. And the story is far from over.

What makes Proprotein Convertase Subtilisin/Kexin type 9 the most exciting frontier in heart health since the invention of statins?

In his office in the pharmacy school, Weiping Tang gives a bold answer: targeting PCSK9 is a game changer in how we think about and combat cardiovascular diseases, the number one cause of death globally.


Cardiovascular diseases are the leading cause of death globally, and statin therapy is not always effective.

Cardiovascular diseases, caused by LDL ("bad") cholesterol building up as plaque and clogging arteries, kill more than 17 million people every year. And they're a multibillion dollar scourge.

"Lowering cholesterol has the highest market share among all pharmaceuticals," says Tang.

Sales of Lipitor alone topped $13 billion annually before it went off patent.

Statins (like Lipitor) are the blockbuster therapy of choice. However, approximately one in five patients cannot achieve the desired results due to side effects. For these patients, an alternative is needed.

That's where PCSK9 comes in.

To understand how, Tang describes the process by which our bodies regulate cholesterol:

When LDL cholesterol travels through the bloodstream, receptors on the surface of liver cells catch the particles, haul them inside and degrade them. A job well done, the receptors then return to the surface of the cell to look for more interlopers.

The same cells secrete PCSK9 protein to bind to the receptors and act as a sort of referee. The problem is that PCSK9 can end up degrading the receptors themselves. The result is dead receptors, and cholesterol getting a free pass.

The process is a big red bullseye for pharmaceutical intervention.

But the drugs that sped to market so quickly following the 2003 discovery are antibodies, and antibodies have drawbacks.

“They require injection which is not ideal, and in some patients there are undesired immune effects because these are biological drugs,” says Tang.

His team of multidisciplinary collaborators (most notably, biochemist and lipids expert Alan Attie) are taking a different approach. Through their collective efforts, the team has been able to identify several small molecule secretion inhibitors that appear highly promising.

The inhibitors are inspired by a class of compounds called indoles that are naturally occurring (e.g., serotonin and tryptophan) and used widely in pharmaceuticals. Indoles and their derivatives are found in drugs for treating everything from cancer and schizophrenia to HIV and asthma.

With support from the WARF Accelerator Program, the team is fine-tuning the pharmacological properties of these small molecules for in vivo studies. Tang says this phenotype-based strategy is the most successful approach for developing first-in-class drugs.

He has reason for optimism. At this stage, the in vitro results are dramatic.

The project now faces a critical juncture. Tang, a Stanford- and Harvard-educated synthetic chemist, is currently “tuning up the soft spots” in the molecules, optimizing their structures to make them more potent, soluble and metabolically stable before proceeding in vivo.

He says support from the Accelerator Program has been essential to moving the project forward. Pharmaceutical development is a marathon not a sprint, and he knows that he’ll need years more data before broaching industry.

“The more work you put in at the beginning,” he says, “the higher chance that the pharmaceutical company will take the licensed compound into clinic.”

He also values the technical insights provided by Brad Henke, who recently joined the Accelerator Program as a biopharma Catalyst. Henke directed chemistry at GlaxoSmithKline for years and led research teams that produced 10 clinical drug candidates.

Tang says they “share a common language.”

Approaching his tenth year at UW-Madison, Tang is uniquely qualified to lead the project. He is co-director of the new UW Medicinal Chemistry Center, launched last summer. The center's mission is to design and synthesize the drugs of tomorrow by collaborating with UW-Madison biomedical researchers.

Current projects include new therapeutics for treating diabetes, breast cancer, metabolic disorders and autoimmune diseases.

With a cool and confident demeanor, Tang carries the heavy mantle of his work in stride. But a stunning quote on the bottom of his slide deck seems to.reveal his inner thoughts. It comes from science writer Stephen Hall, writing in the journal Nature:

"Of all the intriguing DNA sequences spat out by the Human Genome Project and its ancillary studies, perhaps none is a more promising candidate to have a rapid, largescale impact on human health than PCSK9."

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Mark Cook

Institution:

UW-Madison

Summarize the subject or area of research that is being conducted below:
Mark Cook is a U-W Madison animal scientist and runs one of the most entrepreneurial labs on campus. Cook and his collaborator Jordan Sand had received Accelerator support to advance the boldest alternative yet. Which was a natural, drug-free method to protect poultry, pigs, dairy and beef cattle against common infections. Over millions of years, many types of bacteria, parasites and other pathogens have learned to deceive their animal hosts. They flip a "switch" in the immune system telling it to stand down. But Mark Cook and Sand can prevent infection by removing this "switch." They do this by feeding the animals antibodies that neutralize Interleukin 10, a protein, the antibodies are produced in eggs laid by vaccinated hens; those eggs are then added to feed.

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Part consumer demand and part cagey marketing, it's a welcome trend for researchers like Mark Cook who are alarmed by the rise of drug-resistant pathogens in our food supply.

He believes it signals a sea change, considering that 70 percent of antibiotics in this country are used in farm animals. These are the same drugs used in human medicine.

Cook says that Accelerator funding, as well as executive guidance from Catalyst Chris Salm and D2P staff, have been "vital." The support has enabled them to scale up antibody production and answer key technical questions to the point where forming a startup made sense.His success is also the upshot of a staggering breadth of interests. Cook is already making strides in a second Accelerator-supported project directed at the aquaculture industry. That project is investigating how a poultry byproduct (dubbed "cosajaba oil") can be used to promote growth and reduce mortality in high value fish species.

CP Biology Final Essay

Name:

[redacted]

Scientist(s):

Xudang wang

Institution:

WARF

Summarize the subject or area of research that is being conducted below:

Xudong (ZHU-dong) Wang, an assistant professor in UW-Madison's College of Engineering, has been working to create these nanowire electrode forests since he joined UW-Madison in 2008. The trees are actually strands of titanium oxide crystals with branches 1,000 times thinner than a human hair."I started working on nanowires as a graduate student in 2002 because at that time, the nanowires were a very cool, new technology and it seemed like they had the potential to solve a lot of problems," said Wang.To create the tiny trees, Wang starts with the trunks, using a patterned etching process to selectively remove excess material from the silicon wafers and sculpt tiny erect wires embedded on the silicon chip base.Wang's three-dimensional nanowire electrode networks are part of WARF's Clean Technology portfolio.

Cut and paste the text from the source website page below

Using a new class of nanomaterials, a University of Wisconsin-Madison inventor is working to capture energy from the sun much as nature intended—with trees in a forest.

But these forests fit on a silicon wafer. And the trees are actually strands of titanium oxide crystals with branches 1,000 times thinner than a human hair.

Xudong (ZHU-dong) Wang, an assistant professor in UW-Madison's College of Engineering, has been working to create these nanowire electrode forests since he joined UW-Madison in 2008. Aided by funding from the WARF Accelerator Program, the effort now appears close to achieving key goals.

"I started working on nanowires as a graduate student in 2002 because at that time, the nanowires were a very cool, new technology and it seemed like they had the potential to solve a

lot of problems," said Wang. "We are still some months away from being able to demonstrate our findings on a commercial wafer scale, but so far we are looking at solar power energy conversion that is four times more efficient than regular nanowire-based technology. And we also see exciting applications for hydrogen fuel separation—converting water into hydrogen for use in fuel cells."

To create the tiny trees, Wang starts with the trunks, using a patterned etching process to selectively remove excess material from the silicon wafers and sculpt tiny erect wires embedded on the silicon chip base. Growing the branches is more difficult, but necessary to achieve the density and light absorption qualities needed to capture and convert energy more efficiently.

"The branches are critical because they provide a much larger surface area than the nanowire bases alone," Wang said. "The unique structure and chemical composition of the branches also allows for faster charge transport. It's what makes these electrodes so much more efficient."

While other research groups continue to struggle in this area, Wang has developed a patented process that controls the accumulation of material on the surface of the nanowires and ensures that sunlight can penetrate through the entire structure. Wang's method involves exposing the silicon chip to alternating pulses of reactive vapor that saturates the surface growth sites upon the nanowire trunks and establishes the branches. The cycle is repeated 300 to 400 times.

"At the moment, we are on top of this technology, but this is something people have been trying to do for a long time and very competitive research groups in other countries are exploring different processes to reach the same goal," Wang said. "There is a great deal of interest in this area because it is a clean energy technology that will improve people's lives if we can make it commercially viable."

Support from the Accelerator Program is now being used to scale up the technology to the point that it will be attractive for industry. Wang said he expects to be able to refine his methods, achieve greater cost savings and demonstrate technological feasibility for commercial production over the next year.

With several patents pending on the work, Wang's three-dimensional nanowire electrode networks are part of WARF's Clean Technology portfolio.

CP Biology Final Essay

Name: [redacted]

Scientist(s):

Avtar Roopra

Institution:

University of Wisconsin Madison

Summarize the subject or area of research that is being conducted below:
Avtar Roopra has been working on a new diagnostic test and therapy. He works at the University of Wisconsin Madison as a professor. He was inspired to work on this because of his sister's breast cancer and got interested in cancers to help more people who are going through cancer or prevent cancer from occuring.

Cut and paste the text from the source website page below
In a story of scientific discovery filled with as many twists and turns as a Northwoods trail, a rare insight from a massive public database and charitable support from an off-road motorcycle group have paved the way for work that may help some 20 percent of breast cancer patients with hard-to-treat tumors.

Now, funding from WARF's Accelerator Program is helping transform the discovery by Avtar Roopra, a University of Wisconsin-Madison associate professor of neuroscience, into a predictive test and treatment kit that may serve as a model for other diseases.

"The project really encompasses the idea that we should be able to predict how a patient is going to do as soon as that person walks into the doctor's office," says Roopra. "From the patient's standpoint, the benefit of the predictive assay is that it would be coupled to a second, ultimate part of the project — the development of a personalized medicine tool kit.

Roopra's project builds on his previous research related to epilepsy and the workings of a long, powerful gene known as REST that regulates nearly 2,000 other human genes. In 2002, Roopra began exploring connections between excess REST and epileptic seizures — research that led to the development of a drug now in clinical trials to block action of the gene.

After his sister, Gurcharan Roopra- Ryatt, succumbed to an aggressive form of breast cancer, Roopra decided to turn his knowledge of gene interactions as well as his skill in computation and bioinformatics into a search for the genetic underpinnings of hard-to-treat tumors.

“I felt I should dedicate some of my effort to breast cancer research,” Roopra says. “We had no funding so we started out kind of small and we began with databases that already existed. There are literally tens of thousands of gene sets that have been archived at the National Center for Biotechnology Information (NCBI) including breast cancer and prostate tumors, all waiting to be analyzed. That’s how we discovered — utterly to our surprise — that there was a role for REST, a factor that I’d been studying for decades, in breast cancer. It had never been noticed before. It was incredibly compelling.”

In another series of unlikely coincidences, Roopra’s work caught the attention of cross-campus colleague John Newton, an HVAC specialist with the UW Biotron and an avid cross-country motorcyclist. Newton’s cycle group, the Wisconsin Dual Sport Riders, organizes two charity rides through the Northwoods each year and after learning of the work by Roopra’s team, the group selected the lab as one of its beneficiaries for the past five years.

“The effort to understand the role of REST in breast cancer has really been done on a shoestring budget and almost the entire work has been funded by this bunch of bikers raising money in northern Wisconsin,” Roopra says. “We’ve been extremely fortunate not only for the money, but because for the past three years, we’ve succeeded in getting papers published in peer-reviewed academic journals starting with PLOS Genetics. And of course in all of these publications we credit the work as being funded by the Wisconsin Dual Sport Riders.”

Now, however, the research has progressed to the point where additional money is needed to validate the reliability of the predictive tests in mouse models of cancer and begin identifying the best treatment tools to include. WARF’s Accelerator Program is providing the funding for this next step in the commercialization process.

“We know how REST is lost, in at least some of the cases,” Roopra said. “And when REST is lost, a number of signaling pathways get elevated. There are existing, commercially available drugs that interfere with these signaling pathways. To stop tumor growth, it appears we may not have to actually go about restoring REST, we may just have to go and shut down the signaling pathways.”

Until Roopra’s work, however, no one had made the connection between REST and the signaling pathways in these aggressive tumors. And without a test to identify the subset of breast cancer patients who have lost the REST gene in their tumors, there has been no way to study the efficacy of new drugs or target administration of the most appropriate existing medicines.

A further challenge has been the fact that some new medicines with promise to act on the RESTless signaling pathways have not made it out of clinical trials because they show overall low efficacy rates against the majority of cancer types.

“Our strong feeling is that in at least some cases, the clinical trial didn’t go so well because the drug was given to all patients and we believe only about 20 percent of patients with breast cancer have lost REST,” Roopra said. “What we’re hoping is that once it’s possible to identify patients who have lost REST and test the drugs on them, then you should start seeing efficacy.”

So, Roopra’s team is now making a major push to complete development of the antibodies that will detect the loss of REST and serve as the diagnostic portion of the tool kit. Work is underway in mouse models with completion expected in 2014.

Thanks to the long-term research on the unique genetic signature of REST and an understanding of the mechanism behind it, Roopra has identified several potential therapies likely to benefit patients who have lost REST in their tumors.

“We have a good handle on why loss of REST drives tumor progression and we’ve found points to interfere in the progression of the disease and stall tumor growth and that’s what we’re looking at right now,” Roopra says. “We know what those elevated signaling pathways are and there are already drugs that exist that inhibit those pathways. So, it’s very exciting.”

Beyond his team’s eagerness to demonstrate in more detail the initial findings of the work, Roopra also understands that subsequent phases of the project will entail greater costs to establish clinical safety and efficacy of the suite of targeted drugs. However, potential commercial partners stand to benefit not just from the immediate boost of a powerful new tool against breast cancer, but from the broader implications of Roopra’s antibody-based assay.

“This is an important test that’s going to help save lives,” Roopra says. “But the other exciting thing about all this is that we ultimately may be able to eliminate the need to biopsy the tumors and go for a blood test both for diagnosis and to monitor treatment. The three leading genes in the gene signature profile are secreted proteins and antibodies exist for those, so it should be possible to produce a noninvasive monitoring tool for these tumors.”

Post navigation

Jim Steele

d`CP Biology Final Essay

Name: [redacted]

Scientist(s):

George Q. Daley

Institution:

Harvard Medical School

Summarize the subject or area of research that is being conducted below: George Q. Daley is the dean of Harvard Medical School and is a recognized leader in stem cell science and cancer biology. He's a longtime member of HMS faculty whose work spans the fields of basic science and clinical medicine. George Q. Daley has been a professor of biological chemistry and molecular pharmacology at HMS since 2010. He is also an elected member of the National Academy of Medicine and the American Society for Clinical Investigation, along with other professional societies. Daley was an inaugural winner of the Health Director's Pioneer award for highly innovative research.

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George Q. Daley, dean of Harvard Medical School and the Caroline Shields Walker Professor of Medicine at HMS, is an internationally recognized leader in stem cell science and cancer biology. He is also a longtime member of the HMS faculty whose work spans the fields of basic science and clinical medicine.

Daley has been professor of biological chemistry and molecular pharmacology at HMS since 2010 and was an investigator of the Howard Hughes Medical Institute from 2008 until he resigned in 2017 upon assuming the HMS deanship. He previously held, as its inaugural incumbent, the Samuel E. Lux, IV Chair in Hematology/Oncology at Boston Children's Hospital and was the Robert A. Stranahan Professor of Pediatrics and Professor of Biological Chemistry and Molecular Pharmacology at HMS.

A former chief resident in medicine at Massachusetts General Hospital (1994-95), Daley maintained an active clinical practice in hematology/oncology at Mass General and then at Boston Children's, until assuming his administrative role as director of the Pediatric Stem Cell Transplantation Program at Dana-Farber/Boston Children's Cancer and Blood Disorders Center, a post he held until Jan. 2017.

He has served since 1995 as a member of the faculty of the Harvard-MIT Division of Health Sciences and Technology (HST), since 2004 as a founding member of the executive committee of the Harvard Stem Cell Institute, and since 2009 as an associate member of the Broad Institute of MIT and Harvard and as a core faculty member of the Manton Center for Orphan Disease Research at Boston Children's.

Daley's research focuses on the use of mouse and human disease models to identify mechanisms that underlie blood disorders and cancer. His lab aims to define fundamental principles of how stem cells contribute to tissue regeneration and repair and improve drug and transplantation therapies for patients with malignant and genetic bone marrow disease.

Beyond his research, Daley has been a principal figure in developing international guidelines for conducting stem cell research and for the clinical translation of stem cells, particularly through his work with the International Society for Stem Cell Research, for which he has served in several leadership positions, including president (2007-08). He has also testified before Congress and spoken in forums worldwide on the scientific and ethical dimensions of stem cell research and its promise in treating disease.

After earning his bachelor's degree, magna cum laude, from Harvard in 1982, Daley went on to earn his PhD in biology (1989) at MIT, working in David Baltimore's laboratory at the MIT-affiliated Whitehead Institute for Biomedical Research.

He received his MD from HMS, graduating in 1991 with the rare distinction of summa cum laude. He then pursued clinical training in internal medicine at Mass General and was a clinical fellow at Brigham and Women's and Boston Children's hospitals. While running a laboratory as a Whitehead Fellow at the Whitehead Institute, he joined the HMS faculty as an assistant professor in 1995. He was promoted to associate professor in 2004, was named to an endowed chair at Boston Children's in 2009 and became a full professor at HMS in 2010.

Daley's teaching efforts include serving as course director for the Molecular Medicine course at HMS and for an undergraduate course on stem cells in disease in the Harvard Faculty of Arts and Sciences. Earlier,

for more than a decade, he led the Research in Health Sciences and Technology course in the HST program. He has trained dozens of graduate students and postdoctoral fellows and is a frequent participant in seminars and grand rounds at schools and hospitals in the Boston area and beyond. In 2012 he was recognized with the HMS A. Clifford Barger Excellence in Mentoring Award.

Important contributions from the Daley laboratory have included the creation of customized stem cells to treat genetic immune deficiency in a mouse model (together with Rudolf Jaenisch), the differentiation of germ cells from embryonic stem cells, the generation of disease-specific pluripotent stem cells by direct reprogramming of human fibroblasts, and demonstration of the role of the LIN28/let-7 pathway in cancer. In past research, he demonstrated the central role of the BCR/ABL oncoprotein in human chronic myelogenous leukemia, work that provided critical target validation for development of Gleevec, a highly successful chemotherapeutic agent.

Daley was an inaugural winner of the National Institutes of Health Director's Pioneer Award for highly innovative research (2004). His numerous honors include the American Philosophical Society's Judson Daland Prize for achievement in patient-oriented research, the American Pediatric Society's E. Mead Johnson Award for contributions to stem cell research, the American Society of Hematology's E. Donnall Thomas Prize for advances in human-induced pluripotent stem cells and the International Chronic Myeloid Leukemia Foundation's Janet Rowley Prize for outstanding lifetime contributions to the understanding and/or treatment of the disease. He is an elected member of the National Academy of Medicine and the American Society for Clinical Investigation, among other professional societies.

CP Biology Final Essay

Name:

Mr. Klema

Scientist(s):

Mike Arnold

Institution:

University of Wisconsin: WARF (Wisconsin Alumni Research Foundation)

Summarize the subject or area of research that is being conducted below:
Graphene is a layer of graphite that is one molecule thick. The crystals are hexagonal and have ability to function as computer memory and increase processing speed while using less electricity. A single layer of graphene conducts electricity hundreds of times faster than silicon based chips used today. Mike Arnold and his colleague, Padma Gopalan, are on the frontier of creating industrial scale graphene.

Fueled by fire of innovation, UW collaborators close in on faster chips

UW-Madison engineer Mike Arnold peers into an oven used to fabricate sheets of semiconducting graphene. The next phase of the research will require industry partners to explore applications and continue scale-up in larger ovens capable of producing 12 inch sheets.

The heat is on in Mike Arnold's lab.

Furnaces set to 1,800 degrees Fahrenheit blast methane gas over copper substrates to deposit a single layer of carbon-based graphene crystals in a process that may prove more valuable than turning lead to gold.

Yet the heat Arnold and his collaborators feel comes from more than just the furnaces: graphene's potential to revolutionize the semiconductor industry has ignited the interest of researchers around the world who now are racing to perfect manufacturing processes that capitalize on the hexagonal crystal's unique properties. At stake is the future of the computer industry, which must find new ways to boost processing speed and memory capacity without consuming proportionately more energy.

Arnold, an assistant professor of materials science, and collaborator Padma Gopalan, an associate professor of materials science, both with the University of Wisconsin-Madison College of Engineering, intend to create a new generation of hybrid computer chips that blend the memory-based capabilities of silicon with the superior logic or fastswitching capabilities of graphene.

To do so, they must overcome a daunting series of technical hurdles that have stymied other scientists whose expertise is concentrated in a single domain. Together, Arnold and Gopalan bring an unprecedented breadth and depth of skill and knowledge that spans polymer chemistry, nanoscale patterning, graphene crystal growth and advanced chip fabrication techniques.

"We're really pushing the edge of what is currently possible in terms of the manufacturing and performance of a new type of graphene that is semiconducting," Arnold says. "We believe the possibilities justify the effort. When captured as a single layer of atoms, graphene conducts electricity hundreds of times faster than silicon, the material most commonly found in today's computer chips, and its flexibility also may allow for exciting new applications in plastic-like electronics, touch screens, or smart tags for merchandise."

The team's efforts are being supported by the WARF Accelerator Program, which works to speed the advancement of technologies that hold exceptional promise for commercial success. The program helps inventions clear technical hurdles and advance to the marketplace for the benefit of society.

With the help of several catalysts— seasoned business mentors who contribute insights and ready access to networks of industry leaders—Arnold and Gopalan have developed a four-phase research and development plan that identifies key challenges and benchmarks. Along the way, graduate students Nate Safron from Arnold's lab and Myungwoong Kim from Gopalan's lab have contributed to the steady progress. In the first phase of the Accelerator project, the team achieved milestones including fabrication of 1 inch scale graphene samples with perforated holes spaced less than 10 nanometers apart. By comparison, human hair is about 60,000 nanometers in

diameter. The perforations are needed to control the interference of electrons across the surface to transform the graphene into a semiconducting material.

While Arnold and his lab team members excel at the methodology to organize the graphene crystals on top of the copper foil, it is Gopalan's expertise with nanopatterning using polymers that allows the perforations to be formed. Polymers with two components—known as block copolymers—are processed over the surface of the graphene, resulting in the formation of a nanoscale template.

The two components vary in their sensitivity to degradation by ultraviolet light or chemicals. The size of the holes created through the selective degradation can be adjusted at the molecular level based on the combination and length of polymers. To optimize the flow of electrons through the graphene, even the contours of the edges around the holes must be considered in creating the pattern.

> "The challenge and excitement in this area comes from our increasing ability to control the size, shape and orientation of the block copolymers through a combination of surface chemistry and thin-film physics," Gopalan says.

"While mastery of these parameters is crucial to control the flow of electrons and optimize the semiconducting potential of graphene, what we are learning in the process also has other important applications in areas such as catalysis, biofiltration and growth of nanomaterials."

Once the holes in the polymer have been created, oxygen ions are blasted at the chip. The ions pass through the polymer holes and etch the pattern in the graphene, leaving intact the carbon atoms still covered by the remaining polymer. This remaining grapheme honeycomb can then be transferred to other substrates such as a silicon wafer by dissolving or removing the copper backing and the remaining polymer.

For the graphene to outperform the "ON" and "OFF" switching capabilities of silicon, Arnold and Gopalan must reduce the hole spacing from 10 to 5 nanometers, the width of about 50 atoms. To demonstrate that their work holds commercial potential, they also must prove the process is scalable by expanding the size of the copper substrate holding the patterned graphene beyond the current 2 inch samples to 4 inches. The larger the size, the more difficult it becomes to produce an evenly deposited layer of graphene material.

Given the expected progress, the team is currently seeking an industry partner to explore prototype applications and further scale-up the sample size. Part of the lure for a potential partner comes from the fact that the research already has produced several patent-pending technologies.

Arnold says he and Gopalan recognize that their goal of creating a hybrid graphene and silicon chip represents a significant challenge given the current state-of-the-art. It would be far easier, for

example, to identify and pursue an intermediate challenge, such as development of a flexible screen application. Yet, when their research plans were reviewed by the experts on the Accelerator Program Catalyst team, Arnold says the project received resounding support.

“They really encouraged us to go for the gold,” he says. “From a research standpoint, this is fantastic, because if we can achieve that point, it will really transform what computers can accomplish for people. And along the way, there are an awful lot of concepts we will be proving that also hold tremendous potential to benefit society.”