Partners in Science
A MURDOCK TRUST PROGRAM

RESEARCH PARTNERSHIPS FOR HIGH SCHOOL TEACHERS

THE 2018 NATIONAL CONFERENCE HOSTED BY

THE M.J. MURDOCK CHARITABLE TRUST

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2018 Partners in Science National Conference

Hilton San Diego Resort & Spa
1775 East Mission Bay Drive, San Diego, CA 92109

Thursday, January 11, 2018

5:00 – 8:00 p.m. **Registration Open** – *Conference Center Foyer*
Dinner – *Acqua Restaurant (voucher required)*

Friday, January 12, 2018

Presenters may hang posters at the assigned spot in the Pavilion after the off-site tours and over the lunch hour. Thumbtacks will be provided. ***NOTE: All posters should remain displayed for both poster sessions.***

6:45 – 7:30 a.m. **Registration** – *Conference Center Foyer*
Breakfast – *International Ballroom*

7:30 – 7:45 a.m. **Plenary Session** – *International Ballroom*
Welcome and Opening Remarks
Jill Tatum, Program Director, M.J. Murdock Charitable Trust

8:00 a.m. **Buses Leave for Off-Site Tours**

8:30 – 11:00 a.m. **Off-Site Tours** – *Various locations*
Previously selected during registration – page 9

11:45 a.m. – 12:30 p.m. **Lunch** – *International Ballroom*

1:00 – 4:00 p.m. **Oral Presentations** – *Schedule and room list – page 4*
Presentations are 15 minutes in length (12 minute presentation & 3 minutes for Q&A)

5:00 – 6:15 p.m. **Poster Session** – *Pavilion*
All posters displayed. Even-numbered posters present – page 21
Reception/Hosted bar

6:30 p.m. **Banquet and Evening Address** – *International Ballroom*
"From Garbage to Plastics and Beyond: Polymerizations with Elemental Sulfur"
Dr. Jeffrey Pyun, Professor, Department of Chemistry and Biochemistry, University of Arizona

Saturday, January 13, 2018

7:00 – 7:45 a.m.	**Breakfast** – *International Ballroom*
7:45 – 8:00 a.m.	**Morning Welcome & Announcements**
8:00 a.m.	**Buses Leave for Workshops**
8:30 a.m. – 3:30 p.m.	**Workshops** – *Point Loma University* Previous selected during registration – page 11
12:00 – 1:00 p.m.	**Lunch** – *International Ballroom* For those not attending off-site workshops
5:00 – 6:15 p.m.	**Poster Session** – *Pavilion* All posters displayed. Odd-numbered posters present – page 21 Reception/Hosted bar
6:30 – 9:00 p.m.	**Banquet and Evening Address** – *International Ballroom* Closing remarks and special recognitions *"Designing Materials for Advanced Applications"* Dr. Malika Jeffries-EL, Associate Professor, Department of Chemistry, Boston University

Sunday, January 14, 2018

Check-out time is 11:00am

6:30 – 11:00 a.m.	**Breakfast** – *Acqua Restaurant (voucher required)*

Thank you for participating in the 2018 Partners in Science National Conference.

We would greatly appreciate your participation in the evaluation of this conference. Please be sure to complete the online evaluation (emailed to you after the conference). Thanks, again!

ORAL PRESENTATIONS

Friday, January 12 | 1:00 - 4:10 p.m.

(Abstracts listed on page 41)

	St. Tropez Room	Las Palmas/Marbella Room	Portofino/Marseilles Room
	Session Chairs: Cheryl Jorcyk & Dan Burgard	Session Chairs: Tawnya Peterson & Bernard Carlsen	Session Chairs: Henryk Urbanski & Heidi Ware
1:00	A1. *"The Effects of the Inflammatory Cytokine Oncostatin M on Prostate Cancer Cells"* **Steve Tipping**, Borah High School, Boise, ID Dr. Cheryl Jorcyk, Boise State University, Boise, ID	A2. *"The search for drug-like molecules that block the metastatic spread of cancer by inhibiting specific pathways associated with metastasis"* **Lily Apedaile**, Frenchtown High School, Frenchtown, MT Dr. Andrea Stierle, University of Montana, Missoula, MT	A3. *"Imaging and the Co-localization of PGRMC1 and the Sigma-2 Receptor in Liver Tumor"* **Adriane D. Davis**, Irma Rangel Young Women's Leadership School, Dallas, TX Dr. Orhan K. Oz, University of Texas Southwestern Medical Center, Dallas, TX
1:16	B1. *"The use of in-stream structures for improving cutthroat trout habitat on four small creeks in southeast Idaho"* **Eric Rude**, Pocatello High School, Pocatello, ID Dr. Ernest Keeley, Idaho State University, Pocatello, ID	B2. *"The Re-Invasion of the Coos Bay Estuary by the Invasive European Green Crab"* **Christina Geierman**, North Bend High School, North Bend, OR Dr. Bree Yednock, South Slough National Estuarine Research Reserve, Coos Bay, OR	B3. *"Tropical and Sub-Tropical Ozone Trends"* **Dana Coppernoll-Houston**, Thomas Jefferson High School, Tacoma, WA Dr. Audra McClure-Begley, National Oceanic & Atmospheric Administration Earth Systems Research Laboratory, Boulder, CO

	St. Tropez Room	Las Palmas/Marbella Room	Portofino/Marseilles Room
1:32	C1. *"Queensland Coral Fishery Vulnerability Assessment of High-Risk Coral Species"* **Timothy Lewis**, Beacon High School, New York, NY Dr. Vanessa Messmer, James Cook University, Townsville, Queensland, Australia	C2. *"Evaluations of Sagebrush-Steppe Environments: Are Past and Current Pesticide Applications Impacting the Ecosystem?"* **Molly Tuinstra**, Pasco School District, Pasco, WA Dr. Amoret Bunn, Pacific Northwest National Laboratory, Pasco, WA	C3. *"Efficiency of Solar Panels in Real-World Conditions"* **Evan Munger**, Churchill High School, Eugene, OR Dr. Frank Vignola, University of Oregon, Eugene, OR
1:48	D1. *"Impacting Antibody Movement Across the Blood Brain Barrier"* **Hali Hill**, Governor John R. Rogers High School, Puyallup, WA Dr. John Finke, University of Washington Tacoma, Tacoma, WA	D2. *"A Field-deployable instrument for measuring RH-dependent aerosol extinction"* **Alicia Ryan**, Cascade School District, Turner, OR Dr. Dean Atkinson, Portland State University, Portland, OR	D3. *"Mimicking Plant Processes to Produce Renewable Energy"* **Charlie Bruner**, Victor School, Stevensville, MT Dr. Dong Wang, University of Montana, Missoula, MT
2:04	E1. *"The Effect of Amyloid Beta on Neuroplasticity"* **Arlene Ramos**, High School for Health Professions & Human Services, New York, NY Dr. Ottavio Arancio, Columbia University, New York, NY	E2. *"In Situ Measurements of Turbulence Utilizing Radiosondes with Quantification of Relative Estimation Error between NWP Analysis and Measurements"* **Joe Youngberg**, Frenchtown High School, Frenchtown, MT Dr. Jennifer Fowler, University of Montana, Missoula, MT	E3. *"Ecological and Organic Safety Concerns of HFO-1234yf"* **Alberni Ruiz**, Southern California Yeshiva High School, San Diego, CA Dr. Ben Miller, NOAA, Boulder, CA

	St. Tropez Room	Las Palmas/Marbella Room	Portofino/Marseilles Room
2:20	F1. *"Innovations in Visualizing the Activity of Vascular Disrupting Agents"* **Jeff Bivins**, Richardson High School, Richardson, TX Dr. Ralph Mason, University of Texas Southwestern Medical Center, Dallas, TX	F2. *"Determining Erosion Rates: Surface Exposure Dating of Streambed Sediments via Analysis of Cosmogenic Nuclides"* **Jeff Wuebber**, New Rochelle High School, New Rochelle, NY Dr. Christa Placzek, James Cook University Townsville, Queensland, Australia	F3. *"Potential drug leads derived from Tolypocladium geodes"* **Emily Parent**, North Salem High School, Albany, OR Dr. Kerry McPhail, Oregon State University, Corvallis, OR

2:35 – 2:50 p.m. Break

	St. Tropez Room Session Chairs: John Finke & Jennifer Forbey	Las Palmas/Marbella Room Session Chairs: Terry Manning & Dmitri Tenne	Portofino/Marseilles Room Session Chairs: Jennifer Chase & Josh Peterson
2:50	G1. *"Determination of Metformin and Guanylurea in Aqueous Samples Using HPLC-UV"* **Roxanne Kilpatrick**, Oregon City High School, Oregon City, OR Dr. Tawnya Peterson, Oregon Health and Science University, Portland, OR	G2. *"Integrated Plant-Atmosphere-Soil Systems (iPASS): Phenotypic Changes in Two Grass Types Under Elevated CO_2 Levels"* **Kentin Alford**, Chiawana High School, Pasco, WA Dr. Heather Brewer, Pacific Northwest National Laboratory, Richland, WA	G3. *"Using electrochemistry for controlled dissolution of Zircaloy-4 Liners"* **Devin Olson**, New Horizons High School, Kennewick, WA Dr. Dev Chatterjee, Pacific Northwest National Laboratory, Richland, WA
3:06	H1. *"Runoff in Ruston: A water quality study of storm water remediation"* **Matthew Lonsdale**, Science and Math Institute, Tacoma, WA Dr. Dan Burgard, University of Puget Sound, Tacoma, WA	H2. *"Characterizing the chemical composition of Washington State red wines using UHPLC/QTOF-MS"* **Fred Burke**, Chiawana High School, Pasco, WA Dr. Thomas Collins, Washington State University, Richland, WA	H3. *"Adapting micro-controllers for deployment in a smart city with neural networks"* **Trevor Macduff**, Leona Libby Middle School, West Richland, WA Dr. Robert Rallo, Pacific Northwest National Laboratory, Richland, WA
3:22	I1. *"Thyroid Hormone Levels affect the Development of Zebrafish Feeding Mechanics"* **Amy Verderber**, Kamiakin High School, Kennewick, WA Dr. Elly Sweet, Washington State University – Tri Cities, Richland, WA	I2. *"Elucidate Genetic Diversity of Viruses in Washington Vineyards"* **Emily Jordan**, WF West High School, Chehalis, WA Dr. Naidu Rayapati, Washington State University – Irrigated Agriculture Research & Extension Center, Prosser, WA	I3. *"Catching Cosmic Messengers: My work with IceCube and Askarayn Radio Array (ARA) at the South Pole"* **Lesley Anderson**, High Tech High Chula Vista, Chula Vista, CA

	St. Tropez Room	Las Palmas/Marbella Room	Portofino/Marseilles Room
3:38	J1. *"Generation of Ezh2 knockout embryonic stem cells by CRISPR-Cas9"* **Stephanie Harris**, Travis Middle School, Irving, TX Dr. Jian Xu, University of Texas Southwestern Medical Center, Dallas, TX	J2. *"One Step Closer to Mars with Aquaponics: Cultivating Citizen Science in K12 Schools"* **Anne McHugh**, School of Science & Technology, Beaverton, OR Dr. Brad Bebout, NASA Ames Research Center, Moffett Field, CA	J3. *"Exploring the solubility limits of ZrO2 in low-activity nuclear waste (LAW)"* **Randy Hoover**, Southridge High School, Kennewick, WA Dr. Joseph Matyas, Pacific Northwest National Laboratory, Richland, WA
3:54	K1. *"Curing Blindness: Restoring Light Sensitivity to Blind Retinas Using Drugs"* **Larry Bencivengo**, Mercer Island, High School, Mercer Island, WA Dr. Russel Van Gelder, University of Washington, Seattle, WA		

OFF-SITE TOURS

Friday, January 12 | 8:30 – 11:00 a.m.

*(Buses leave **promptly** at 8:00 a.m.)*

Off-Site 2: Scripps Community Outreach Program for Education (SCOPE)
The Scripps Community Outreach Program for Education is a volunteer organization based at Scripps Institution of Oceanography composed of graduate students and researchers. We connect educators, students, and interested community groups directly with the incredible science conducted here at Scripps by giving tours and facilitating educational outreach activities.

Off-Site 3: Scripps Research Institute
The Scripps Research Institute is a nonprofit American medical research facility that focuses on research and education in the biochemical sciences and is especially strong in the areas of immunology and infectious disease, biochemistry, structural biology, chemical biology, and organic chemistry. The visit to this research site will include Q&A sessions with researchers on topics such as synthetic chemistry and a tour of an immunology lab.

Off-Site 4: Salk Institute for Biological Studies
The Salk Institute for Biological Studies is an internally renowned, nonprofit, scientific research institute founded in 1960 by Jonas Salk, the developer of the polio vaccine. The institute focuses its research in three areas: Molecular Biology and Genetics; Neurosciences; and Plant Biology. Research topics include cancer, aging, Alzheimer's, diabetes and infectious diseases. The visit to this research site will include an overview of the work of the institute, presentations by researchers and a tour of the facility including an opportunity to view the unique architecture of the institute.

Off-Site 5: General Atomics - Fusion Education Program
The General Atomics Fusion Education Program (http://fusioned.gat.com) helps to promote an increased understanding of gaseous plasma and high temperature fusion sciences at the elementary through college level by providing exciting workshops and tours for teachers. We offer you a fascinating workshop and tour using the nation's largest magnetic confinement fusion device as the centerpiece. Materials will be provided to each participant for use in their classroom.

NOTE: *All participants will need to bring a government-issued photo ID (and VISA or green card, if applicable). Cameras are welcome, shorts are okay, but CLOSED TOED SHOES ARE A MUST (tennis shoes are okay).*

Off-Site 6: United States Naval Health Research Center
The United States Naval Health Research Center Naval Health Research Center (NHRC) serves as a leading research and development laboratory for the Department of Defense. Research focus includes medical modeling & simulation, warfighter performance, behavioral sciences & epidemiology, deployment health research, and operational infectious diseases. The visit to this research site will include an overview of the components and the work of the center, presentations by researchers and a tour of the facility.

NOTE: *Please be sure to bring government-issued photo ID.*

Off-Site 7: Englekirk Center
Earthquakes have had considerable destructive effects on society in terms of human casualties, property and infrastructure damage, and economic losses. To build a disaster-resilient and sustainable environment, we must better understand how buildings, critical facilities, lifelines, and other civil infrastructure perform under extreme events. The NHERI outdoor shake table located 10km east of the University of California, San Diego conducts large-scale, state-of-the-art research in structural and geotechnical earthquake engineering to develop effective technologies and policies to prevent these natural hazard events from becoming societal disasters. During this laboratory tour, you will learn about past experiments conducted at the facility, which have led to improvements to our building codes, and will get a tour of the shake table (above and below ground) to see how the system operates. Earthquake engineering educational curriculum that has been developed for high school will also be presented.

NOTE: *CLOSED TOED SHOES ARE A MUST (tennis shoes are okay)*

Off-Site 8: High Tech High Chula Vista
Are you a fan of project-based learning? Have you wondered what it might look like if your ENTIRE SCHOOL practiced project-based learning ALL THE TIME? Take a student-led tour of just that sort of high school. HTHCV integrates liberal arts and hands-on technical learning that prepares students for college, civic life, and careers and supports the development of deeper learning competencies. HTHCV fuses project-based learning with real cooperative community learning experiences.

High Tech High is an equity project that promotes individualized learning through projects that connect students to authentic and meaningful experiences. As a full-inclusion school, teachers tailor projects to a wide range of student needs including diversity in socio-economic status, race, ethnicity, and ability. Projects connect students to the real world and allow them opportunities to become fully engaged in hands on learning and critical thinking. Highlights of authentic learning are the senior project, junior academic internship, and individual teacher project design.

WORKSHOPS

Saturday, January 13 | 8:30 a.m. – 3:30 p.m.
Point Loma Nazarene University

*(Buses leave **promptly** at 8:00 a.m.)*

SESSION 1 | 8:30 – 11:30 A.M.

Workshop 1: Detect GMOs with PCR, the relatedness of fish with their protein profiles and build your own gel box for electrophoresis

Sator Hall Lab #120 (north side)

Presenters
Damon Tighe, Bio-Rad, Hercules, CA
Tim Renz, Foster High School, Tukwila, WA

Abstract
In this workshop three part workshop get to know the core of modern biology; extracting, separating and amplifying macro molecules in the context of food. Bring and test your own food for the presence of GMOs by using DNA extraction, PCR amplification and gel electrophoresis. Build your own gel electrophoresis box from house hold items and use it to separate food dyes, so you can figure out exactly what you are eating when you eat candy. What exactly is in fake crab meat? Use SDS-PAGE to separate proteins from fish and fake crab to not only figure out how the fish are related, but which one of them might be in your fake crab meat.

Participant Requirements
None

Note:
This workshop is a 5 hour workshop that will use both sessions.

Workshop 2: The Latest in Data Collection with Vernier

Sator Hall Lab #117 (north side)

Presenters
Tom Smith, Vernier Software and Technology, Beaverton, OR
Kimberly Newman, Camas High School, Camas, WA

Abstract

Explore Vernier's new wireless (Bluetooth) sensors, as well as freshen up on best practices for data collection. We plan to have plenty of time to dive into subject-specific labs and activities - something you rarely have time for at your schools. Contact tsmith@vernier.com to request specific sensors/tools - we will accommodate requests if possible.

Participant Requirements
Laptop/chromebook/iPad

Workshop 3: Teaching Evolution using Inquiry, *C.elegans*, and technology

Sator Hall Lab #108

Presenters
Lara Dean, Eastlake High School, Shoreline, WA
Stephanie Narnciu, Pacific Northwest Research Institute, Seattle, WA

Abstract
C.elegans, was the first multicellular organism to have its genome mapped and is used by researchers as a model system for biomedical research. There is a highly-conserved gene in this organism which allows speciation to be determined. Researchers at the University of Washington use this gene to look for new species. This workshop introduces curriculum developed by the presenter and funded by a Murdock Supplemental grant to teach Evolution and allows students to be part of the hunt for new species. Teachers will learn to incorporate *C.elegans* into their classroom using inquiry, molecular biology laboratories and bioinformatics software.

Participant Requirements
Laptop

Workshop 4: Using a transformed photoyntheis and respiration lesson sequence

Sator Hall Lab #209 (2nd floor chemistry)

Presenters
Kim Popham, Murdock Trust Implementation Coach, Belgrade, MT
Kris Ablin-Stone, Murdock Trust Implementation Coach, Council, ID

Abstract
Photosynthesis and respiration are common topics taught in high school biology, but can be difficult for students to understand. Come see how to utilize a Community of Practice model (QPOEE) tranformed Bio-Rad algae bead kit for a more student centered lab experience.

Participant Requirements
None

Workshop 5: DNA Microarrays and Smoking: What a BLAST!

Sator Hall Lab #105

Presenters
Amy Lindahl, Grant High School, Portland, OR
Coleen Swihart, Aloha High School, Aloha, OR

Abstract
Add biotechnology techniques and bioinformatics to your existing cell cycle/cancer unit to create a more dynamic learning experience for your students. You will use a DNA microarray kit to explore how smoking affects the expression of several genes in lung tissue. In the second portion of the workshop, you will further explore these genetic changes with bioinformatics tools. Using BLAST, you will identify the function of genes impacted by smoking and connect changes in gene expression to cancer risk. Finally, you will learn about additional microarray labs and bioinformatics resources that will excite and engage your students.

Participant Requirements
A laptop or chromebook for the BLAST portion of the workshop, although each 3 person group can proceed with a single device.

Workshop 6: Reproductive Biomedicine Workshop

Sator Hall Lab #221 (2nd floor chemistry)

Presenters
Mary Zelinski, Ph.D., Oregon National Primate Research Center, Beaverton, OR
Diana Gordon, MAT, MPH, Oregon National Primate Research Center, Beaverton, OR
Lynda Jones, MS, Oregon National Primate Research Center, Beaverton, OR

Abstract
Using a specific biomedical research area as an overarching organizational theme for teaching biology provides a context for student learning and answers that question, "Why do I need to know this? . Oncofertility, a new field of medicine, encompasses comprehensive approaches to preserving fertility in patients before their cancer treatment begins. Biological, bioengineering, and ethical concepts, including cell division, genetics, reproduction, cryobiology, and biomaterials, can be explored under the umbrella concept of oncofertility: How do cancer and normal cells differ? How do chemotherapy and radiation affect patient fertility? How can fertility be preserved? Who legally owns the cryopreserved eggs and sperm if the patient does not survive? When students have a context for learning, they grasp the science concepts much more quickly and are inspired to continue learning more about them and to possibly pursue a career

in biomedical research.
In oncofertility research, scientists are freezing ovarian tissue for transplantation or growing follicles containing oocytes (eggs) outside of the body. Hands-on activities in this workshop will include determining which cryopreservation solution is least damaging to tissue, and exploring the use of alginate as a biomaterial for 3-dimensional follicle growth as the oocyte matures in vitro.
Participants will explore the free online curriculum resources that have been devised to support this approach to learning. The curricular framework will be presented, discussed, and used to provide context for the laboratory activities. Following completion of the lab activities, the group will view a classroom-ready PowerPoint on how ethical discussions are made and then individually apply those ideas to several cancer patient case studies. As time allows, more of the curriculum – teacher background on various topics and PowerPoints and on related topics - will be explored.

Participant Requirements
Laptop or iPad

Workshop 7: How are you hearing me? Engaging Students in a 3D Learning Progression

Latter Hall #101

Presenters
Bradford Hill, Mountainside High School, Beaverton, OR
Stephen Scannell, Gresham High School, Gresham, OR

Abstract
This hands-on session aims to engage participants in a cell phone and telecommunications project. This NGSS 3D learning progression integrates PBL, Modeling, and the science and engineering practices. We begin with the phenomenon of a cell phone call where the student asks "How are you hearing me?". That launches us into telecommunications and a learning progression that targets all the NGSS wave PEs, in addition to how the ear works, and coding a simple App to send text message. Students make a text message, encode the message as binary digital information, send it, and decode it back into a text message.In oncofertility research, scientists are freezing ovarian tissue for transplantation or growing follicles containing oocytes (eggs) outside of the body. Hands-on activities in this workshop will include determining which cryopreservation solution is least damaging to tissue, and exploring the use of alginate as a biomaterial for 3-dimensional follicle growth as the oocyte matures in vitro.

Participant Requirements
Laptop recommended

Workshop 8: Kinematics Learning with Kinesthetics: Using Position Trackers in Physics Education

Latter Hall #01

Presenters
Ralf Widenhorn Ph.D., Portland State University, Portland, OR
Gabe Mukobi, Portland State University, Portland, OR
Thomas Allen, Portland State University, Portland, OR

Abstract
We will present the use of commercially available position trackers for introductory kinematics laboratory experiments. Using position trackers, students will actively engage with the concepts of position, velocity and acceleration. Students can connect these concepts with their graphical and mathematical representations. We will show how postion trackers can be used to study 1-dimensional, 3-dimensional and rotational motion through multiple kinesthetic activities that involve students walking, running, jumping, spinning and throwing objects.

Participant Requirements
Nothing required, but welcome to bring a laptop or notebook to take notes.

Workshop 9: Tackling Complex Problems with Systems Thinking and Beautiful Visualizations

Latter Hall #02

Presenters
Claudia Ludwig, Institute for Systems Biology, Seattle, WA
Mark Buchli, Liberty High School, Bellevue, WA
Mari Knutson Herbert NVCT, Lynden High School, Lynden, WA
Anne Thompson, Ph.D., Portland State University, Portland, OR

Abstract
This workshop offers teachers the opportunity to leverage technology and large publically available datasets to explore the interdisciplinary science of oceanography with their students. Data sets will be investigated with commonly used software (Excel & LoggerPro) along with adaptive and beautiful web-based visualizations. The workshop will contain a two level menu the attendee can choose from (general and advanced.) Principles of oceanography, basic statistics, and data management will be presented in an accessible and engaging format. The expected outcome is that teachers will become equipped to integrate exploration of large datasets into existing lessons in chemistry, physics, or biology.

Participant Requirements
Personal computer, cell phone (to connect to wifi), note taking supplies, and basic computer skills.

Workshop 10: Creating Agents of Inquiry

Latter Hall #102

Presenter
Jason Niedermeyer; South Salem High School, Salem, OR

Abstract
Our students, regardless of their age, are seeking agency. In order to achieve the independence that is a hallmark of agency, they recognize they need some direction. As teachers, we often assume that direction has to come from us, but often students' natural inclination is to look at peers or at individuals who are only a bit older than them for modeling or inspiration. My goal in this session is to facilitate your learning how to get your students to not only learn the process of inquiry from each other but also to teach it to students younger than themselves. You will be put through scaleable lessons (applicable for ages K-12) that integrate technology, engineering, and competition so you can experience the process before enacting it yourself.

Participant Requirements
Something to write with and on.

LUNCH (OPTIONAL SESSIONS) | 11:30 A.M. – 1:30 P.M.

Brownbag Workshop 1: Bringing the Science Fair Experience to Your Classroom

Latter Hall #101

Presenters
Debra Dimas, Santa Teresa High School, San Jose, CA
Larry S. Sherman, Ph.D., Oregon National Primate Research Center, Beaverton, OR

Abstract
Always wanted to have a Science Fair in your classroom, but were afraid to do so? Unclear about what is required to have your students actively complete a Science Fair project? Ever wondered if you could use a Science Fair as a way to achieve other curricular goals? Dr. Larry Sherman, a neuroscientist at the Oregon Health & Science University, has been running a science fair workshop and science fair for elementary and middle school students for the past 15 years. Debra Dimas has been incorporating Science Fairs with her Physics and Chemistry students for 18 years and is currently mentoring 3 other teachers at her school to complete projects with their classes. This lunchtime discussion will include a presentation on the steps required to complete a project as well as how to manage the logistics while teaching 150 students. We will end with group discussion time to brainstorm how to implement this at your own school. It is doable and worthwhile. Come join us and include food for thought with food for your stomach.

Brownbag Workshop 2: Using Popular Literature from Science to Teach NGSS: Cause and Effect

Latter Hall #01

Presenter
Chung Sinn Khong, Yerba Buena High School, San Jose, CA

Abstract
A part of my 3 year IISME fellowship at Stanford University's School of Earth Sciences was understanding what caused animal body sizes to change through geologic time. When asked to put in a few words what I did for my fellowship, I would just say, "the study of causes and effects". The causes I researched were manifold chief among them were the changes in atmospheric oxygen content. So, how do I bring this back to my classroom? I will address in this workshop 3 Dimensions of NGSS which are cross-cutting concepts, science and engineering practices, and disciplinary core ideas. Of which, I will specifically address the sub-area of cause and effect which is found in cross cutting concepts. We will examine how popular literature from science such as "Jurassic Park" by Michael Crichton and "The Hot Zone" by Richard Preston can be used to further students understanding of cause and effect. Also, we will also examine how Hollywood movies accompanying these works of popular literature can also be used to further students' understanding of cause and effect. Curricular areas to be address includes biology, chemistry, earth science, and environmental science.

SESSION 2 | 1:30 – 3:30 P.M.

Workshop 11: Exponential inquiry- merging math and biotech to amplify learning

Sator Hall Lab #221 (2nd floor chemistry)

Presenter
Dawn Tessandore, veteran Partner
Richard Chan, Embi Tec, San Diego, CA
Callen Hyland, The Mini One Systems, San Diego, CA
Rita Wong, The Mini One Systems, San Diego, CA

Abstract
Amplify your knowledge exponentially by combining the powerful tools of MiniOne Systems and mathematical modeling. In this immersive, hands-on lab, you get to drive and get under the hood to learn how the process really works. Modeling PCR with math is daunting, but with this step-by-step scaffolding approach students start with what they already know, explore simple scenarios, generalize these scenarios into a model, and use the model to predict the outcome of specific PCR amplifications. Students will design an experiment to test their predictions while getting hands-on with PCR and gel electrophoresis.

Participant Requirements
None

Workshop 12: Low Floors and High Ceilings: Strategies for Teaching All Students to Think Critically About Quantitative Relationships

Sator Hall Lab #209 (2nd floor chemistry)

Presenter
I-Heng McComb, Fremont Union High School District, Mountain View, CA

Abstract
Statistician George Box once wrote, "Essentially, all models are wrong, but some are useful." In this workshop, we'll take a look at what happens when teachers embrace the essential wrongness of models, taking students' focus away from "what's the right answer," leveling the playing field so students with less developed math skills can fully engage, and raising the expectations for thinking critically about the formulas and other models we ask students to apply.

Participant Requirements
Tablet/laptop desirable for full participation.

Workshop 13: Drones in and out of the classroom

Sator Hall Lab #108

Presenter
Ken Dickey, Nyssa High School, Nampa, ID

Abstract
Drones are not just for taking photos and delivering packages. They can also be used as an affordable tool for teaching physics. I've developed five student-tested lesson ideas around the use of drones. This workshop features one lesson in which students experiment with a microdrone (cost $30) to solve a classic physics problem which was previously only feasible on a conceptual level.

Participant Requirements
Laptop recommended

Workshop 14: Data as Art: Data Visualizations as a Tool to Explore Science Inquiry, Research, and Content

Sator Hall Lab #105

Presenter
Maria Laws, Acalanes High School, Lafayette, CA

Abstract
In this session, we will investigate multiple strategies to incorporate creative analog and digital data visualizations for student driven data collection and analysis, science content explorations, and effective communication with an emphasis on multiple intelligences, creative thinking, and student driven scientific inquiry. This is a hands-on session where participants will experience and analyze strategies through the

frame of the learner and the teacher. Connections to CCSS and NGSS and additional resources will be highlighted and shared.

Participant Requirements
None

Workshop 15: Using computer coding, CAD software, and 3D Printing to enhance ALL core science curriculum classes, and yes that includes biology

Latter Hall #101

Presenter
Dave Holz, Beaverton High School, Beaverton, OR

Abstract
With societies high demand for technology skills in the workforce it is increasingly important that all sciences not only incorporate computer technology into their curriculum, but also teach aspects of computer technology. The advent of cheap micro controllers and reasonably priced 3D printers, as well as the multitude of online training sites has made the idea of teaching students computer technology in the core science classes much less daunting. The intent of this workshop is to explore some options that are currently being implemented at the high school level to incorporate computer coding, CAD design, and 3D printing into all core science classes as an enhancement to their current curriculum. New ideas are welcome!

Participant Requirements
Please bring your own laptop with some sort of cheap CAD software (such as Google's Sketch Up which is free) already installed, as well as Arduino or possibly Rasberry Pi software (also free).

Workshop 16: Using Student-Held Whiteboards to develop discourse and reasoning skills in the science classroom

Latter Hall #02

Presenter
Karl Englert, Nathan Hale High School, Seattle, WA

Abstract
Participants of this workshop will practice with four different methods of classroom whiteboard use: 1) using lab-team created whiteboard reports, 2) solving and presenting problem solutions, 3) individual whiteboards for use in formative assessment and reasoning, and 4) a location for exhibition of student ideas and work.

Participant Requirements
None

Workshop 17: Converting Cookbook Curriculum to Curiosity Driven in the Development of Creative Minds

Latter Hall #102

Presenter
Jennifer Dean, Camas High School, Camas, WA

Abstract
This workshop will share a google template for organizing open-ended lab investigations that facilitate collaboration and offer more opportunities for student-driven creativity and exploration within existing curriculum. Participants will engage in the use of the template for specific activities used in biology, chemistry and environmental science classrooms. Brainstorming and sharing of best practices and experiences from the participants to be encouraged in forming a shared document with the wisdom and experiences that exist within the room. Discussion topics to include but are not limited to, methods to incorporating explanations and designing solutions for real world problems into student projects for all scientific disciplines.

Participant Requirements
Smart device and a digital copy of your curriculum.

Workshop 18: Using the Cornell Laboratory of Ornithology's e-Bird program to enhance authentic student research in your classroom and introduce students to the importance of citizen science

Latter Hall #01

Presenter
Craig Kuchel, retired educator and former Partner, Florence, MT

Abstract
The free online tool e-Bird now has over a third of a million contributors. The resulting, massive database is being used to inform scientists about critical bird habitats and to guide conservation efforts. Learn how to involve your students in this important global effort to document bird distribution and migration. Workshop participants will take a short field trip, set up individual e-Bird accounts, learn to use some of the powerful tools for sharing and analyzing data, and explore ways to use this online tool to create a research environment in the classroom. Expertise in bird identification is not required.

Participant Requirements
Binoculars, a field guide (if possible), and a personal electronic device with internet capability.

POSTER PRESENTATIONS

January 12 & 13 | 5:00 – 6:15 p.m. | Pavilion

Even numbered posters present Friday, Jan. 12 | Odd numbered posters present Saturday, Jan. 13
All posters to be displayed both sessions

1 *"Comparative Analysis of Polyhedral Oligomeric Silsesquioxane (POSS) Using ToF-SIMS"*

Danielle Baur, STAR Program, San Marco, California

Dr. Xioa-Ying Yu, Pacific Northwest National Laboratory, Richland, Washington

In order to generate new materials and improve the development of existing systems, we must have some background on the surface or film of that structure. The surface can reveal a large amount of information about the material, such as chemical reactivity, corrosiveness, electrostatic behavior, etc. At the Pacific Northwest National Laboratory (PNNL), Dr. Xiao-Ying Yu created an instrument which is able to analyze liquids that had previously been too volatile to undergo TOF-SIMS analysis. This development was followed by an interest arose in the surface analysis of fingerprints through examination of the natural substrates which cover skin. One specific interest was usage of Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS) to successfully determine substrates as well as provide a detailed fingerprint which could be used for forensic applications. This inquiry was tested by a variety of research facilities and results concluded that TOF-SIMS can be used successfully for forensic application as well as effectively detect substrates. It was also uncovered that TOF-SIMS could be used for a plethora of other practices in the forensic area.

2 *"Is There a Case for Case Studies In High School?"*

Emily Bertelsen, University of Arizona, Green Valley, Arizona

Dr. Sanlyn Buxner, University of Arizona, Tucson, Arizona

High school biology classes provide students with a variety of avenues to engage their curiosity and learn new content. After asking students what they believed was the largest problem in public school curriculum, in both science and non-science classrooms, they agreed that the way materials are being used in class requires the most attention. These "structures", students suggested, do not always match their learning needs and are therefore often ineffective. In this research project I examined the impact of using science case studies as a learning structure on 82 sophomore biology students learning two of the most complex processes in biology, photosynthesis and cellular respiration. Students completed a case study on cellular respiration but not photosynthesis.

3 *"How Does Phytoplankton Diversity Shift Across the North Pacific Subtropical Front?"*

Heather Blair, David Douglas High School, Portland, Oregon

Dr. Anne Thompson, Portland State University, Portland, Oregon

Oceanic phytoplankton play a crucial role in photosynthetic processes on a global scale. However, phytoplankton diversity on the submesoscale (0-10km) is understudied relative to their global importance and the global prevalence of submesoscale oceanic features. To address this lack of knowledge, I studied the relationship between phytoplankton diversity, abundance, and submesoscale features at the North Pacific Subtropical Front using flow cytometry. I found that although prochlorococcus dominates warmer waters, synechococcus follows a similar pattern, which is inversely related to larger picoeukaryotes. This research is a useful model of what aspects of the ocean drive phytoplankton ecology, which can be incorporated in climate change models.

4 *"Comparison of event-related potentials recorded from the anterior and posterior hippocampus of epileptic patients"*

Constance Bond, Naaman Forest High School, Garland, Texas

Dr. Bradley Lega, University of Texas Southwestern Medical Center, Department of Neurosurgery, Dallas, Texas

Rodent studies show that the ventral (anterior in humans) and dorsal (posterior) hippocampus each have unique functionalities. In humans, the hippocampus is believed to play an important role in response inhibition, episodic memory, and spatial cognition, yet, it is not understood which area of the hippocampus accounts for each function. Epileptic patients undergoing stereo electroencephalography (sEEG) monitoring in the hippocampus are prime candidates for testing episodic memory. These patients are asked to participate in verbal Free Recall (FR) testing to examine Event-Related Potentials (ERPs). The resulting ERPs are compared across the right and left hemispheres, anterior and posterior hippocampus, as well as recalled and non-recalled events. Though we hoped for more variation between data sets, we did observe a difference in ERPs between the anterior and posterior hippocampus in the non-dominant (right) hemisphere. This is interesting because research has shown that the left hippocampus has a much more important role in verbal memory than the right, which is more involved in pictorial and spatial memory.

5 *"Detecting $ILDR_2$ Expression in the Mouse Brain Using IHC"*

Aja Brown, Metropolitan Soundview High School, Bronx, New York

Dr. Yiying Zhang, College of Physicians and Surgeons, Columbia University, New York, New York

Obesity can develop through the control of many genes. This leads to the question, which genes cause obesity that leads to Type 2 diabetes? This leads to the question, which genes cause obesity that leads to diabetes? Immunoglobulin Like Domain Containing Receptor ($ILDR_2$) is a membrane-span protein localized on the endoplasmic reticulum membrane (ER). It has been found to regulate beta cell mass in the pancreas and fat content in the liver of mice. $ILDR_2$ expression level is markedly lower in diabetes-susceptible mouse, relative to diabetes-resistant mouse. Inactivation of $ILDR_2$ also leads to obesity. This research was done to determine where $ILDR_2$ is expressed in the mouse brain and which antibody is specific for $ILDR_2$, through Immunohistochemistry (IHC).

6 *"The Effects of Urbanization on the Movement and Habitat Preference of Local Wildlife"*

Jeffrey Buckingham, Beaverton High School, Beaverton, Oregon

Dr. Catherine de Rivera, Portland State University, Portland, Oregon

The Effects of Urbanization on the Movement and Habitat Preference of Local Wildlife, Jeffrey Buckingham, Beaverton High School, Beaverton, Oregon; Catherine de Rivera, Portland State University, Oregon. The Portland population density heavily impacts local wildlife movement; necessary for breeding, food, water and shelter. A habitat assessment survey was developed by de Rivera et. al. to incorporate vegetation type, presence of water and potential barriers to wildlife in urban areas. Habitat field surveys in poor, moderate and good habitats were conducted for Red Legged Frogs (RLF) and American Beavers (AB). AB scored higher in both moderate/good habitats and RLF scored higher in poor habitat.

7 *"Growth Factors in Cartilage Tissue Engineering for Next Generation Knee Replacement"*

Anna Bute, Academy for Software Engineering, New York, New York

Dr. Gerard Ateshian, Columbia University, New York, New York

Tissue engineered cartilage is a necessary innovation. Currently, when osteoarthritis and/or traumatic cartilage injuries are too severe, a total knee arthroplasty (TKA - total knee replacement) is the treatment. TKAs are a reliable treatment, but they last 20 years and can only be completed on the same joint twice. Tissue engineering hopes to assuage these issues by creating tissue with native tissue capabilities that have longer lifespans. However, growing large pieces of cartilage pose a challenge. Growth factors play a major role in the growth of cartilage. This study focused on latent TGF-β's impact on adult canine cells with hopes of culturing adult human cells in the future. Adult canine cells cultured with latent TGF-β grew very little and did not perform well in biochemical and mechanical testing.

8 *"Exploring the Roles of Understudied Antiviral Proteins"*

Katie Capp, Belgrade High School, Belgrade, Montana

Dr. Joel Graff, Montana Tech of the University of Montana, Butte, Montana

Tripartite motif (TRIM) proteins are an understudied family of proteins encoded by the human genome that act as antiviral molecules. TRIM proteins are expected to have E3 ubiquitin ligase activity. Exploration of the role of these understudied antiviral proteins required the cloning of TRIM protein genes into two different yeast two-hybrid plasmids and fluorescently tagged protein plasmids. Multiple TRIM genes were successfully cloned. The cloned genes are being subcloned into additional plasmids. Successful RT-PCR of other TRIM genes was also performed. Obtaining RNA from various human cell lines and optimization of the RT-PCR conditions required frequent troubleshooting.

9 *"Do Nutrients Limit Phytoplankton Growth in the Columbia River?"*

Alixandra Coker, Camas High School, Camas, Washington

Dr. Stephen Bollens, Washington State University - Vancouver, Vancouver, Washington

Harmful algal blooms (HABs) have increased in the Columbia River Basin and many other temperate water bodies in recent years. In order to better understand why, we conducted laboratory experiments to test whether phytoplankton growth (measured as change in chlorophyll α biomass) is affected by nutrient amendments. The nutrient amendment (treatment) was chosen based on previously published data on the highest concentrations of nitrogen, phosphorous, and silica that occurred in the Columbia River in late summer. Water samples were collected from the surface of the Columbia River (CR) from a dock at Vancouver, WA. After initial samples were taken for chlorophyll α analysis, the remaining river water was filtered via negative filtration, divided into control and treatment (nutrient amendment) groups, placed on a plankton wheel and incubated in a room with temperature and light conditions similar to ambient conditions in the CR. Triplicate control and treatment jars were filtered at the end of each 24-hour period over 5 days. Chlorophyll α concentration was measured with a fluorometer. We saw very little phytoplankton growth (change in Chl) over the course on our experiment, although there was a statistically significant increase in growth on day 2. Thus, our initial conclusion is that phytoplankton in the CR were not nutrient limited in late August. This lack of nutrient limitation could potentially be due to run-off from local agricultural operations. Other potential factors and candidates for future study are the impact of microzooplankton grazers (e.g., ciliates, rotifers, etc.) as well as the effects of individual nutrients on phytoplankton growth. Ultimately, the results from these experiments will inform what is known about nutrient impacts on phytoplankton growth and how this growth could impact the development of harmful algal blooms in the Columbia River Basin and elsewhere.

10 *"Molecular Dynamics Computer Simulations for High School Chemistry"*

Michael Davis, Albany High School, Albany, California

Dr. Joseph Napoli, Stanford University, Stanford, California

When experimental techniques are insufficient for observing atomic-level phenomena, scientists use advanced computer simulations to model complex systems. As the advancement of processing power continues its exponential increase, molecular simulations are becoming increasingly relevant to scientific progress. These activities allow students to create realistic atomic simulations, and to visualize molecules interacting. In these exercises, students create systems, define initial conditions, and simulate a variety of interesting phenomena. Using programs OpenMM and Visual Molecular Dynamics (VMD), students can change initial conditions in their simulations and observe the effect of those changes on an atomic scale. Some concepts that can be enhanced with computer simulations are properties of solids and liquids, ionic and covalent bonding, colligative properties, solvation processes, and bond energy. While using OpenMM requires some knowledge of the Python programming language, the resources provided in this lesson are designed so that Python experience is not required for students or teachers. Lesson includes an implementation guide for teachers, handouts for students, and online resources for downloading the required open-source software.

11 *"Hummingbirds and Climate Change: What Can Pollen Tell Us?"*

Kate Dircksen, Boise State University, Boise, Idaho

Dr. Heidi Ware, Intermountain Bird Observatory at Boise State University, Boise, Idaho

Hummingbirds evolved to use day-length cues to determine when it is time to migrate. In the past, day-length was correlated with plant flowering, allowing hummingbirds to match their nesting with peak food availability. Climate change is affecting this connection: flowers are blooming earlier because of earlier springs, so hummingbirds migrating based on day-length arrive too late to catch peak flowering. The U.S. Fish and Wildlife Service places the Calliope (Selasphorus calliope) and Rufous (Selasphorus rufous) hummingbirds on their list of "Birds of Conservation Concern". One of the breeding grounds for Calliope hummingbirds includes our study area outside of Idaho City, Idaho, on private lands directly adjacent to the Boise National Forest. Documenting key food resources and understanding how climate change affects them will be important for determining direction of future conservation efforts. During the 2017 field season, a pollen library was created by collecting 71 species of flowering plants in our study area and mounting the pollen on microscope slides using safranin stain. Pollen samples were also collected from the foreheads/chins/bills of 8 hummingbirds to begin to determine what plants they use and when. During the 2018 field season, numerous samples will be collected during the banding procedure to determine the main food sources of the hummingbirds in our area.

12 *"Competitive infection of Aiptasia sea anemones with Symbiodinium algae as a model to understand coral-algae symbiosis"*

Elizabeth Doggett, San Mateo High School, San Mateo, California

Dr. John Pringle, Stanford University, Palo Alto, California

Symbiosis between reef-building corals and dinoflagellate algae is crucial to the survival of coral reefs. When this symbiosis breaks down ("coral bleaching"), corals and the diverse ecosystems they support die. Since corals are very difficult to work with, the Pringle Lab uses a closely related small sea anemone, Aiptasia, as a model organism. Symbiosis in both corals and anemones is established in a very specific manner: a given host species will only establish a relationship with certain types ("strains") of algae. The goal of this project is to determine patterns of symbiosis by tracking different Symbiodinium strains when they are in competition to infect an Aiptasia host. Symbiotic and aposymbiotic Aiptasia strains H2 and CC7 were infected with algae strains SSA01, SSB01, and SSE01 in multiple combinations and tracked over a 30 day period. Infection was quantified using BCA protein assay, flow cytometry, and fluorescence microscopy. Preliminary results suggest that Symbiodinium strain SSE01 does not interfere with Aiptasia infection by SSB01, CC7 Aiptasia populate with Symbiodinium faster than H2 Aiptasia independent of Symbiodinium strain, and CC7 Aiptasia are more densely populated with Symbiodinium than H2 Aiptasia. More work is currently being done to determine infection ratios of different Symbiodinium strains in a single Aiptasia host using qPCR.

13 *"Do flavonoid compounds promote healing in Multiple Sclerosis lesions?"*

Paul Donelson, Valor Christian School International, Beaverton, Oregon

Dr. Lawrence Sherman, Oregon National Primate Research Center, Beaverton, Oregon

Neuroscience research conducted within the last 15 years has indicated that the inhibition of particular enzymes in the brain may serve as a way to mitigate and even reverse the detrimental effects of demyelinating diseases such as Multiple Sclerosis (MS) and Alzheimer's disease. Studies have previously identified PH20 as an enzyme of particular interest, although subsequent work has called its significance into question. This study sought to identify compounds that would inhibit PH20, which if accomplished may promote the maturation of oligodendrocyte progenitor cells (OPCs). An array of compounds (SuBr, Subr1, SuBr2, SuCl, and S2) was tested. Each of these compounds was novel to this application. Mouse OPCs were grown in OPC media for 24 hours, at which point it was replaced by Differentiation Media (DM) infused with the tested compounds at various concentrations (1,2,4 uM, n=4 per condition). A control (n=4) was run without the presence of inhibitor. DM was replaced every 24 hours for the next 72 hours, at which point cells were fixed in 4% PFA, and stained for imaging by immunohistochemistry (IHC). Although issues with the IHC staining process made it impossible to confidently evaluate the compounds' capacity to promote OPC maturation, it was determined that all of the compounds other than SuBr1 were toxic to OPCs at concentrations higher than 1 uM. The unique tolerance of SuBr1 warrants further investigation, though other tested compounds may ultimately prove to be effective at promoting OPC maturation if used at 1 uM or less.

14 *"A Compressive Strength Comparison of Nano-Crystalline and Micro-Crystalline Cellulose"*

Robert Edrington, Southridge High School, Pasco, Washington

Dr. Xiao Zhang, Washington State University - Tri-Cities, Richland, Washington

Mr. Edrington's research examines the differences of Nano and Micro-crystalline cellulose (NCC & MCC) materials which come from highly renewable resources. Using these nature-based NCC and MCC materials offers ecological advantages and mechanical performances that can be adapted to a large array of applications. The research this summer (2017) was focused on the differing mechanical strengths between several formulations of NCC and MCC.

15 *"Development and Implementation of an Optimization Model to Improve Airport Security."*

Kassandra Guajardo, Sunnyside High School, Wapato, Washington

Dr. Robert Brigantic, Pacific Northwest National Laboratory, Richland, Washington

What if airport security teams across the world could quantify and then minimize the amount of risk throughout areas of an airport? The Operations Research Team at the Pacific Northwest National Laboratory is developing and implementing an optimization model called ARAM (Airport Risk Analysis Model) for the Seattle-Tacoma International Airport. ARAM will provide a recommended optimal deployment of security assets to reduce risk in areas of an airport. The model is based on a

risk equation that considers consequences, vulnerabilities, and threat magnitudes at airports. ARAM will also provide the estimated risk buy down percentage, which is how much risk can be reduced from the baseline based on how many security teams are available when optimally deployed. Currently, there are six different asset types that were used in this model: TSA (Transportation Security Administration) Playbook Team, TSA Canine Team, TSA VIPR (Visible Intermodal Protection and Response) Team, POS (Port of Seattle) PD (Police Department) Canine Team, POS PD Patrol Team, and POS Security Team. Based on initial analysis, the asset team that had the greatest risk buy down was the POS PD Canine Team with a 5.1% risk reduction during the shifts of 0300-1000 hours and 0400-1100 hours. The next steps for the ARAM model will be to translate the Microsoft Excel program into a web accessible software platform that runs the calculations in a timely manner for airport security teams to implement on a daily basis.

16 *"Collective Behavior of Leafcutter Ants"*

Julia Harvey, South Eugene High School, Eugene, Oregon

Dr. Tristan Ursell, University of Oregon, Eugene, Oregon

Leafcutter ants (Atta) have complex social behaviors with clear divisions of labor. For maximum energy efficiency, information is communicated to foragers when scouts lay down a pheromone trail. This trail leads to a path optimization. Image analysis software is used to transform the visual data into quantitative data to draw conclusions regarding ant path establishment.

17 *"How do environmental inputs trigger rapid changes in gene expression that maintain physiological homeostasis in the face of a fluctuating environment?"*

Sonja Ljungdahl, Springfield High School, City View, Oregon

Dr. Alice Barkan, University of Oregon, Eugene, Oregon

Light is a necessary resource for plants, but it is also a source of photo-oxidative damage. Adaptations to fluctuating light conditions serve to optimize photosynthetic yield and minimize light induced damage. Light-regulated synthesis of the chloroplast gene product D1, which forms the reaction center of Photosystem II, is at the core of these responses. The rate of D1 synthesis changes rapidly in response to shifting light intensity due to regulation at the level of translation. To elucidate mechanisms that mediate the effects of light on D1 synthesis we are examining the roles of nucleus-encoded proteins that we hypothesize participate in this process. I analyzed a maize mutant lacking one such protein, PPR66. My experiments showed that PPR66 does not influence psbA translation but instead is required for the translation of the chloroplast psbJ mRNA, which encodes a different subunit of PSII.

18 *"21st Century workplace skills meet 17th century institutionalized formal education"*

Sheila Marquez, University of Arizona, Tucson, Arizona

Dr. Javier Lopez, University of Arizona, Tucson, Arizona

Current education must catch up to the 4th industrial revolution which is a fusion of technologies: physical, digital, and biological. To prepare the students for the 21st century in the 4C's (critical thinking, communication, collaboration, and creative problem solving) teachers need to become skilled themselves and experience the 21st century workplace. From my summer experience in the hospital I created 3 project based learning (PBLs) units for my anatomy students to utilize the 4C's. The students learned to create solutions for real life problems I witnessed in the hospital. The PBL was authentic and relevant.

19 *"Impacts of plant diversity and fertilizer applications on soil biodiversity and soil carbon cycling"*

Violet Martin, Capital High School, Boise, Idaho

Dr. Marie-Anne deGraaff, Boise State University, Boise, Idaho

A diverse soil community is an indicator of healthy soils. However, intensive agricultural practices threaten soil biodiversity. With this study, we ask if increasing plant diversity and reducing nitrogen (N) inputs in bioenergy crops increases soil biodiversity. Our study was conducted at Fermilab National Environmental Research Park in Batavia, IL. We took soil samples from an existing experimental trial of varying switchgrass diversities, with or without N fertilization. We analyzed the quantities and classification of microarthropods and nematodes, as well as measured the amount of soil carbon. Preliminary data indicates that our treatments may affect soil communities.

20 *"Nanoscale Microstructural Analysis of Coal Power Plant Boiler Plate"*

Tomas McGriff, Pasco High School, Richland, Washington

Dr. Arun Devaraj, Pacific Northwest National Laboratory, Richland, Washington

Ultra-supercritical power plants has higher efficiency and operate at much higher temperature and pressure, which means reduced fossil fuel consumption and lower CO_2 emission. Boiler is a critical component in such power plants. However a type of high strength steel (P91) can fail when welded together and used in boilers which needs to be prevented. Using electron microscopy and atom probe system we analyzed the nanostructures in P91 steel and in future we plan to analyze the weld region.

21 *"Digestion of Disinfection By-Products in a Simulated Stomach Environment"*

Lisa Melendy, San Jose Conservation Corps Charter School, San Jose, California

Kirin Furst, Stanford University Chemical and Environmental Engineering, Palo Alto, California

The Mitch Lab at Stanford researches organic chemical reaction pathways involved in safely disinfecting water, and specifically involved in the research I work on the lab are efforts to eliminate disinfected-by-products (DBPs) from swimming pool treatment. These DBPs result from the necessary disinfection process to make recreational water pools safe for public use, but unfortunately are themselves highly toxic byproducts of the disinfection process and are linked to cancer and asthma. In this mETP, algebra students will learn to read graphs, interpret concentration

measurements, evaluate the point slope point of the line in terms of studies dealing how to reduce stable dust to protect horses from airborne particulates respiratory illnesses. Once we have an idea of measuring and preventing airborne particulates we will extend it to data involving human lungs and the effects of smoking. Our knowledge of particulate matter will then be used once again to understand the proportions involved in chemical formulas, and the ratios involved in balancing chemical reactions in terms of how DBPs develop in pool water. We will use our knowledge of concentration to evaluate reducing concentration of DPBs in pool water. The goal of these activities is to integrate chemistry and algebra, using science data, linear relationships, and stoichiometry as a means of describing algebraic phenomena in real world contexts. The conceptual backdrop for these various activities is the concept that matter is neither created nor destroyed. What is carried into the pool on our bodies washes into the pool, the same chemicals that protect us from fatal microbes also create dangerous organic molecules. The same dust that causes us to cough and develop asthma does the same to horses. Using our lungs as the delivery path for nicotine and cannabis also requires that we use them as a filter for other harmful smoke by products. Using the proper coefficients to account for reactant and product symbols reinforces a larger lesson that nothing disappears and that many small microscopic things can be studied for the threat they pose.

22 *"Mini-brains on Drugs: Small Molecule Activation of Folds in Midbrain Organoids"*

Joshua Modeste, The Urban Assembly School for Global Commerce, New York, New York

Dr. Yosif Ganat, The New York Stem Cell Foundation, Manhattan, New York

Parkinson's Disease is a common neurodegenerative disease which is characterized by the loss of dopaminergic neurons in the substantia nigra of the midbrain and other motor-control related symptoms. A previous study has shown that a genetic deletion of the PTEN gene causes increased proliferation and folding in cerebral organoids. In this investigation, three dimensional organoids were generated from stem cells to emulate the mid-brain development. The objective of this investigation is to see if small molecule inhibition of PTEN or activation of Akt can create brain like folding in the organoids an alternative to gene manipulation. This result could lead us closer to a more effective morphologically and physiologically accurate model of PD in-vitro.

23 *"Defects in ZnO nanocrystals studied by photoluminescence and Raman spectroscopy"*

Jonathan Moreno-Ramirez, Riverstone International School, Boise, Idaho

Dr. Dmitri Tenne, Boise State University, Boise, Idaho

Zinc oxide (ZnO) is a direct, wide bandgap semiconductor material with many promising properties for blue/UV optoelectronics, transparent electronics, spintronic devices, sensor applications and various biomedical applications. ZnO nanocrystals of varied sizes were studied for this project using low temperature photoluminescence and Raman spectroscopy. The ZnO nanocrystal samples were synthesized using the forced hydrolysis of zinc acetate dihydrate, where various amounts of nanopure water were added to control the size of the nanoparticles. Portions of each sample were annealed in air or nitrogen atmosphere at various temperatures from 350-550°C. The samples were then characterized by x-ray diffraction, transmission electron microscopy and x-ray photoelectron

spectroscopy. Ultraviolet light of a helium-cadmium laser (325 nm) was used for excitation of Raman and PL spectra measured at 10 K. The spectra of samples subject to variable synthesis parameters (nanocrystal size, annealing temperature, surfractant/surface capping agent) showed that defects leading to the appearance of visible PL bands can be introduced in the nanocrystals in a controllable way. Raman spectra show the appearance of a defect-related band, which correlates with the corresponding PL spectra.

24 *"Effects of Current and Future Environmental Stressors on Freshwater Ecosystems"*

Kendra Moser, Lewis & Clark High School, Spokane, Washington

Dr. Betsy Bancroft, Gonzaga University, Spokane, Washington

Study was conducted using stock tank mesocosms to model and evaluate effects of phosphate, hydroperiod, and invasive species on freshwater ecosystems. Copepod and midge densities decreased in the presence of brook stickleback (Culaea inconstans), an invasive fish in Eastern Washington. Daphnia densities were more complex resulting in decreased density in the presence of brook stickleback with increased phosphate levels when hydroperiod was reduced. Brook stickleback are invasive on Turnbull National Wildlife Refuge in Eastern Washington. These suggests brook stickleback negatively impact trophic structures under current conditions and will likely have a greater negative impact under future conditions.

25 *"Magnetic Nanopillars and Magnetic Levitation with Superconductors"*

Sadequn Nahar, Sunnyside High School, Tucson, Arizona

Dr. Weigang Wang, University of Arizona, Tucson, Arizona

In 21st century nanotechnology has captured high interest and has occupied a vast research area in all branches of science. Our project involved to analyze and study nanosphere arrays (nanopillars) and building a superconductor track to demonstrate magnetic levitation - the method is used for maglev train, medical diagnosis, power cable, communications etc. Researches are underway in designing superconductors that can operate in room temperature. Nanotechnology is a technology executed on the scale of less than 100 nm. The goal is to control individual atoms and molecules especially to create computer chips and other microscopic devices. Nanoparticles are now being used in various ways including manufacturing of scratchproof eyeglasses, crack- resistant paints, transparent sunscreens etc.

26 *"Water Hyacinth and Primrose: Invasive Plants in the Delta"*

Carolina Nava, WyEast Middle School, Hood River, Oregon

Dr. Christopher Potter, NASA Ames, Mt View, California

Water in the Sacramento-San Joaquin Delta has three main uses: it serves as a habitat for the fish, irrigation, and a small amount of the water is distributed to the city. The presence of water hyacinth and primrose, two invasive plants, kills fish by depleting the oxygen in the water, they also interfere

with shipping and clog the water channels. Integrated Pest Management (IPM) strategies that include chemical, mechanical and bio-control have been used to eliminate water hyacinth and primrose at the delta. During this research, we obtained and analyzed pictures at the Delta and used their geospatial (longitude and latitude) information to calculate the presence of water hyacinth and primrose at different zones that were not chemically treated and other areas that were treated. Our analysis was object-based and we used ENVI software's feature extraction tool to draw boundaries around the leaves of water hyacinth and primrose to segment the picture and create polygons. We used the polygons's RGB (Red-Green-Blue) bands and their roundness to classify the polygons into six classes using ArcMap. Water hyacinth was seen in a lower percentage in our pictures because this year it rained more in the delta compared to 2015 and this allowed the plant to flow and be flushed out. An equation to calculate the velocity of the plant rafts can help to make predictions of the presence of water hyacinth at different sites in the Delta. This information will serve the economists to plan the mechanical and chemical efforts made to eradicate the plant. Our observations also confirm that the chemical treatments fulfill their purpose and water hyacinth is killed.

27 *"Characterization of Induced Pluripotent Stem Cells and Neuroprogenitor Cells"*

Suzette Nelson, Clara Barton High School, Brooklyn, New York

Dr. Panagiotis Douvaras, The New York Stem Cell Foundation Research Institute, New York, New York

Induced pluripotent stem cells (iPSCs) offer the potential of drug testing and disease modeling without sacrificing embryos. These cells proliferate extremely well in vitro and have been shown to exhibit properties and behaviors similar to embryonic stem cells (ESC). In this study we set out to investigate the characteristics of iPSCs cells and neuroprogenitor cells. iPS cells and Neuronal progenitor cells (NPCs) from a multiple sclerosis patient were cultured alongside cells from a healthy patient. These cells were tested for pluripotency as well as for their ability to differentiate into the three embryonic germ layers spontaneously. In addition, we differentiated neurons from NPCs on an electrode assay plate and tested for electrical activity. We found that the iPS cells from the multiple sclerosis line and the control displayed the same markers known to be on human embryonic stem cells.

28 *"Variability of enterococci solar inactivation rates among lab and wastewater samples"*

Bryan Olney, Thurgood Marshall Academic High School, San Francisco, California

Jill McClary, Stanford University, Palo Alto, California

Fecal indicator bacteria often correspond with the presence of pathogenic bacteria, and are a common metric to determine water quality in recreational areas. Many factors can affect the concentration of these indicator bacteria, including UV photoinactivation. This project compared photoinactivation rates of enterococci bacteria from three different sources: lab-sourced enterococcus faecium, enterococcus faecalis, and enterococci species in wastewater. Samples were exposed to UV and visible light using a solar simulator in a controlled laboratory setting. Subsamples were removed at given time intervals and grown on selective media to determine enterococcus

concentrations. The data we collected showed significant differences between photoinactivation rates of lab-sourced enterococcus faecium and lab-sourced enterococcus faecalis, while lab-sourced enterococcus faecium and enterococci in wastewater photoinactivated at similar rates. Understanding how different species of fecal indicator bacteria photoinactivate at different rates could be useful in developing parameters for future water quality models.

29 *"Weed of the west turns bedbug bane: the inhibitory effect of Artemisia tridentata on cimix sp."*

Jenna Raino, Skyview High School, Nampa, Idaho

Dr. Jennifer Forbey, Boise State University, Boise, Idaho

Bedbugs (cimix sp.) are a particularly irksome and persistent parasite for many species, including humans and golden eagles. While studying golden eagle nests, researchers from Boise State University noticed eagles preferentially searching for and acquiring native sagebrush (Artemisia tridentata) to line their nests. Anecdotally, researchers observed that nests with less sagebrush seemed to be infested with cimix sp, while nests with more sagebrush were less infested. Sagebrush contain a class of secondary compounds called phenols that previous research has shown to bind and disrupt some insects' antenna. We collected sagebrush from the eagle nesting area, and recorded the antennal grooming and movement of bedbugs around both whole leaf and extracted Artemisia samples. There was a significant difference in behavior between bedbugs exposed to sagebrush and the control group. While still in the beginning stages of research, use of sagebrush as a deterrent of bedbugs has exciting implications. Since bedbug pesticides must be applied within the home, the non-toxic qualities of sagebrush or its derived phenols could be a major advantage. Identifying a helpful use for sagebrush products could have both economic and environmental benefits for the arid western United States.

30 *"A study of segmentation algorithms for fruit recognition"*

Lloyd Verhage, Northwest Nazarene University, Wilder, Idaho

Dr. Duke Bulanon, Northwest Nazarene University, Nampa, Idaho

Small unmanned aerial vehicles (UAVs) equipped with multispectral imaging system provide means for quick, low-cost, autonomous, and high resolution imaging that could support the crop management system for a variety of agricultural applications. Typically, the most efficient and accurate platform (or UAV) is desired for this so that the data obtained is as accurate and precise as possible. Due to this necessity, a comparison of off-the-shelf UAVs used in the research toward developing a crop management system was conducted to determine which of the two would work the best for the desired conditions. Two of the major tests consisted of measuring the stability of the UAV (or drone). The first stability test consisted of measuring the stability of the UAV while hovering (specific altitude and GPS coordinate). The second measured the stability of the UAV while in motion down a straight line. Both of these tests provided a firm grasp on the stability of each UAV tested and, with other considerations such as battery life and flight time, an answer to which drone is better for this application can be determined.

31 *"Using enzyme kinetics in human endometrial cells to understand infertility"*

Brittany Sanchez, Kuna School District, Boise, Idaho

Dr. Jennifer Chase, Northwest Nazarene University, Nampa, Idaho

Despite the high volume of infertility diagnoses, currently available infertility treatments are frequently ineffective, due to a lack of understanding of the multifaceted causes. Current research has shown that some women who are infertile have low enough uterine carbohydrate levels to prevent their embryo(s) from receiving enough nutrients. In the uterus, endometrial cells are responsible for carbohydrate storage and distribution through glycogen metabolism. A model of the glycogen metabolism system and its controlling enzymes in uterine cells could provide indicators for infertility, targets for new infertility treatments, and improvements for current infertility treatments. To create this model, the rates of every enzyme involved must be measured. In this project, the rates of the enzymes lactate dehydrogenase, phosphoglucose isomerase, and aldolase were measured.

32 *"A Brain-Gut Model of Irritable Bowel Syndrome (IBS) and Depression"*

Cenia Santana, Port Chester High School, Port Chester, New York

Dr. Michael Gershon, College of Physicians and Surgeons, Columbia University, New York, New York

Have you ever heard the expression, "Go with your gut feeling?" Well, as it turns out, the expression is not far from the truth. Most of us are familiar with serotonin as a modulator of an individual's mood. Low levels of serotonin may lead to depression or anxiety, hence its nickname "the happiness hormone". However, very few people are aware that 95% of serotonin is actually produced in the gut (Gershon, 2013). Serotonin has multiple functions in the enteric nervous system such as stimulating enteric neurogenesis (Li, et al 2011), regulating gastrointestinal (GI) motility, and promoting intestinal epithelial growth (Margolis, et all 2014). Coincidentally, about 50% of patients with Irritable bowel syndrome (IBS) also suffer from depression with a stronger association in constipation-predominant IBS (IBS-C) than in diarrhea-predominant IBS (IBS-D). Despite the prevalence of these co-occurring conditions, there are no therapies that optimally treat the brain and gut manifestations. There is thus a critical need for effective therapies that target the gut-brain axis in IBS. Targeted treatments can only be developed, however, with a greater understanding of brain-gut connections. Tryptophan hydroxylase 2 (Tph2), the rate-limiting enzyme in both CNS and ENS 5-HT biosynthesis, could thus be a brain-gut link. A genome-wide association study identified a single nucleotide mutation in Tph2, R441H, that is overexpressed in patients with depression. A novel transgenic mouse containing a knockin of this mutation (R439H; equivalent to human R441H) displays an 80% decrease in CNS 5-HT levels and a predisposition to depression. We sought to determine whether abnormalities in Tph2 could be the link between depression and constipation by evaluating the R439H mouse for defects in ENS development and GI function.

33 *"The Effect of Caloric Restriction on the Aging Primate Brain: Food for Thought"*

Rachel Stagner, Madison High School, Portland, Oregon

Dr. Henryk Urbanski, Oregon Health & Science University, Portland, Oregon

By 2030, approximately 20% of the population of United States will be 65 years of age or older. The high medical costs associated with caring for an older population and the ethical considerations of ensuring that aging adults have a maximal healthspan has led to a need for research investigating ways to mitigate some of the most serious effects of aging. One treatment that shows potential is caloric restriction (CR). Research in short-lived animals such as nematodes, mice and rats has suggested that caloric restriction results in increased lifespan, decreased brain atrophy, and lesser rates of mortality due to common age-related diseases such as cancer, heart disease and diabetes. Building on this research, two long term-studies were conducted using rhesus macaques, (Macaca mulatta), a primate which has a similar aging process to humans. My study aims to quantify any differences in the brains of aged macaques involved in one of these studies conducted at the National Institute of Aging (NIA). Coronal brain slices were taken from representative areas of the brains of 14 rhesus macaques, half of which were in the calorie-restriction group, and half of which were fed normally for several years. Using immunohistochemistry, the sections were stained for the presence of the obligate NMDA receptor, NR1, in the post-synapse and mounted on slides. NDMA is a neurotransmitter that is critical for memory retention, formation, and neural plasticity, thus we posit that a significant difference between the numbers of NR1 receptors between rhesus macaques in the different treatment groups will suggest a mechanism through which CR affects increased cognition in aged monkeys.

34 *"Investigating Ancient Actinomycetes for Antibiotic Properties"*

Amy Sutton, Benson Polytechnic High School, Portland, Oregon

Dr. Angela Hoffman, University of Portland, Portland, Oregon

Actinomycetes are soil-dwelling bacteria that often produce antibiotics. Soil excavated from an ancient Roman graveyard in Mallorca was cultured to isolate actinomycetes. One strain was fermented in a potato broth and extracted. The extract prevented growth of Pythium spp., a water fungus, for over two weeks. The compound was separated into fractions using chromatography and tested again. While two fractions showed promise, none met the five-day threshold for preventing growth. The extract's effectiveness makes it a possible source for chemotherapy drugs. Further work will be to identify the active compound(s) and optimal concentration and to analyze DNA for species identification.

35 *"Osteocalcin Favors Glucose Production in Heptatocytes"*

Rachel Taylor, Williamsburg High School for Architecture and Design, Brooklyn, New York

Dr. Gerald Karsenty, College of Physicians and Surgeons, Columbia University, New York, New York

Through a direct or indirect mechanism, osteocalcin may favor de novo glucose synthesis by the liver.

36 *"Sharpen this! A case study on how industry partnerships can help teachers ask better questions"*

Caroline Torres, University of Arizona, Tucson, Arizona

Dr. Sanlyn Buxner, University of Arizona, Tucson, Arizona

Teacher questioning has been identified as a critical and challenging aspect of a teacher's work. The act of asking a good question is cognitively demanding; requires considerable content and pedagogical knowledge; and necessitates that educators know their students well (Boaler & Brodie, 2004). Good questions can set the stage for meaningful classroom discussion and learning. As educators work to emphasize problem-solving, application of concepts and procedures, and the development of a variety of thinking skills in our mathematics curricula, it becomes critical that teachers focus on improving questioning techniques in math lessons.

37 *"Is there evidence for Cope's Rule in early Paleozoic bivalves?"*

Elsie Carrillo, Morrill High School, San Jose, California

Dr. Jonathan Payne, Stanford University, Palo Alto, California

The Payne Paleobiology Lab at Stanford University focuses on extinction risks in marine animals. In amassing a more complete dataset of the fossil remains of all marine genera, the lab is working to provide better answers to the question "Are humans at risk for causing a sixth mass extinction?" This whole-class activity challenges students to use claim-evidence-reasoning (CER) to organize the geologic timeline from the beginning of life 4.6 billion years ago to modern time. To start, students will work in groups based on time intervals, or "geologic era" (e.g., Precambrian, Paleozoic, Mesozoic, and Cenozoic). (Note: To split groups evenly for an average class size, there will be two different groups working on each era for a total of 8 groups.) These groups will receive specific "Era Event Envelopes" containing evidence cards in the form of Instagram posts that are sorted randomly. These posts contain information on various events that occurred within their designated geologic era. Students will need to unscramble the cards and determine the correct chronology by analyzing the pictures and captions included in each post and discussing with their group members. Once groups have organized their timelines in chronological order, students will jigsaw into the other groups who are working on the same era to compare results. Then, those groups will use CER to come to a consensus on the correct order of events pertaining to their assigned era. Finally, these groups will use a GSA Geologic Time Scale handout as a reference to combine their era timelines in correct chronological order with those of other era groups to create one whole-class Geologic Instagram Time Scale displayed in the classroom. To wrap up, as an individual summative assessment, students will watch a video about the current state of the Earth and use design thinking to individually create timelines for a foreseeable future based on what they learned using the Instagram template handout.

38. *"What aspects of Instructional Practice Positively affect Active Engagement by Influencing Student Motivation"*

Travis Goeden, University of Arizona, Green Valley, Arizona

Dr. Sanlyn Buxner, University of Arizona, Green Valley, Arizona

The purpose of this research was to identify the primary aspects of classroom instruction at the high school level that influence affective, behavioral, and cognitive engagement in students. Within industry, I had the opportunity to observe first-hand what aspects of the work day have a direct influence on Active Engagement, and this had a direct correlation with students in the classroom setting. Data for this study was collected using surveys, classroom assessment data, observations, and interviews to determine any possible relationships between the Instructional Day, Work Day in Industry, and Active Engagement. The case determined that the positive and negative methodology in both instances demonstrated a unique ability to either enhance or diminish motivation in both the classroom and industry setting.

39 *"Formation and Isolation of Endothelial Microvesicles"*

Chelsea Defino, Institute for Collaborative Education, New York, New York

Dr. Jahar Bhattacharya, College of Physicians and Surgeons, Columbia University, New York, New York

Microvesicles are a type of sub-cellular particle released from the plasma membrane of a cell. My goal is to use microvesicles for disease therapy at the cellular level. Microvesicles released from endothelial cells have been found to deliver proteins, nucleic acids, and even organelles to nearby injured cells. Since microvesicles have potential therapeutic uses, in this study we investigate the cellular mechanisms of the release of microvesicles by rat endothelial cells. Thus far our studies show that cultured endothelial cells can be engineered to release microvesicles under conditions of serum starvation.

40. *"Math, Machines, and Metacognition: Creating Hybrid Learning Environments in STEM Classrooms"*

Victoria Docherty, Everest Public High School, Redwood City, California

Jeremy Morton, Stanford University, Palo Alto, California

Traditional teaching methods and curriculum are quickly becoming outdated with each technological advancement, especially when students are expected to continuously adapt to a dynamic world. Mathematics, therefore, should be taught in learning environments that reinforce relevancy and self-reflection. My research shows two possible projects where students combine advanced concepts in calculus and statistics to programming and robotics. Additionally, they participate in metacognitive reflection as a daily practice to develop sustainable growth mindsets around approaching challenges.

50. *"Dendrochronological Investigation and Radioisotope Dating of a Subfossil Forest in the Puget Lowland and Southeast Olympic Mountains"*

Emily Carson, Centralia High School, Centralia, Washington

Dr. Pat Pringle, Centralia College, Centralia, Washington

Exploration of the channel of Johns Creek, a tributary to the Hamma Hamma River on the west side of the Hood Canal, Washington revealed a forest of semi-buried subfossil trees, one of which had previously been dated to ~1100 yr ago (Contreras and others, 2012). Using saws and increment borers, we sampled seven of the subfossil trees, five that lie subhorizontal and two growth-position stumps. Because the death date on the tree dated in 2012 was similar in age to the circa 900 CE Seattle Fault, we used a combination of radiocarbon dating and tree-ring analysis in order to determine if these partially buried subfossil trees were victims of the Seattle fault rupture that were later exposed during channel migration of Johns Creek. We submitted two wood samples from tree Ham01 for radiocarbon analysis. The calibrated radiocarbon lab results on the two samples yielded ages of 877–950 CE and 932–985 CE (95% probability), consistent with the age of the Seattle Fault. Previous dating of a coseismic subsidence event in the Hamma Hamma River delta (Lindstrum, 2002) resulted at ~930 ±30 yr B.P. and at up river at Lena Lake at 767–997 CE (95% probability; Logan, et al., 1998). Provisional results of our tree-ring analysis shows the buried trees in Johns Creek died the same year as a tree from the Seattle Fault tsunami deposit at West Point Atwater (1999).

POSTER PRESENTATIONS - SUPPLEMENTAL
(PNW PROGRAM)
January 12 & 13 | 5:00 – 6:15 p.m. | Pavilion

Even numbered posters present Friday, Jan. 12 | Odd numbered posters present Saturday, Jan. 13

41 *"Spatial Distribution and Monitoring of Radon Gas in Montana's Yellowstone Valley"*

Craig Beals, Billings Senior High School, Billings, Montana

It has been suggested that the Yellowstone River Valley north of Yellowstone National Park has elevated levels of Radon, a radioactive gas formed through the decay of radioactive Uranium. Rumor has it that many of the homes throughout the valley, extending out into Eastern Montana have elevated levels of radon as well. Our school and community lie within this zone so we decided to search for an answer to these questions. Students have been sampling and collecting data on radon levels throughout the valley to build a model of the spatial distribution and concentration of radon throughout our community and region. The goal has been to engage students with real-world applications of chemistry while allowing them to leave a lasting, positive impact on their community.

42 *"Effects of phytochemicals on yeast survival rate following UV exposure."*

Debbra Brewer, Lumen Christi High School, Anchorage, Alaska

Most large research projects in high schools often involve only advanced students and classes. A main purpose of this investigation was to allow general biology students to engage in real time research using the equipment and procedures they would find in advanced labs. Students spent the first year examining yeast and the effects of varying levels of UV radiation on growth rates and survival. Results obtained from these initial studies were compared to previously published work, allowing students to critically evaluate their outcomes. They also researched various phytochemicals and micronutrients that have been suggested as cancer preventers and developed the protocols for phytochemical dosage and UV exposure times. Second year students have taken the information from year one and are attempting to follow and expand on the protocols. Anecdotally, student engagement in the research project was increased compared to textbook lab procedures. The research project was well received by students and feedback was positive that they appreciated the ability to utilize and learn advanced equipment and procedures.

43 *"Isolation and Identification of Unknown Soil Bacterium and The Effect of pH on Bacterial Growth"*

Marria Coriell, Glenns Ferry High School, Glenns Ferry, Idaho

An increase in opportunities through the M.J. Murdock Partners In Science Program allowed students at Glenns Ferry High School to learn proper laboratory procedures and experience the rigors of formal laboratory work through real-world inquiry-based science. Student researchers were able to explore how bacteria in the microbiome can be manipulated by the change in pH due to

farming practices to encourage or discourage the growth of microbial organisms. Through a series of investigations, students at Glenns Ferry were able to extract bacterial samples from soil growing a variety of crops and worked to isolate colonies in order to extract DNA from the bacteria. Student researchers then worked to identify the bacteria through PCR and gel electrophoresis, as well as manipulate the growth of the bacteria through extreme changes in pH.

44 *"Using a Polymerase Chain Reaction Kit and Gel Electrophoresis to isolate an Alu repeat called PV92 on chromosome 16."*

John Doherty, Capital High School, Boise, Idaho

The procedure used in my classroom was a Polymerase Chain Reaction (PCR) test, which also included running electrophoresis gels. The test is called the 'PV92 PCR Informatics Kit' from Bio-Rad. My students used real-world forensic techniques to extract DNA from their own hair follicles or cheek cells, and then used PCR amplification and electrophoresis to fingerprint their own DNA at a specific genetics site on chromosome 16. The goal was to find what percentage of students carried this sequence and then compare it to genetic data of populations worldwide. On Day one, my students obtained one of their own hair follicles or some of their cheek cells to extract their DNA using an Instagene matrix in a micro test tube. After incubation and vigorous agitation using a vortexer their samples were then centrifuged for 5 minutes to separate out their DNA. Samples were then refrigerated overnight until Day 2. On Day two, a master mix that included primers, nucleotides, reaction buffer and DNA polymerase was added to a 200 microliter PCR tube. The students DNA supernatant was then transferred using a micropipette to the PCR Tube. PCR Tubes were then placed in a Thermal Cycler where the target DNA sequence was amplified. On Day three, controls and student samples were run on an electrophoresis gel at 100v for 30 minutes. Gels were then stained and left overnight. On Day four, student results were recorded, analyzed and discussed.

45 *"Inquiry Investigations in Alternative Energy: Nuclear, Solar and Wind"*

Jacqui Hall, Capital High School, Olympia, Washington

Students in my chemistry and physics courses have carried out various investigations related to energy sources. This supplemental grant has allowed for hands-on and data driven projects and analysis including inquiry investigations in nuclear radiation, the development and analysis of biodiesel fuel, and the building of dye-sensitized solar cells. I am continuing to develop this unit to further align with Next Generation Science Standards.

46 *"Investigating Pharmaceuticals in Local Water Supply using Organic Chemistry"*

Gina Portillo, Valley Catholic High School, Portland, Oregon

Students learn about organic chemistry, molecule purification and characterization as well as organic lab techniques that brings professional level science to a high school classroom. My original Murdock research grant was used to extract, isolate, and identify molecules in the weed Dysphania ambrosiodies that inhibit growth of neighboring plants. While I used expensive and advanced machines to perform this work, such as a High Pressure Liquid Chromatography (HPLC), I was able

to use more affordable equipment to bring these skills into a high school classroom. We used the organic chemistry concepts along with environmental science concepts to analyze the local water supply for pharmaceuticals.

47 *"Using Biotechnology to Study Cell Signaling, Inheritance and Evolution"*

Dawn Tessandore, Highline High School, Burien, Washington

How do scientists research patterns of evolution? How do biotechnology tools, mathematical models and bioinformatics help scientists find new understandings about evolutionary change? I designed a unit that introduces students to the use of bioinformatics tools, perform a series of biotechnology labs to isolate and identify a gene of interest, and create a mathematical model of evolution in a population in order to analyze the change in allele frequencies over time. Lessons ask to formulate, test and revise a hypothesis of PTC gene function in different mammals. This curriculum is intended to meet the objectives stated for AP Biology Labs 2 (Mathematical Modeling: Hardy-Weinberg), 3 (Comparing DNA Sequences to Understand Evolutionary Relationships with BLAST) and 9 (Biotechnology: Restriction Enzyme Analysis of DNA), as well as teach sensory nerve communication, review DNA replication and Central Dogma.

48 *"Field Biology Monitoring Methods in Boise, ID"*

Jeremy Thompson, Borah High School, Meridian, Idaho

This project is designed to involve students in field biology and the scientific inquiry process. Students will be using various field biology tools to observe the environment and wildlife in and around Boise, ID. Students will use initial observations from placing nesting boxes, game cameras and track traps in a variety of locations, including the campus at Borah High School, various urban locations along the Boise River, and rural locations outside of Boise to develop unique questions about influences on biodiversity.

49 *"Zebra fish in the Environmental Science and Biology Classrooms"*

Crystal Wulff, Mountain View High School, Vancouver, Washington

Zebrafish were used as model organisms in inquiry and hands-on experiments in Biology classes. Students participated in animal husbandry, learned the zebrafish life cycle and anatomy. Students gained an understanding of nutrient cycling and conducted water quality tests. Students studied fish development and cell division. Students conducted genetic crosses with the fish to determine how traits were inherited. Future investigations will test how chemicals in the local environment may affect development.

ORAL PRESENTATIONS | ABSTRACTS

January 12 | 1:00 – 4:00 p.m. (see page 4 for details)

A1 *"The Effects of the Inflammatory Cytokine Oncostatin M on Prostate Cancer Cells"*

Steve Tipping, Borah High School, Boise, ID

Prostate cancer is the second leading diagnosed cancer among men in the United States. In my research, we exposed human prostate cancer cells (DU145 cells and PC3 cells) to the inflammatory cytokine Oncostatin M (OSM). These cytokines induce prostate cancer cells to undergo epithelial-mesenchymal transition (EMT). EMT is the process that allows a tumor cell to become invasive and migrate away from the tumor, eventually leading to metastasis. The cell's gene expression must be altered in specific ways so that cells undergo EMT and become invasive. Here, we measured the levels of specific proteins that are linked with EMT in order to determine how their gene expression is influenced by the exposure to OSM.

A2 *"The search for drug-like molecules that block the metastatic spread of cancer by inhibiting specific pathways associated with metastasis"*

Lily Apedaile, Frenchtown High School, Frenchtown, MT

The treatment of metastatic cancer – cancer that spreads to remote sites in the body - is the most challenging task facing cancer researchers and oncologists. According to the National Cancer Institute, the majority of people who die of cancer, die of metastatic cancer. In spite of progress in the understanding of the onset and progression of cancers and in the treatment of localized malignancies, metastatic disease is often incurable. The primary goal of our research project is to discover drug-like molecules that inhibit this metastatic spread. The secondary goal is to gain insights into mechanisms associated with metastasis. To understand how various drug-like molecules discovered in the Stierle Lab may inhibit metastatic spread of various cancer cell lines, *in vitro* cell migration and invasion assays were used. These assays allowed for quantitative measurement of how well each drug-like molecule was able to block the cancerous cells from migrating through a porous membrane, or to block invasion into an extracellular matrix membrane.

A3 *"Imaging and the Co-localization of PGRMC1 and the Sigma-2 Receptor in Liver Tumor"*

Adriane D. Davis, Irma Rangel Young Women's Leadership School, Dallas, TX

It is proposed that there is a direct correlation between the Progesterone Receptor Membrane Component 1 (PGRMC1) expression by immunochemistry and the Sigma-2 Receptor 18F-ISO-1 molecular imaging in rat liver tumors. Rats that were treated with the nitrosodiethylamine carcinogen for 6-8 weeks to induce HCC tumor growth, were injected with 18F-ISO-1 radio tracer. Images were then acquired 1.5 hours post injection using Positron Emission Tomography. To detect PGRMC1 expression in liver samples, Rabbit anti-PGRMC1 was used with a DAPI stained nuclei. Immunofluorescent microscopy allowed visualization of the DAPI and anti-PGRMC1 distribution in the tissues. Autoradiography revealed 18F-ISO-1 accumulation in HCC tumors, while non-tumor

tissues showed lowered uptake of the radiotracer. The data obtained through immunochemistry and autoradiographs did not support the hypothesis.

B1 *"The use of in-stream structures for improving cutthroat trout habitat on four small creeks in southeast Idaho"*

Eric Rude, Pocatello High School, Pocatello, ID

Cutthroat trout (*Oncorhynchus clarkii*) have experienced severe population declines in recent decades. This study examined the use of artificially-created in-stream structures to increase the amount of energetically profitable fish habitat. Four creeks in southeastern Idaho were studied. Initial data concerning cutthroat population estimates, habitat conditions, and abundance of aquatic insects, were gathered during the summer of 2016. Structures were installed in streams in the fall of that year. Follow up data were collected in 2017. It was observed that the structures increased trout habitat diversity by creating slow-water pools upstream and scour pools immediately below the structure..

B2 *"The Re-Invasion of the Coos Bay Estuary by the Invasive European Green Crab"*

Christina Geierman, North Bend High School, North Bend, OR

The invasive European Green Crab first appeared in Coos Bay after the 1998 El Nino, but the ocean conditions in the following years were not favorable and, if any became established, they persisted in such low numbers that they did not affect the bay. Last year, 127 green crabs were in Coos Bay by our team. This year, traps were set in six of the sites where the most crabs were caught last year. Significantly more green crabs were caught in the estuary this year than last year at all six sites. In addition, fewer Dungeness crabs were caught at five of six sites. Green crabs were caught that were hatched in 2014, 2015, 2016, and 2017. While the ocean conditions were favorable for the larval green crabs to ride the currents up from San Francisco, it is also possible that there are enough green crabs in the estuary now that they have formed a reproductive population. In order to address this threat to our estuary, and attempt was made to remove green crabs from a site by trapping every day for six days and euthanizing and discarding the green crabs each day. Not only did the number of green crabs caught each day decrease, but the number of Dungeness crabs caught increased. This shows that trapping may allow us to improve the nursery habitat of the Dungeness crabs even if it is impossible to completely remove the green crabs.

B3 *"Tropical and Sub-Tropical Ozone Trends"*

Dana Coppernoll-Houston, Thomas Jefferson High School, Tacoma, WA

Tropospheric ozone is a toxic pollutant which negatively impacts human health and ecosystem function. It is formed from reactions involving carbon compounds, nitrogen oxides, and sunlight. In this study, data were analyzed from four isolated islands in the Pacific and Atlantic oceans. General trends and extreme events were examined. It was found that high ozone concentrations were influenced by horizontal and vertical transport in the atmosphere. Additionally, strong seasonal sinks in the form of tropical storms influence annual ozone variations. These tropical and sub-

tropical islands provide a good representation of expected ozone patterns without strong human influence.

C1 *"Queensland Coral Fishery Vulnerability Assessment of High-Risk Coral Species"*

Timothy Lewis, Beacon High School, New York, NY

Corals and associated species are especially vulnerable to the compounding effects of global climate change, increasing ocean acidification, and an ever-growing presence of the coral eating, Crown-Of-Thorns Starfish. The additional threat of commercial fishing and harvesting further agitates many of the ecological changes taking place within The Great Barrier Reef. This study, initiated by The Queensland Coral Fishery seeks to survey a previously identified population of vulnerable coral species. Of particular interest in this study are *Acanthastrea hillae, Duncanopsammia axifuga, Euphyllia glabrescens, and Trachyphyllia geoffroyi.* Four sites were identified in the Western Australia Territory and coral species of interest were tagged, measured in two dimensions, and assessed for noticeable changes. The work set forth here is a small branch of the novel framework put forth to assess and ultimately mitigate ecological changes to The Great Barrier Reef.

C2 *"Evaluations of Sagebrush-Steppe Environments: Are Past and Current Pesticide Applications Impacting the Ecosystem?"*

Molly Tuinstra, Pasco School District, Pasco, WA

Land development has reduced the sagebrush steppe ecosystem by half in Washington State. The ecosystem value of sagebrush steppe in the arid environment of eastern Washington is similar to the better-known value of wetlands in western Washington. Understanding the implications of land management decisions can help to sustain this important resource in the region. This presentation will cover the results of plant growth study using pesticide contaminated soils from the Hanford site in Eastern Washington.

C3 *"Efficiency of Solar Panels in Real-World Conditions"*

Evan Munger, Churchill High School, Eugene, OR

As more solar energy systems are deployed, millions of dollars are being spent on cells and installations. Costs are falling, and solar energy is becoming more competitive with other forms of energy production. However, despite an increasing market, manufacturers usually rate their equipment in a lab setting; thus, little is known about the real cost of solar energy production in applied environments. Important questions about the actual cost of solar energy remain unanswered.

D1 *"Impacting Antibody Movement Across the Blood Brain Barrier"*

Hali Hill, Governor John R. Rogers High School, Puyallup, WA

Work done under this grant is part of a larger investigation into the effect of altering antibody glycosylation on blood-brain barrier transport. Prior work has shown that sialic acid on an anti-beta amyloid antibody slowed its efflux from the brain to the blood. However, questions remain regarding the mechanism of how this occurs. One such question was the location of the sialic acid. It was known that some sialic acid exists on a glycan in the variable region of a light chain in the Fab domain. However, there was a second question about whether sialic acid was also present in the conserved glycosylation site in the Fc domain. This question is difficult because the Fc glycans are more sterically hindered and sialic acid at this site cannot readily bind lectin probes. High Performance Liquid Chromatography (HPLC) analysis can answer this question but requires relatively high concentrations of antibody.
A Biacore Surface Plasmon Resonance (SPR) approach known as Calibration Free Concentration Analysis was used. The concentration of IgG chains exhibiting sialic acid was determined for both intact IgG as well as IgG for which the Fc glycan had been removed with EndoS enzyme. Thus, after denaturation, one would expect a reduction in sialylated chain concentration in the EndoS-treated sample if the Fc domain contained sialic acid. Our experiment found a reduction in SPR signal, confirming that there is sialic acid in the Fc glycan.
Prior to my second summer, glycans had been labeled with a fluorescent marker. During the second summer of research, a method was created to gain specific information about which glycans were present on IgG using HPLC with Fluorescence detection. Not only could this confirm the findings from the first year (that sialic acid was present in the Fc region) but could also provide the protocol for establishing the "fingerprint" of the glycans on an antibody of interest.
Compared with a standard (Waters), the protocol developed was found to consistently identify the glycans on the test material. After my departure, mouse monoclonal antibody glycans will be manipulated (sialyation) and individual glycans tested for efflux. Based on results with mouse antibodies, we may eventually see improved treatment for those with Alzheimer's Disease and other diseases/disorders of the brain.

D2 *"A Field-deployable instrument for measuring RH-dependent aerosol extinction"*

Alicia Ryan, Cascade School District, Turner, OR

One of the major sources of uncertainty in climate models is the contribution of aerosols to changes in the Earth's radiative balance. Particles have both direct and indirect effects on climate and their interaction with atmospheric relative humidity (RH) is an important part of the puzzle. Our instrument measures the change in the aerosol optical extinction coefficient (the sum of scattering and absorption of light by particles) with changes in RH. This project uses laboratory-generated aerosols as a proof of principle for the instrument and its theory of operation.

D3 *"Mimicking Plant Processes to Produce Renewable Energy"*

Charlie Bruner, Victor School, Stevensville, MT

A growing concern in our world is the availability and production of energy. One available source for clean energy is water. The problem with using water as a fuel source is that splitting water into its native elements requires energy. Our project is looking at using inspiration from photo system II to design a catalyst that will reduce the energy requirements for splitting water.

E1 *"The Effect of Amyloid Beta on Neuroplasticity"*

Arlene Ramos, High School for Health Professions & Human Services, New York, NY

The understanding of the pathology of Alzheimer's disease (AD) is up to this day not yet fully understood but a growing body of evidence suggests that AD begins as an impaired synaptic function caused in part by increased levels of amyloid beta (Aß) protein. In this study, we investigated the role of amyloid beta protein in affecting long term potentiation (LTP) which is a type of synaptic plasticity. Also, we wanted to find out if the absence of the amyloid precursor protein (APP) gene would affect the activity of Aß. LTP was observed through extracellular field recordings between the Schaeffer collateral fibers and the CA1 *stratum radiatum* of the mice hippocampus. We found out that LTP was impaired in the Aß perfused mice. Suppression of APP expression in APP knock-out mice protected against the damage of LTP. These findings confirm previous data showing that an increase in beta-amyloid (Aß) load in the brain is likely to trigger abnormal synaptic communication in AD. In addition, these data show that APP gene is required for Aß to impair synaptic plasticity in the hippocampus.

E2 *"In Situ Measurements of Turbulence Utilizing Radiosondes with Quantification of Relative Estimation Error between NWP Analysis and Measurements"*

Joe Youngberg, Frenchtown High School, Frenchtown, MT

Radiosondes are balloon-borne devices which provide basic atmospheric measurements including temperature, relative humidity, wind speed, wind direction and pressure. Parameters such as temperature, wind speed and wind direction are being used to locate atmospheric gravity waves. Gravity waves are thought to be a cause of clear air turbulence. Learning to identify and isolate certain parameters can help us possibly forecast pockets of clear air turbulence. This periodic movement of air parcels may have great effects on wildfires and airplane travel.

E3 *"Ecological and Organic Safety Concerns of HFO-1234yf"*

Alberni Ruiz, Southern California Yeshiva High School, San Diego, CA

The nature of my research was to delve into the possible ecological and biological side effects of the new updated coolant compounds being introduced into the coolant system of motor vehicles and refrigerators. The research I did included reading an accumulation of published reviewed journals discussing the possible benefits of the coolant HFO-1234yf . The journals allowed me to better understand the pros and cons of the use of this HFO compound and its effect on our atmosphere, freshwater bodies, and soil. This research was done to better understand whether or not we are heading in the right direction to preserve our planet and progress mankind to a healthier happier future.

F1 *"Innovations in Visualizing the Activity of Vascular Disrupting Agents"*

Jeff Bivins, Richardson High School, Richardson, TX

In this experiment, various imaging tools were used to detect the effects of vascular disrupting agents. Mice were injected with 4T1-wildtype and 4T1-luciferase transfected mouse mammary carcinoma. Over a period of days, mice were imaged with a bioluminescence imaging system as well as a photoacoustic imaging system. The bioluminescence imaging system provided nice images of the effects of the administered drugs on the 4T1-luciferase transfected mouse mammary carcinoma. The newly acquired photoacoustic imaging system provided promising results for the 4T1-wildtype mouse mammary carcinoma. The 4T1-luciferase infected mouse mammary carcinoma had some draw backs with the procedure and future experiments would require a different protocol for implementation of the tumor cells. The new technology using photoacoustic topography may be the ideal imaging tool when studying vascular disrupting agents on non-transfected tumors.

F2 *"Determining Erosion Rates: Surface Exposure Dating of Streambed Sediments via Analysis of Cosmogenic Nuclides"*

Jeff Wuebber, New Rochelle High School, New Rochelle, NY

Water is the main agent of erosion on Earth. However, there exists a gap in previous research regarding the quantification of whether climate or tectonics exerts more control on erosional rates. Previous research has also failed to find a distinctive correlation between mean annual precipitation rate and the erosional rate of a given area. Surface exposure dating can be performed to determine how long sediments have been exposed to cosmic rays at the surface of the Earth. This gives information regarding the amount of time sediments have been at a location before an agent of erosion moved them away. Samples of sediment were collected from streambed locations northwest of Townsville, Australia, along the Coral Sea. These sediments were then analyzed for the presence of Beryllium-10 to determine their surface exposure time.

F3 *"Potential drug leads derived from Tolypocladium geodes"*

Emily Parent, North Salem High School, Albany, OR

Tolypocladium geodes is a hypocrealean fungus isolated from soil, although its ecology is mostly unknown. While *Tolypocladium* species in general possess numerous (30-35) biosynthetic gene clusters for making secondary metabolites, *T. geodes* has a remarkably large number of gene clusters (54) and also expresses a significant portion of these in laboratory culture, which facilitates detection and isolation of the product secondary metabolites. Hence, T. *geodes* is a promising candidate for the study and elucidation of secondary metabolites with pharmacological benefits. The present study examined the antibacterial and cytotoxic potential of secondary metabolites produced by *T. geodes*. Co-cultivation of *T. geodes* with four bacterial strains showed selective activity against *Staphylococcus aureus*. In addition, *T. geodes* cultivated with *S. aureus* alone showed complete inhibition of growth of the bacterium. Organic extracts of *T. geodes* also inhibited S. aureus. Cancer cytotoxicity screening is in progress. Future steps include fractionation of *T. geodes* extracts for purification of the active secondary metabolite(s), guided by LC-MS/MS analysis. Additional biological testing will also be performed to determine ecologically significant associations between *T. geodes* and other organisms.

G1 *"Determination of Metformin and Guanylurea in Aqueous Samples Using HPLC-UV"*

Roxanne Kilpatrick, Oregon City High School, Oregon City, OR

Metformin is a pharmaceutical drug used to treat Type II Diabetes. It is one of the most widely produced and prescribed drugs in the world. Metformin is not metabolized in the body and is therefore excreted in urine and feces, entering sewage treatment plants unaltered. Metformin undergoes bacterial transformation in wastewater treatment plants to form the compound guanylurea. Both metformin and guanylurea are resistant to water treatment techniques and have therefore been found in wastewater treatment plants, natural surface waters, and drinking water samples. This work includes an HPLC-UV method that was developed to quantify both metformin and guanylurea in aqueous samples, using a reverse-phase ion-pair liquid chromatography with a Waters XTerra C18 column and a mobile phase of 33% acetonitrile and 67% aqueous phase of sodium phosphate buffer and sodium dodecyl sulfate. The developed HPLC-UV method was used to quantify metformin and guanylurea in samples taken from several stages of two wastewater treatment plants in the Midwest United States and in samples from degradation experiments carried out in the lab including exposing metformin to simulated sunlight and strong chemical oxidizers. Degradation experiments showed no breakdown of metformin during exposure to Rose Bengal photo-sensitizer, Fenton reaction oxidation, or simulated full-spectrum solar irradiance from a solar simulator. Analysis of wastewater treatment samples showed metformin in wastewater influent at both treatment facilities sampled. Preliminary results show that concentrations of metformin were lower in after biological nutrient removal or oxidation in both wastewater treatment facilities.

G2 *"Integrated Plant-Atmosphere-Soil Systems (iPASS): Phenotypic Changes in Two Grass Types Under Elevated CO_2 Levels"*

Kentin Alford, Chiawana High School, Pasco, WA

The Integrated Plant-Atmosphere-Soil Systems (iPASS) CO_2 PhenoGrass study was performed at Pacific Northwest National Laboratory (PNNL) to define first-principles that govern flow and transformations of carbon, nitrogen, and water through the integrated plant-atmosphere-soil system. Briefly, we looked for phenotypic changes in two grass types under elevated CO_2 levels. Brachypodium distachyon (a C3 model grass) and Setaria viridis (a C4 model grass) were exposed to ambient and elevated CO_2 levels over 8 weeks, with replicate (N=5) roots and leaves being harvested each week from each plant. The collected samples were dried, ground, and extracted using a folch method. The metabolite (top liquid layer), proteome (interphase pellet) and lipidome (lower liquid layer) were all harvested. The metabolite and proteome were submitted for Mass Spectrometric (MS) analysis and the results will be presented.

G3 *"Using electrochemistry for controlled dissolution of Zircaloy-4 Liners"*

Devin Olson, New Horizons High School, Kennewick, WA

Tritium is a naturally occurring isotope of hydrogen, but it is very rare. It can be manufactured in a nuclear reactor. However due to safety concerns, the US quit producing it in 1988. Tritium is used to increase the power of an atom bomb. One problem with Tritium, is that it has a very short half-life of just 12 years. Due to arms reduction, the US has been able to use Tritium from dismantled warheads to replenish its supply, but that isn't a sustainable solution. To address this problem

PNNL developed specialized control rods called TPBARs that can be used in commercial nuclear reactors to produce and capture Tritium. However, too much of the Tritium was making its way into the reactor coolant instead of being captured by the TPBARs. What my research is trying to do is to understand how hydrides such as Tritium are moving through the Zircaloy-4 liner part of the TPBAR.

H1 *"Runoff in Ruston: A water quality study of storm water remediation"*

Matthew Lonsdale, Science and Math Institute, Tacoma, WA

Historic industry in Ruston, WA has created heavy metal contamination in the local soils that wash from property through the storm water system and into Puget Sound untreated. A water bioremediation site was installed at the outflow of the Ruston watershed that reports to remove heavy metals from storm water as it passes through a filter media and plant root systems before being released to the Puget Sound. However, there is no data on if the system's media also removes other contaminants such as organic compounds of emerging concern that are often found in storm water. System influent and effluent water samples were collected to assess removal of additional contaminants. Methods were developed over two summers to quantify Acepromazine (pet medication), caffeine, cotinine (a metabolite of nicotine), Diquat Dibromide (herbicide), Mecoprop (herbicide), Nonylphenol (a component of soaps), and Triclosan (antifungal and antibacterial). Analysis was performed on a Waters Xevo G2-XS UPLC-QToF or ultra performance liquid chromatography quadrupole time of flight tandem mass spectrometer. However, due to complications in method development, only caffeine was quantified using the instrument as more method development is needed for the other compounds. Preliminary analysis of the storm water filtration system indicated that caffeine is removed at an average of 630 parts per million (ppm) before filtration down to an average of 175 ppm in the outflow, a 73% decrease. This indicates that the facility's design is functionally removing additional organic pollutants before they enter Puget Sound.

H2 *"Characterizing the chemical composition of Washington State red wines using UHPLC/QTOF-MS"*

Fred Burke, Chiawana High School, Pasco, WA

The chemical composition of red wines from several different growing regions within Washington State, made from three different grape varieties, and three vintages were characterized using ultra-high pressure liquid chromatography coupled with quadrupole-time of flight mass spectrometry (UHPLC/QTOF-MS) for flavor (non-volatile) compounds. The resulting chemical profiles of the wines were analyzed using multivariate statistical techniques to determine whether the profiles could be used to differentiate among the wine types.

H3 *"Adapting micro-controllers for deployment in a smart city with neural networks"*

Trevor Macduff, Leona Libby Middle School, West Richland, WA

Cyber-physical devices are a fundamental component of the so-called "Internet of Things" (IoT). Sensors and actuators can be found in a broad variety of scenarios that include large-scale sensor networks in smart cities and critical infrastructures as well as personal devices such as wearable

health monitors. The scalability of these highly distributed cyber-physical systems requires adding data processing capabilities to edge devices (i.e., sensors and actuators). This is especially critical in environments that require fast response times (e.g., energy production, health monitoring and emergency response) where data cannot be sent to a central processing facility for analysis. A new generation of "smart, autonomous and cooperative" IoT devices capable of peer-to-peer distributed learning is needed to implement analytics on actionable data (i.e., where only relevant data are processed).

The aim of the project is to investigate the deployment of machine learning algorithms on devices with limited processing power such as Arduino boards. We will also explore the development of "virtual" replicas of physical devices ("virtual siblings") to detect anomalies and malfunctions on IoT devices. The digital sibling provides virtual sensing capabilities that facilitate the reconstruction of missing data when the device fails.

During the project execution, the investigator has evaluated the feasibility of implementing machine learning systems in Arduino and Raspberry Pi systems. In particular, neural networks and deep learning have been explored as the most promising automated learning technologies. Our results indicate that the Arduino board has too limited capabilities to implement and scale neural networks. Arduinos, however can be used as front-end microcontrollers suitable to implement basic filtering capabilities in data acquired from a variety of sensors.

Given the current limitations of the Arduino platform, the investigator explored the deployment of Tensorflow (a backend developed by Google for deep learning) in Raspberry Pi devices. A set of Python libraries (Keras) for deep learning and Jupyter Notebooks were successfully installed in the Raspberry Pi. Subsequently, the investigator explored the use of data captured from the Pi temperature sensor to train a deep learning system suitable to distinguish between two ranges of temperature (warm / cold) based on a predefined temperature threshold.

Overall, we have evaluated the deployment of machine learning algorithms (neural network) in two simple and low-cost hardware platforms. The Raspberry Pi appears to be the most promising system for developing intelligent sensor networks suitable for autonomous learning and adaptation. A potentially promising architecture could be the use of Arduino as a sensor front-end for the Raspberry Pi, so that basic data cleaning and preprocessing can be performed by the Arduino and the more complex machine learning tasks can be deferred to the backend Raspberry Pi system.

l1 *"Thyroid Hormone Levels affect the Development of Zebrafish Feeding Mechanics"*

Amy Verderber, Kamiakin High School, Kennewick, WA

Researching the impact of thyroid hormone on the development of jaw shape and jaw biomechanics in the zebra fish. The researchers hope their research will shed light on how the abnormal thyroid hormone levels during development can lead to human skull deformities.

l2 *"Elucidate Genetic Diversity of Viruses in Washington Vineyards"*

Emily Jordan, WF West High School, Chehalis, WA

Washington wine grapes are susceptible to various viruses. One virus is causing the greatest reduction in production and quality of grapes in our region. This virus is Grapevine Leaf Roll associated Virus- 3 (GVLRaV-3). My research at Washington State University: Irrigated Agriculture Research and Extension Center was focused on accurate diagnostics of this virus. Since there is

known genetic variation within the GVLRaV-3 classification, we want to know that our diagnostic tools will reliably identify the virus no matter which strain of the virus a plant has.

I3 *"Catching Cosmic Messengers: My work with IceCube and Askarayn Radio Array (ARA) at the South Pole"*

Lesley Anderson, High Tech High Chula Vista, Chula Vista, CA

It is an exciting time in astronomy and astrophysics, with new technologies giving us glimpses of unimaginably powerful cosmic environments and events. This talk describes my trip to the South Pole to work with two projects that are trying to add information by searching for neutrinos, nearly massless, neutral particles. These ghostly cosmic messengers escape from dense environments, and travel in a straight line from their source to the IceCube Neutrino Observatory, and hopefully one day, to a fully completed ARA project. The IceCube Neutrino Observatory consists of a one square kilometer surface array constructed above a cubic kilometer of ice that has been instrumented with over 5000 light sensors. ARA will use radio antennas spaced a kilometer apart about 200 meters below the surface to search for extremely high energy neutrinos. This talk will describe what it takes to get to the South Pole as well as providing a brief overview of the workings of the IceCube Neutrino Observatory and ARA, and what I actually worked on at the South Pole. Finally, I will briefly describe how to bring this research into the classroom.

J1 *"Generation of Ezh2 knockout embryonic stem cells by CRISPR-Cas9"*

Stephanie Harris, Travis Middle School, Irving, TX

CRISPR-Cas9 is a genetic engineering technique that uses the same mechanisms of bacterial immune systems that edit the DNA of harmful viruses. It consists of two key components: Cas9, an enzyme that can cut a double stand of DNA at a very precise location, and CRISPR, a short strand of RNA that helps guide the Cas9 to bind with a specific target sequence. This allows scientist to either splice out part of a gene to disrupt its function, or insert a new sequence into the genome to code for a new function.

J2 *"One Step Closer to Mars with Aquaponics: Cultivating Citizen Science in K12 Schools"*

Anne McHugh, School of Science & Technology, Beaverton, OR

Aquaponics systems are supported by microbial communities who perform many complex ecosystem services, including cycling nitrogen. Microbes are integral to the stability and productivity of food production systems that are essential for building life support systems for long-distance space travel. In 10 parallel aquaponics systems, students collected macro-level data and microbial samples to measure productivity and stability. Our lab has sequenced water samples from each of the 10 tanks at 3 timepoints using an Oxford Nanopore MinION sequencer. Students will be involved in analyzing of the bioinformatics data generated through this collaboration. See our website: https://go.nasa.gov/2uJhxmF.

J3 *"Exploring the solubility limits of ZrO_2 in low-activity nuclear waste (LAW)"*

Randy Hoover, Southridge High School, Kennewick, WA

The U.S. Department of Energy is building a Tank Waste Treatment and Immobilization Plant at the Hanford Site in Eastern Washington to vitrify a large inventory of low-activity nuclear waste (LAW) into a durable borosilicate glass in joule-heated ceramic melters. To do this effectively and cost efficiently, the amount of waste glass must be maximized. With increased amount of waste more zirconia is added to nuclear-waste feed to maintain the high durability of glass for a long period of time. Therefore there is a need to explore the solubility limit of ZrO_2 in the LAW glasses. Our study was investigating the dissolution of ZrO_2 in the LAW glass (ORP-LB2). Nine glasses containing from 0-10 mass% of ZrO_2 were batched from chemicals and melted in Pt-crucibles at 1150°C for 2 or 4 Hrs. Then the glasses were ground and analyzed with XRD for the quantity of undissolved ZrO_2 and crystalline phases. Only glasses with 8 and 10 mass% of added ZrO_2 contained some undissolved ZrO_2, ranging from 0.07 to 0.078 mass%, as well as sodium zirconium silicate ($Na_4Zr_2Si_3O_{12}$), ranging from 0.53 to 3.66 mass%. The longer the heat-treatment the lower was the concentration of ZrO_2 and $Na_4Zr_2Si_3O_{12}$ in the glass. The next phase of the project will explore the effect of convection and number of melts on ZrO_2 incorporation into the glass.

K1 *"Curing Blindness: Restoring Light Sensitivity to Blind Retinas Using Drugs"*

Larry Bencivengo, Mercer Island, High School, Mercer Island, WA

Millions of Americans currently suffer from blindness due to diseases such as *retinitis pigmentosa* or macular degeneration which cause the light-sensitive cells of the retina to die. Dr. Van Gelder's lab is currently developing a therapy intended to restore vision by delivering small soluble molecules called photo-switches to the retina to make the surviving cells light-sensitive. The concept has been proven viable already in animal models, but it remains unclear how extensive the restored vision would be. Dr. Van Gelder's lab is currently using micro-electrode arrays and data processing algorithms to study the electrical responses of blind mouse retinas treated with photo-switches. In my presentation I review the current state of the work in Dr. Van Gelder's lab and describe my efforts to create computer models to help analyze the visual properties of the cells in treated retinas.