# Poster Presentation Titles and Abstracts

**<u>Posters 1-35</u> are from current Partners, sharing their first summer of research**

1. "Epigenetic control (EpiCon) of sorghum drought resistance"

   **Kentin Alford,** Chiawana High School, Pasco, Washington

   Ms. Heather Brewer, Pacific Northwest National Laboratory, Richland, Washington

   Understanding the biochemistry and biology of an environmental microbiome is a challenging task. Sampling issues, matrix effects, biomass contamination and analyte extraction method development are some of the challenges faced when trying to explain what is happening within a microbiome in the environment. The goal of this project is to generate a model linking physiology and genetics of sorghum with its epigenetic regulatory machinery. Sorghum was chosen as an ideal model system for identifying the genetic and physiological mechanisms underlying plant responses to drought due to its relative drought hardiness, phenotypic variability in response to drought stress, and novel methods of drought response. The methods for sample and analytical preparation used for better understanding these effects are described.

2. "Archival and analysis of sea ice thickness in the Arctic Ocean based on on-ice *in situ* historical measurements"

   **Lesley Anderson**, High Tech High, San Diego, California

   Benjamin Holt, NASA (Jet Propulsion Laboratory), Pasadena, California

   Explorers have been conducting research on sea ice thickness in the Arctic Circle for over a century using over a dozen different techniques. *In-situ* measurements of sea ice thickness can be useful for creating models that map global climate change and can be used to calibrate sonar and radar measuring devices. The available *in-situ* data range in accessibility, legibility and comprehensiveness while the methods for data collection also range from drill-hole grid plots to electromagnetic sounding lines. Researchers at the Jet Propulsion Laboratory are interested in compiling information about ice, snow, and freeboard thickness into a database that can be updated to analyze the change in sea ice thickness over the range of nearly one hundred years. The data will be calibrated by a seasonal correction program and will then be analyzed through a graphical user interface designed in Matlab that will compare various graphs of the data. Most of the data is being compiled in Excel spreadsheets saved in a standard format and imported to Google Earth through KML programming to gain a more complete picture of the Arctic Circle. Preliminary analyses suggest that there is some correlation between the date and sea ice thickness.

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

   **Lily Apedaile**, University of Montana, Missoula, Montana

   Dr. Andrea Stierle, University of Montana, Missoula, Montana

   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.

4. "The eye of the beholder: A novel method for determining the visual properties of blind retinas with artificially restored photosensitivity"

   **Larry Bencivengo,** Mercer Island High School, Mercer Island, Washington

   Dr. Russel van Gelder, University of Washington, Seattle, Washington

   Roughly 1 in every 4,000 people suffers from some form of retinal degeneration that may lead to blindness. However, even as the photoreceptors die off, most of those people will retain the other nerve cells in the retina, such as the retinal ganglion cells whose axons project to the brain through the optic nerve. Researchers around the world are experimenting with various methods to restore light sensitivity to those surviving cells in order to regain at least partial vision. Currently, there is no standard method to assess the nature of the visual images that would be generated by retinas of animal models with restored photosensitivity. Our lab has developed a method to determine the visual properties of mouse retinas *ex viva* using a microelectrode array (MEA) system combined with a projector that generates moving images such as bars and grating patterns. This system will create a uniform method for assessing the effectiveness of different treatments that seek to restore light sensitivity to blind retinas.

5. "Biomimetic, catalytic water oxidation by molecular nickel complexes with redox active ligands"

   **Charlie Bruner,** Victor School, Stevensville, Montana

   Dr. Dong Wang, University of Montana, Missoula, Montana

   A growing concern in our world is the availability and production of energy. One available source for clean energy is water. Water contains hydrogen and oxygen and both can be used as an energy source or to boost energy production. The problem is that splitting water into its native elements requires energy. Our project is looking at using coordination chemistry to design a catalyst that will reduce the energy requirements for splitting water.

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

   **Frederick Burke**, Chiawana High School, Richland, Washington

   Dr. Thomas Collins, Washington State University, Richland, Washington

   The chemical composition of red wines from several different growing regions within Washington State, made from three different grape varieties, and two 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.

7. "Generation of Ezh2 knockout embryonic stem cells by CRISPR-Cas9"

   **Stephanie Cartwright**, Travis Middle School, Irving, Texas

   Dr. Jian Xu, University of Texas Southwestern, Dallas, Texas

   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.

8. "Imaging assessment of SCD-1 expression in tumor xenografts using a novel $^{18}$F-labeled radiotracer"

   **Adriane Davis**, Dallas Environmental Science Academy, Dallas, Texas

   Dr. William Silvers, University of South Texas Medical Center, Dallas, Texas

   Over-expression of SCD-1 in cancer cells has been shown to lead to increased cell proliferation, tumorigenesis, and increased drug resistance; generally accompanied by a poor prognosis. Based on evidence that inhibition of this enzyme leads to the death of cancerous cells, it is important to develop a non-invasive imaging technique to assess SCD-1 expression in tumors. Therefore, the goal of this research focused on generating SCD-1 targeted PET images using a newly developed novel $^{18}$F-labeled radiotracer, and validating those findings, by determining the expression levels of SCD-1 in the imaged tumors. The hypothesis was tested by quantifying the SCD-1 protein expression of PC-3 and MDA- MB-231 tumors through Western Blot analysis and the RNA expression with qPCR to compare with the original scan imaging results. The data obtained through the Western Blot analysis supported the imaging results, in that the SCD-1 enzyme was expressed at higher levels in the PC-3 cell line. $^{18}$F-FPPPT uptake in PC-3 tumors was approximately 1.5-fold higher than MDA-MB-231 tumors. SCD-1 was found to be present in PC-3 in two isoforms, while not expressed in MDA-MB-231. Future considerations include determining whether the $^{18}$F-FPPPT radiotracer can be used to determine the efficacy of therapies that target expression of the enzyme.

9. "Characterization of s-SWCNT/PF-PD dispersions and networks"

   **Tamara El-Hayek**, Escondido Charter High School, Escondido, California

   Dr. Andrew Ferguson, National Renewable Energy Lab, Golden, Colorado

   Single-Walled Carbon Nanotubes (SWCNTs) are being investigated for their use in a wide variety of renewable energy applications. Their unique physical properties contribute to desirable traits such as a high carrier mobility, strong optical absorptions and tunable electronic band gap. Unfortunately, due to variability in certain parameters, SWCNTs are limited in their application. The major drawback is that SWCNTs are variable in size and type and typical synthetic methods are not selective. As a result, selective methods must be developed in order to sort these tubes and extract those which are desirable for a particular application. Though there are several enrichment strategies, polymer-wrapping was used to select semiconducting SWCNTs (s-SWCNTs) in this research. Some issues with polymer-wrapping include inability to remove polymer post-enrichment as well as difficulty re-dispersing s-SWCNTs post polymer removal. Polymer removal is necessary for certain applications and the presence of excess polymer in SWCNTs can decrease their efficiency. To address the first issues, a removable polymer, PF-Pd was used in the dispersion making process. The second issue of re-dispersal was discovered to be specific to a particular batch of PF-PD and was combated by altering the polymer removal step from an overnight centrifuge run to a TFA vapor treatment.

10. "In search of the uber grass: Seeking resistance to stress induced wasting disease in populations of eelgrass in Puget Sound, Washington"

    **Victor Garcia**, Anacortes High School, Anacortes, Washington

    Dr. Sylvia Yang, Western Washington University, Anacortes, Washington

    Eelgrass (*Zostera marina*) provides numerous ecosystem services. It is critical spawning ground for Pacific herring (*Clupea harengus pallasi*), out-migration corridors for juvenile salmon species (*Oncorhynchus* spp.) and important feeding and wintering habitat for waterfowl, including both the Pacific Brant (*Branta bernicola*) and Great Blue Heron (*Ardea herodas*). Locally, Padilla Bay has a National Estuarine Research Reserve that is home to the second largest concentration of eelgrass in the U.S.; up to 8,000 acres. This local bay is ranked among the top 500 most important bird areas in the United States by the American Bird Conservancy; providing habitat and food for up to 200,000 migrating and overwintering waterfowl each year. The importance of eelgrass as habitat led the Puget Sound Partnership to adopt a goal in 2011 to increase native eelgrass habitat by 20% by 2020. However, seagrasses are in worldwide decline, due to anthropogenic stressors. Potential stressors may contribute to the prevalence of eelgrass wasting disease. Our goal is to evaluate resistance to wasting disease resistance in eelgrass populations around the Salish Sea. If we can find populations with natural resistance, this stock can be used to repopulate decimated areas.

11. "A new wave of invaders: spatial patterns to European green crab distribution in Coos Bay"

    **Christina Geierman**, North Bend High School, North Bend, Oregon

    Dr. Bree Yednock, South Slough National Estuarine Research Reserve, Charleston, Oregon

    Green crabs are native to Europe, and have been introduced to the east and west coasts of the United States. This study sought to monitor the re-invasion of the Coos Bay estuary by green crabs and look at spatial patterns in the distribution of green, Dungeness, and red rock crabs. Crabs were trapped, identified to species, and their carapace diameter was measured at twenty-four different sites around the bay. Green crabs were present in the South Slough, near the tip of the North Bend peninsula, and upriver but were absent in the subtidal and near the mouth of the bay. The presence of green crabs is correlated with red rock crabs being absent or scarce and Dungeness crabs being less than 100mm in carapace diameter. The distribution of green crabs can have serious implications for the Dungeness crab fishery, as the green crabs have been known to out compete similarly sized Dungeness crabs.

12. "Impacting antibody movement across the blood brain barrier"

    **Hali Hill**, Governor John R. Rogers High School, Puyallup, Washington

    Dr. John Finke, University of Washington, Tacoma, Washington

    My project is part of a larger investigation into the effect of altering antibody glycosylation on blood-brain barrier transport. Prior work had showed 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 this sialic acid was also present in the conserved glycosylation site in the Fc domain. We used a Biacore Surface Plasmon Resonance approach known as Calibration Free Concentration Analysis. The concentration of IgG chains exhibiting sialic acid was determined for both intact IgG and in 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. However, our experiment found no such reduction in SPR signal, confirming that the level of sialic acid in the Fc glycan was minimal.

13. "Exploring the boundary of high alkali content in low activity waste glasses for vitrification at Hanford"

    **Randy Hoover**, Southridge High School, Kennewick, Washington

    Mr. Michael Schweiger, Pacific Northwest National Laboratory, Hanford, Washington

    Nuclear waste from the 177 storage tanks at Hanford will be divided between a high radiation fraction, noted as high-level waste (HLW), and waste that has low radioactivity and can be handled by radioactive workers, therefore called low activity waste (LAW). At least 80% of the nuclear waste at Hanford is LAW, so determining ways to increase the amount of waste in glass benefits the environment with less glass to be disposed of, and the tax payer who pays for the disposal of each canister filled with glass. Present research efforts are at 22 to 23 weight percent waste in LAW glass. Efforts are being made to increase waste loading to 25 and 26 percent waste in glass. The investigation proposed is to take known matrix glasses with a combination of oxides of potassium and sodium, major components in the LAW waste streams, and lithium oxide (a glass additive) and examine the waste loadings at between 24 and 26 wt% loadings by removing the lithium oxide from the glass formulation and increasing the radioactive waste and determining if environmentally durable glasses can be processed at the Waste Treatment Plant at Hanford.

14. "Investigating protein localization in mammary gland cells grown on soft and stiff interpenetrating networks"

    **Katherine Huang**, Dougherty Valley High School, Dublin, California

    Dr. Joanna Lee, Stanford University, Stanford, California

    Mechanical forces surrounding cells in tissue may lead to cancer invasion. Cells grown on 2D cultures are observed to be morphologically different and do not best physiologically represent cells in the 3D body. Mammary gland cells were grown on soft and stiff 3D interpenetrating networks to investigate protein localization using immunofluorescence staining. The highest upregulated gene S100A7 associated with the protein Psoriasin was observed to be localized differently in soft vs stiff IPN.

15. "Plant viruses affecting wine grapes"

    **Emily Jordan**, Chiawana High School, Pasco, Washington

    Dr. Naidu Rayapati, Washington State University, Prosser, Washington

    Dr. Rayapati and his team are working to understand a specific virus that is affecting wine grapes in the Columbia Valley. They are researching a virus called Grape Vine Leaf Roll associated Virus. It causes the leaves to turn red and roll at the ends, which decreases the vine's photosynthetic capabilities and affects grape production. Currently, the main research is centered around using a process called Polymerase Chain Reaction to test which plants have the virus. They have also used this method to find the RNA sequence of this virus, which allows them to test for genetic diversity among the local vineyards.

16. "Determination of metformin and guanylurea in aqueous samples using HPLC-UV"

    **Roxanne Kilpatrick**, Oregon City High School, Oregon City, Oregon

    Dr. Tawnya Peterson, Oregon Health and Science University, Portland, Oregon

    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. Studies of the distribution of metformin and guanylurea in environmental samples use mass spectrometry (MS) detection of the compounds of interest, often times using solid phase extraction (SPE) techniques to extract analytes and clean-up samples. Multiple HPLC methods with UV detection have been published for the determination of metformin in tablet purity analysis, and human urine and serum analysis. However, no published HPLC-UV methods were found detecting both metformin and guanylurea in aqueous samples. This work includes an HPLC-UV method that was developed to quantify both metformin and guanylurea in aqueous samples, including wastewater treatment and photo-degradation experiment samples.

17. "Runoff in Ruston: A water quality study of storm water remediation"

    **Matthew Lonsdale,** Tacoma Public Schools, Tacoma, Washington

    Dr. Daniel Burgard, University of Puget Sound, Tacoma, Washington

    Historic industry in Ruston has created heavy metal contamination in the local soils that washes from property through the storm water system and into Puget Sound untreated. In the past two years, a water remediation site was installed at the outflow of the Ruston watershed that removes heavy metals from storm water before releasing it into Puget Sound. However, there is no data on if the system also removes complex organic compounds that are often found in storm water. Methods were developed at a known concentration of 500 Parts Per Billion (PPB) for Acepromazine (pet medication), Caffeine, Cotinine (a metabolite of Nicotine), Diquat Dibromide (herbicide), Mecoprop (herbicide), Nonylphenol (a component of soaps), and Triclosan (antifungal and antibacterial) on a Waters Xevo G2-XS UPLC-QToF or ultra performance liquid chromatography quadrupole time of flight tandem mass spectrometer. Acepromazine, Caffeine, Cotinine, Diquat Dibromide, and Mecoprop can be determined at the concentrations of 500 PPB on the instrument and quantified accurately down to a level of 100 PPB. The methods were developed using the methods of James, Miller-Schulze, Ultican, Gipe, and Baker (2016). Both Nonylphenol, and Triclosan produced M/Z that was not quantifiable and further work is necessary to optimize the instrument for analysis of water.

18. "Assessment of the susceptibility of adult American eels (*Anguilla rostrate*) to rapid decompression associated with simulated hydroturbine passage"

    **Trevor Macduff,** TRHL, Pasco, Washington

    Ms. Katie Wager, Pacific Northwest National Laboratory, Richland, Washington

    Passage through hydroelectric dams can cause stress and mortality to migratory fish. One stressor that fish can be exposed is rapid decompression. Rapid decompression can lead to mortality and injury (e.g., emboli, hemorrhaging, and swim bladder rupture). This study examined the effects of rapid decompression on American eels, a migratory species that have suffered recent population declines. We exposed 100 adult American eels to rapid decompression. There was one mortality. We observed two fish with injuries that would have been fatal for juvenile Chinook salmon. Based on our results, adult American eels do not seem susceptible to rapid decompression.

19. "Efficiency of solar panels in real-world conditions"

    **Evan Munger**, Churchill High School, Eugene, Oregon

    Dr. Frank Vignola, University of Oregon, Eugene, Oregon

    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. The IV Curve Tracer will provide the most comprehensive measurement of PV panel characteristics and performance. Current and voltage measurements will be taken simultaneously across varying resistances. The data will produce a graph that characterizes the performance of the solar panel. Power is current times voltage and the IV curve along with the incident solar radiation can be used to determine the efficiency of the panel.

20. "An investigation on the antibacterial action of silver nanoparticles on *Escherichia coli*"

    **Bryan Allan Nase**, Westmoor High School, Daly City, California

    Mr. Chris Lindsay, Stanford University, Stanford, California

    Silver nanoparticles were deposited on titanium discs. Titanium discs were submerged in silver nitrate and a small volume of sodium chloride was added to precipitate silver chloride salts. Similar steps were taken for deposition of silver sulfite and silver bromide salts. The particles were allowed to react for at least 6 hours. Discs were installed onto *E.coli i*noculated agar plates and grown overnight. Antibacterial activity was assessed by measuring the zone of inhibited bacterial growth. Zone of inhibition (ZOI) increased with increasing concentrations of silver. For the three salts studied, silver mixed with sodium bromide showed the largest ZOI at around 9 mm for the 5mM and 10mM concentrations of silver. Silver inhibits *E. coli* growth in a dose-dependent manner. Silver nanoparticles can prevent growth of *E. coli*.

21. "Materials synthesis and analysis with applications in tank waste remediation"

    **Devin Olson**, New Horizons High School, Kennewick, Washington

    Mrs. Frances Smith, Pacific Northwest National Laboratory, Richland, Washington

    From 1943 to the 1980's the main goal out at the Hanford area was to produce weapons grade plutonium. Plutonium is created through a fission reaction of uranium within a nuclear reactor. Occasionally the nucleus of a uranium atom will capture a neutron changing it to U-239. Then through beta decay, that Neutron becomes a proton and plutonium 239 is created. A very small percentage of the uranium actually becomes plutonium. Once the nuclear rods are spent, the plutonium needed to be separated from the spent uranium. Various chemical treatments were used to separate the plutonium. These treatments resulted in a lot of liquid wastes at Hanford. Scientist mixed the acidic waste with sodium hydroxide and stored the waste in huge underground tanks. The problem is that these tanks are now leaking. One of the solutions to the leaking waste problem is to turn the liquid waste into a solid waste form. This is done through a process called vitrification. Vitrification is a process where tank waste is mixed with a borosilicate glass to become a solid waste. This solid waste can be stored without it leaking into the ground.

22. "Stromatolite microbial communities as a source of new secondary metabolites"

    **Emily Parent**, North Salem High School, Salem, Oregon

    Dr. Kerry McPhail, Oregon State University, Corvallis, Oregon

    Tufa stromatolites have been found to contain unique microbial communities that produce secondary metabolites with potential pharmacological benefits. The present study examined stromatolite samples collected from two distinct pools in Nelson Mandela Bay, Eastern Cape, South Africa. Extracts from the sampled pools were fractionated for LC-MS/MS analysis. Molecular networking of MS/MS fragmentation data revealed limited clustering of chemical fractions suggesting the presence of newly discovered secondary metabolites. Of the putative known compounds identified, the majority are known to be protease inhibitors. Future steps include purification of fractions, followed by NMR spectroscopy to elucidate structures of new compounds.

23. "Identification of spacecraft-associated microorganisms using matrix- assisted laser desorption/ionization time-of-flight mass spectrometry"

    **Melanie Phillips,** Rancho Minerva High School, San Diego, California

    Dr. Parah Vaishampayan, Jet Propulsion Laboratory, Pasadena, California

    The process for identifying microbes located on space-bound hardware in JPL cleanrooms is currently less efficient and precise than it could be using the technique called matrix-assisted laser desorption and ionization time of flight (MALDI-TOF). Once this identification technique is fully implemented, the process time will be reduced from two weeks to one hour, and the cost will be reduced from $5 per sample for external identification to free for in-house identification. The MALDI-TOF database was created with microbes located in the clinical setting and contains 5,989 microorganism profiles, but was only comprehensive enough to identify 6.87% of JPL isolates. This called for the need of our own unique in-house MALDI database composed of the complete array of our microbial diversity. This database was created using bacterial isolates with known 16S rRNA sequences collected from various Mars mission hardware from the last 40 years. A mass spectral profile (MSP) was created and archived for each isolate so in the future we can identify unknown isolates by running it against the database using real time classification (RTC). After identifying 288 new operational taxonomic units (OTUs), a rarefaction curve was created which estimated that 500 more samples need MSPs before our database is comprehensive.

24. "Properties of thin porous copper layers for dissipating thermal energy from microelectronics"

    **Kenneth Pringle,** Abraham Lincoln High School, San Jose, California

    Dr. Ken Goodson, Stanford University, Stanford, California

    Characterization of thin, porous copper layers designed for two-phase heat dissipation was conducted through measuring resistance of the dry samples as a proxy for thermal conductivity and by measuring heat dissipation via boiling with pressurized water as the working fluid. Phase separation membranes were applied to control liquid/vapor distribution. Challenges associate with making these measurements on thin porous films were explored.

25. "Evaluating the influence of in-stream structures to improve cutthroat trout habitat on four small creeks in southeast Idaho: A preliminary report"

    **Eric Rude,** Pocatello High School, Pocatello, Idaho

    Dr. Ernest Keeley, Idaho State University, Pocatello, Idaho

    Yellowstone cutthroat trout have experienced a severe population decline caused by habitat destruction and by competition from introduced trout species. Our goal is to determine if artificially-created instream structures will increase the amount of energetically profitable fish habitat. Four creeks in southeastern Idaho were examined. Preliminary data, including cutthroat population estimates, water flow and temperature, and abundance of aquatic insects, were gathered during the summer of 2016. Structures were introduced to stream segments in the fall of that year. Final data will be collected in the summer of 2017 to determine the success of the structures.

26. "A field-deployable instrument for measuring RH-dependent aerosol extinction"

    **Alicia Ryan,** Cascade School District, Turner, Oregon

    Dr. Dean Atkinson, Portland State University, Portland, Oregon

    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.

27. "Designing the next generation lithium battery"

    **Carolyn Sturges,** Three Rivers HomeLink, West Richland, Washington

    Dr. Vijay Murugesan, Pacific Northwest National Laboratory, Richland, Washington

    There is great scientific interest in lithium-sulfur (Li-S) battery design to improve current Lithium-ion technology because of its highly desirable power to size ratio, and the natural abundance of sulfur. A major challenge to the realization of a practical Li-S battery comes from polysulfides dissolving into the electrolyte, a phenomenon known as the "polysulfide shuttle". This reduces the capacity and severely limits cycle life of the battery. To overcome this challenge we have studied the electrolyte design formulation to gain further insight of possible solvent types which can inhibit the dissolution of sulfides. Computational modeling based on density functional theory (DFT) is used in the bonding energy analysis of sulfide solvate structures. The solvate structures studied in this research are $Li_2S_x$ (x=4,6,8) interacting with dimethoxyethane (DME), 1,3-dioxolane (DOL), and a mixture of both. Li-S battery performance can be subsequently improved by rational electrolyte design from understanding of solvate structure.

28. "Inflammatory cytokines promote prostate tumor cell migration essential for tumor cell metastasis"

    **Steve Tipping**, Borah High School, Boise, Idaho

    Dr. Cheryl Jorcyk, Boise State University, Boise, Idaho

    Prostate cancer is the second leading diagnosed cancer among men in the United States. In my research, we exposed prostate cancer cells (DU-145) to the inflammatory cytokines Oncostatin M (OSM), Interluken-6 (IL-6), and Interluken-1β (IL-1β). The hope is to induce the prostate cancer cells to undergo epithelial-mesenchymal transition (EMT). EMT is the process that allows a tumor cell to metastasize and migrate from its tumor. Gene expression in the cell must differentiate in specific ways in order for the cell to transition out of the tumor. We measured specific protein levels which are linked with EMT to see how their gene expression is influenced by the cytokines.

29. "Electron interferometry with a diffraction grating, and an optical demonstration of the technique"

    **Asher Tubman**, South Eugene High School, Eugene, Oregon

    Mr. Ben McMorran, University of Oregon, Eugene, Oregon

    Interferometry involves imaging via manipulating waves to create an interference pattern. Traditionally done with light, this can be done with any wavelike phenomena, including electrons. An interferometer-enhanced Transmission Electron Microscope can image and characterize a wider range of properties and scales than traditional microscopy alone.
    We used a variation on a Mach-Zehnder interferometer setup, designed to function in a wide range of TEM's. We assembled an optical mockup of this interferometer, to demonstrate qualitatively the types of results expected. We also attempted to use a grating in a thermionic source TEM to demonstrate this technique.

30. "Evaluations of sagebrush-steppe environments: are past and current pesticide applications impacting human health and the ecosystem?"

    **Molly Tuinstra**, Pasco High School, Pasco, Washington

    Dr. Amoret Bunn, Pacific Northwest National Laboratory, Richland, Washington

    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. The project will involve evaluation of past and current pesticide and herbicide applications at U.S. Department of Energy's Hanford Site and implications with sagebrush steppe ecosystems. Techniques for the project include field characterization, plant identification, GPS and GIS tools, laboratory studies, and risk assessments.

31. "Development of the functional morphology in zebrafish and anemonefish"

    **Amy Verderber**, Kamiakin High School, Kennewick, Washington

    Dr. Elly Sweet, Washington State University, Richland, Washington

    Utilizing experimental zebrafish lines with different thyroid hormone (TH) levels we will do the following: (1) Use developmental analyses of skull shape to determine whether changes in TH levels produce extensions of cranial development, different developmental trajectories, or combinations of these. (2) Comparison between zebrafish lines and Anemone Fish biomechanics. (3) Determine if TH levels Pre and Post-Metamorphosis affect or alter shape correspondence between the upper and lower jaws. (4) Use high-speed video of fish feeding to determine how TH levels affect jaw biomechanics.

32. "Liquid time-of-flight secondary ion mass spectrometry"

    **John Weisenfeld**, Pasco High School, Pasco, Washington

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

    The surface of liquid and films has different chemical reactivity that leads to interesting chemical properties at the interface. However, direct analysis at the liquid surface using surface sensitive vacuum-based techniques is challenging because of the high volatility of liquid. This is especially true for aqueous solutions or biological systems that need water to survive. We have developed a novel microfluidic reactor that is vacuum compatible and it enables the liquid surface and interface analysis using time-of-flight secondary ion mass spectrometry (ToF-SIMS). Our current research involves live biofilms, single cells, ionic liquids, battery materials, complex liquid with particles, to name a few.

33. "*In situ* measurements of turbulence utilizing radiosondes with quantification of relative estimation error between NWP analysis and measurements"

    **Joe Youngberg**, University of Montana, Missoula, Montana

    Dr. Andrew Ware, University of Montana, Missoula, Montana

    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.

34. "Distribution of anthropogenic mercury in waters, plants and subsistence foods of southeast Alaska"

    **J. Patrick Malone**, Hoonah City Jr./Sr. High School, Hoonah, Alaska

    Dr. Lawrence Duffy, University of Alaska, Fairbanks, Alaska

    Mining and smelting, waste incineration, wood burning and fossil fuels result in substantial environmental mercury (Hg) contamination. Lake sediment concentrations in Northern latitudes increased several-fold since the Industrial Revolution with growing emissions and climate change feedback systems. Alaskan anthropogenic Hg contamination is greatest in subsistence foods. Hg contamination typically occurs as methyl mercury (MeHg), dimethyl mercury (DMHg), $Hg^{O}$, and $Hg^{2+}$, each representing a health risk including cardiomyopathies and arrhythmias, hepatic and renal damage, immunotoxicity, carcinogenesis, teratogenic effects and devastating neurotoxicity in children. This 2-year longitudinal assessment will produce a proxy means to determine Hg load in stakeholder subsistence foods.

35. **Jeff Bivins**, University of Texas Southwestern, Dallas, TX

**<u>Posters 36-53</u> are from Pacific Northwest supplemental award Partners, sharing their science instruction implementation projects at their schools**

36. "Experimental biology: An inquiry based classroom studying climate change"

    **Andrew Bosworth**, Ririe High School, Idaho Falls, Idaho

    The M.J. Murdock Charitable Trust and their Partners in Science program allowed me to spend two summers studying climate change with Idaho State Researcher Dr. Keith Reinhardt. Working with his graduate student, Kate McAbee, we measured respiration and photosynthesis via gas exchange in sagebrush ecosystems on the Idaho National Lab. It was during this experience that I realized that if we want the next generation of voters to have a better understanding of climate change then what better way than through a hands on experimental class. With the support of my administration I designed an Experimental Biology class where through guided inquiry students design and test concepts pertinent to climate change. The funding provided by the Supplemental Grant allowed me to purchase the necessary equipment to implement this class. Using Vernier data loggers and probes we have explored plant respiration, photosynthesis and the environmental conditions that may affect these that are related to climate change.

37. "Development of water quality curriculum for lecture and inquiry-based interactive laboratory lessons"

    **Kourtney Brown-Hogan**, Sonoran Science Academy, Tucson, Arizona

    The curriculum has been designed to teach concepts of water quality, microbiology and genetics. This had been accomplished by teaching basic microbiology, genetics and the chemical parameters used to judge water quality. The first component of this project examined general parameters used to assess water quality, while the second component of this project focused on the prevalence of bacteria and bacterial genes in water. The lesson was completed by a discussion of their results versus the results from my fellowship to highlight differences and similarities, and provide a real-world research application of the lesson objectives.

38. "Genetic engineering in a high school classroom"

    **David Burmester**, Grant High School, Portland, Oregon

    My supplementary grant introduced many introductory bioengineering techniques within a 9$^{th}$ grade biology classroom including micro-pipetting, electrophoresis, recombinant DNA technology, and transformations. The overall goal was to provide realistic biological applications to high school students that connected to my Murdock experience. As a result, students were successful in introducing GFPs to competent bacteria.

39. "Algae or aquaponics challenge: to feed and/or to fuel the world!"

    **Tamara Caraballo**, Glacier Peak High School, Snohomish, Washington

    Glacier Peak students are interested in the study and culturing of aquaponics and algae innovations that may be used as a food source to alleviate not just global hunger but hunger in our local area. The premise of the Advanced Molecular Biology class is to challenge students to make a difference in the health and sustainability of the world. This project encourages and models collaboration between students, industry, and the local food bank to address hunger. Ultimately students understand the impact a STEM career can have upon the world. Critical thinking and problem-solving skills will be crucial as well as an understanding of the process of science. This project is designed to provide students with an opportunity to apply what they have learned from course work; design their own active inquiry experience; research and upload their data to a database maintained by ISB. The overarching goal is to expose students to relevant and rigorous science in a collaborative team effort between teachers nationwide and local industry (ISB) while providing food for the local food bank. Emphasis will be on "doing" science to impact real-world local as well as global health issues.

40. "Molecular tools for inquiry-based exploration"

    **Amanda Crisostomo,** Lincoln High School, University Place, Washington

    The QPOE2 Community of Practice model was used to transform inquiry activities. The results on student engagement and attitudes toward science will be documented.

41. "A systems approach to the growth, environmental response of the centric diatom *Thalassiosira pseudonana* to different nitrogen sources"

    **Jennifer Duncan-Taylor**, Port Angeles High School, Sequim, Washington

    Students conduct a modification of the work that I have started while at Institute for Systems Biology (ISB). Sophomore students will grow diatoms *Thalassiosira psuedonana* ("Thaps") in different nitrogen-source seawater, count cells and determine population growth curves, monitor pH, CO2 and O2 levels. The junior/senior Biotechnology students will use Thaps and other algae species to extract DNA and compare their glyceraldehyde 3-phosphate dehydrogenase (GAPDH) activity, which is an essential gene for cellular respiration.

42. "Seismology in the Pacific Northwest—designing buildings to withstand earthquakes"

    **Karl Englert,** Nathan Hale High School, Seattle, Washington

    On July 20, 2015 *The New Yorker* published an article about the potential for a catastrophic earthquake in the Pacific Northwest titled "The Really Big One." The relevance of seismology in the Pacific Northwest, student fear and interest about earthquakes, the interesting physics of earthquakes and tsunamis, and the newly adopted Next Generation Science Standards that require student engineering activities helped me decide to develop this unit for my physics classes. This project centered unit has students annotate LIDAR data to identify different landforms including faults, analyze past earthquake information to find the location and type of earthquake, and construct balsa building models to withstand shaking on a shaker table. Future units will include the use of geophones to create and analyze our own "earthquakes," and making earthquake preparedness kits and plans for school families.

43. "Increasing science lab authenticity by characterizing CRISPR knockouts of *Arabidopsis* telomerase"

    **Michael Frank**, Empire High School, Tucson, Arizona

    Students are learning molecular biology concepts and techniques growing *Arabidopsis* telomerase CRISPR-generated mutant plants throughout the year. Students screen transformants and then observe the telomerase CRISPR knockout phenotype of mutants as it emerges over multiple generations. Students then extract DNA from transformants and use PCR and gel electrophoresis to genotype and confirm transformation. Beilstein group researchers visit the class monthly to teach techniques, and to share their research and college experiences with my students. The students in turn contribute to the research goals of the lab by assisting with genotyping while gaining a better understanding of academic science.

44. "Students in streams: measuring and monitoring the ecological health of the Grande Ronde River"

    **Brandon Galvez**, La Grande High School, La Grande, Oregon

    Students are using the river in their backyard to better understand the concepts that are being taught in the classroom. Specifically *geology*, *hydrology*, *botany*, and *aquatic ecology*. Students collected samples from the Grande Ronde River in September and are processing these samples throughout the year as they are learning about the relevant topics in the classroom. For example, students learned about minerals and rocks in November and then in December, using their new knowledge and equipment purchased with Murdock Trust grant funds, they processed and identified these rock samples.

45. "From ovaries and follicles in the research lab to ELISA-detected disease outbreaks in the science classroom; technology and the road to certification"

    **Larry Hiday,** Columbia Adventist Academy, Battle Ground, Washington

    Taking the information gained in the research lab back into the classroom, along with the renewed passion for science and the technology learned, in a meaningful way that enhances and improves student learning is the challenge for many teachers. Having focused my learning on the reproductive system and fertility, it was especially difficult to simply drop that learning into the existing curriculum. The supplemental grant has allowed for the purchase of technology that was nonexistent at our school and allowed for research protocols to be learned through practice. After developing a unit in the curriculum, "An 'Eggsacting' Science; Cracking the Egg with Technology," the egg-centered research has morphed into the ongoing development of a research certification. Networking with research scientists as a result of Partners in Science, has led to new opportunities and insights into the many protocols and technologies used for research. Working with Loma Linda University Medical School and OHSU (through my mentor, Dr. Mary Zelinski,) Columbia Adventist Academy is currently working toward a research certification. Students will document their competency in several areas (see samples identified below) involving the use of technology and research protocols.

46. "Why you may be what you eat…epigenetics in the high school classroom"

    **Deborah LaZerte,** Kennedy Catholic High School, Seattle, Washington

    Epigenetics is at the forefront of current genetic research. An understanding of these genetic controls and how our choices may affect them is relevant and will stimulate student's enthusiasm and curiosity. In this project my students learned how the spatial and temporal expression of genes must be tightly controlled for proper growth and development of the plant *Arabidopsis*.

47. “Investigating hyaluronic acid concentration in mouse brains treated with chemotherapy drugs”

    **Angela Little,** Westside Christian High School, North Plains, Oregon

    Approximately 18% of patients on standard dose chemotherapy develop learning and memory problems. It has long been known that the hippocampus in the brain has been linked to learning and memory. Recent studies have shown that neurogenesis occurs in this area of the brain. It is the failure of maturation of new neurons in this area that has been implicated in a condition known as "chemo brain", where patients who survive chemotherapy go on to experience much greater challenges in learning and memory. Control mice were treated with saline while experimental mice were treated with a chemotherapy drug called 5-fluorouracil (5-FU). Dr. Sherman's lab found that a substance called hyaluronic acid (HA) regulates neural stem cell division and differentiation in the adult brain. Students will be testing the hypothesis that 5-FU causes a loss of HA, and that consequently causes problems with neuronal maturation and difficulty with learning and forming new memories. Students will be working with sections of mouse brain. They will be staining with hyaluronic acid binding protein and with a peroxidase substrate solution, which will cause areas with high concentration HA to turn red. Students will be sending their tissue slide images to Dr. Sherman and discussing their results through Skype.

48. “Kotlik River quality monitoring in Fall, Winter and Spring”

    **Raphia Maglinao,** Kotlik School, Kotlik, Alaska

    Year 1 (2015-2016): For the first time in the district through Kotlik School, due to this project, the Environmental Careers/Science classes were offered. The district Curriculum Dept. upon my request purchased new Environmental Science textbooks. While waiting for the purchase of the digital tools and related supplies specified for the student project on monitoring the “Kotlik River Quality in Fall, Winter and Spring”, students were taught basic concepts of Environmental Science focused on aquatic ecosystems accompanied by outdoor trips for river water sampling and studying some parameters with available tools, like thermometer, pH paper, simple microscope. The Kotlik Tribal Environment Office extended support. The lab-quests, digital probes, TI-84 calculators and related supplies were delivered in Feb, 2016. Limited training on the digital tools through videos and online info available was done in March-April, 2016.
    Year 2 (2016-2017) Activities: September to October 2016 (Fall) - Learning the use of the digital tools through videos available in the Vernier website; simple experiments operating them; setting up of 4 sampling stations along the Kotlik River bank; bi- weekly river water sampling were conducted. Three major Fall samples from the 4 stations were tested for pH, temperature, DO, turbidity and conductivity.

49. “Promoting scientific inquiry using Vernier Logger Pros”

    **Robert Miron,** Century High School, Pocatello, Idaho

    The supplemental Murdock Grant has enabled me to utilize Vernier Logger-Pros and data collection probes to create a lab environment that fosters scientific inquiry for my students. Due to the ease of data collection with Logger Pros, students have more time to design, set-up and analyze laboratory experiments. This promotes creativity in the science classroom and provides the students with tools that help them visualize and comprehend fundamental scientific concepts and address common scientific misconceptions.

50. "Inquiry into water quality and the invertebrate communities of Brezee Creek"

    **Teridee Newman,** La Center High School, La Center, Washington

    The Zoology and Marine Biology students were given the opportunity to test the water quality and investigate the invertebrate communities of a near-by creek, Brezee Creek. Students researched the importance and impact of dissolved oxygen, ammonia/nitrogen, pH, and temperature to living organisms in the creek. They practiced performing these water quality tests in a controlled lab setting. Students also learned about using plankton nets and care and use of cameras while in the field and in the lab.
    The students decided on focusing on three broad populations of invertebrates: copepods, rotifers, and daphnia. The invertebrates chosen were more easily recognized by the students since a majority of the students have never used the microscopes for observing living organisms.
    This is an ongoing investigation of the water quality and invertebrate communities of Brezee Creek. We are in the process of getting some baseline data. The students are also comparing data with the Environmental Studies class that has water quality data gathered at another site upstream from their site.

51. "The effect of temperature & pH on the fermentation rate of yeast: an inquiry-based biology project using Vernier technology"

    **Tawny Olsen,** Victory Charter High School, Meridian, Idaho

    Understanding the fundamentals of metabolic pathways is often difficult for introductory biology students. However, cellular respiration and metabolism are important topics that are revisited in higher-level biology courses. Students are expected to understand the differences between aerobic and anaerobic pathways, types of organisms that perform each pathway, as well as the details about how, when, and where the enzyme reactions occur. One common misconception students have is that metabolism only occurs in humans. This guided inquiry laboratory experiment is designed to provide students with the opportunity to engage in an open-ended investigation that involves growing yeast and using advanced digital technology to collect data. From there, students perform data analysis and communicate their results in a laboratory report.
    Students will choose to vary either the temperature or the pH level of the yeast environment in order to determine how those changes affect the fermentation rate of the yeast in a closed system. Temperature and pH probes will be used to monitor the environmental conditions present in each yeast suspension. Yeast concentration will be determined using the Vernier spectrophotometer probes, and the change in gas pressure due to the release of carbon dioxide during the fermentation process will be measured using the Vernier gas pressure sensors.

52. "Advancing molecular & microscopic instruction at Central Linn High School"

    **Darrelle Parker,** Central Linn High School, Harrisburg, Oregon

    Over the past year I have been able to improve the previous molecular techniques at Central Linn High School, with the specific aim of enhancing student learning in science through hands-on, inquiry based research. To enhance student learning, I used funds from this supplemental grant to purchase two types of equipment that will allow new and exciting lessons to be taught in the science classes offered at Central Linn High School. The equipment included DNA inquiry kits, a PCR machine, additional gel electrophoresis materials, and compound microscopes. They have improved how students learn and apply the scientific method in the classroom through the incorporation of additional hands on laboratory exercises, which would not be accessible without this equipment.

53. "Encouraging students to pursue science careers by introducing biotechnology skills and techniques into the high school classroom"

    **Tim Renz,** Foster High School, Auburn, Washington

    The introduction of higher level biotechnology skills/techniques into a high school classroom increases student interest in pursuing science as a career. This was shown through an increase in graduating seniors pursuing science related college majors as well as an increase in retention rates of Pre-AP Biology students taking AP Biology.

54. "Using real collaborative research for teaching evolution and genetics to high school students"

    **Carole Tanner,** Henry M. Jackson High School, Lake Stevens, Washington

    Students learn and engage when they are part of real life, local research that makes a difference. This project was a collaborative effort between Dr. Catherine Peichel of Fred Hutch Cancer Research Center and high school teacher Carole Tanner. Together we developed a unit that included students phenotyping, using PCR to genotype, and statistics to evaluate the evolutionary trend in stickle back fish in Lake Washington. We used 50 years of historical data to teach population evolution and biotechnology techniques to add to the current body of knowledge of the Lake Washington Stickleback population.