

IGEM Program

First 6-month Progress Report

Project Title: Sustaining the Competitiveness of the Food Industry in Southern Idaho: Integrated Water, Energy and Waste Management

Principal Investigator: Dr. Karen Humes

Institution: University of Idaho (lead) with subcontracts to Boise State University and Idaho State University

Grant Number: IGEM19-001

Award Amount: \$700,000

Fiscal Period: July 1, 2018 – June 30, 2019

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1) Summary of project accomplishments for first reporting period and plans for the remainder of Yr 1:

The accomplishments and plans for the four primary tasks identified in the original proposal are summarized here (Tasks A-D). A summary of accomplishments for the overall project management and coordinated stakeholder engagement activities are also summarized below, listed as Task E.

Task A) Recovery of energy, nutrients, water and bioproducts from waste streams: bench to place-based pilot projects

Team: Erik Coats (UI, environmental engineering/molecular biology; emphasis on resource recovery from waste streams); Armando McDonald (UI, biomass conversion and bioproducts); Kevin Feris (BSU, algae-based resource recovery and microbial ecology))

Accomplishments this reporting period/Plans for next reporting period:

A note on staffing: As noted above, this task is being carried out by the joint UI/BSU team comprised of three Co-Is. It is the largest and most complex of our four major tasks, in terms of resources and personnel committed. Nearly all of the students planned to be hired in Year 1 have been recruited, including 1 Ph.D. student and 8 undergraduate students hired in the Coats' (Environmental Engineering) lab in Fall 2018 and 1 graduate student coming onboard in January 2019 in the McDonald lab to work on bioplastics. Some delay in getting the subcontract to BSU set up has prevented the expenditure of the funds for one graduate budgeted at BSU in Fall 2018. However, this has allowed a helpful re-examination by the team of the most effective assemblage of personnel types for accomplishing the important objectives of this grant, which go beyond that of traditional research (which is well-accomplished by faculty and graduate students) to include the vital component of developing relationships with potential commercial partners for future implementation of our research advances. The team feels that this latter objective would benefit from the creation of a Research Scientist position (funded partly by this initiative and partly by the BSU institutional funding) that would be filled by and occupied longer by someone with a broader experience base and better sense of private-industry constraints than is typically possible with a graduate student. Indeed, a central goal in conducting research that addresses societal problems is the eventual application of novel research-based solutions beyond the research laboratory. However, often even when research-based solutions are economically viable they may not reach the market or be applied beyond research focused studies. This scenario is often termed "The Valley of Death" which is a colloquialism describing the phase between research and successful application of innovation in a commercial context. Although many research active faculty have the intellectual ability and research funding to support development of economically viable innovations, rarely do they have the time and skills necessary to cross the "Valley of Death". We are pursuing a partnership between research-focused grant funding and institutional support (i.e. Boise State) to create a Research scientist position specifically focused on the research goals of this project and development of the relationships necessary to cross the "Valley of Death". We believe that personnel specifically focused on these integrated goals are necessary to elevate research-based solutions from the Bench to Market.

Meanwhile, however, the many students and several faculty members who have begun work on this task have made good progress on the three sub-tasks within this task, as reported below.

Sub-task i: Bench scale activities

a) Characterization of waste streams from a variety of producers and processors in the Twin Falls area (e.g., dairies, yogurt, cheese, and potato processors);

- Obtained and conducted preliminary analysis on agro-industrial wastes available in the Twin Falls area. Results are summarized below. Further investigations ongoing in remainder of Yr 1.

Entity	Flow (mgd)	BOD (mg/L)	TSS (mg/L)	FOG (mg/L)
AmeriPride	0.13	178.28	70.36	110.53
Chobani	0.80	144.97	164.22	24.16
City of Kimberly	0.30	302.56	285.07	24.59
Clif Bar	0.01	659.22	444.06	23.86
Eagle Eye	0.01	143.01	410.35	2.78
Glanbia	0.51	601.50	244.21	89.27
Independent Meat	0.11	84.34	91.58	17.33
KapStone	0.01	401.69	196.97	3.15
Lamb Weston	1.76	2305.13	510.47	93.24
Total	3.65	1267.98	349.38	69.34

b) Assessment of optimal process sequences (biological, chemical, physical, thermal) to recover energy, bioproducts (biofuels; bioplastics) and nutrients from mixed waste.

- Bench-scale bioreactor operations are set up and underway. Performance assessment is ongoing and will be continued in the second half of Yr 1. One current focus is analysis of process “success” vs. “failure.” Stable operations of any resource recovery system at full scale demands intrinsic knowledge on what constitutes stable operation, and how unstable, or “failed,” operations might be recovered. Investigations are being conducted using macro- and molecular-level methods.
- Phosphorus recovery from wastewater is best achieved through a process known as enhanced biological phosphorus removal, EBPR. Bench-scale EBPR operations are ongoing, with a focus on ascertaining the effects of key process operational criteria on maximal P recovery. Results will ultimately inform pilot and full-scale operations.
- Another current focus is on achieving stable nitrification in an activated sludge wastewater treatment system achieving carbon, ammonia-N, nitrite-N, nitrate-N, and phosphorus removal. Nitrification is a biological process whereby ammonia-N is oxidized only to nitrite. Process success will result in significant energy savings in wastewater treatment.
- Two of Coats’ undergraduate students are investigating the production of bioplastics (polyhydroxybutyrate-co-valerate, PHBV) on fermented dairy manure. Results will inform operations of our pilot scale system for 2019.

- Bench scale algal investigations have focused on establishment of algal cultivars to be employed in testing the effluent streams deemed most economically viable as determined by the wastewater modeling and bench-scale reactor experiments being performed in the Coats lab. Based on these initial wastewater characterization and viability experiments we will determine the most opportunity mechanism for algal cultivation in our integrated system and initiate cultivation tests with individual or consortia of algal strains selected based on their ability to grow in the selected wastewater streams and based on their growth rates, yields, biomass characteristics, and economic potential. These experiments will be initiated in the January/February time frame.

Sub-task ii: Pilot scale assessments - Conduct pilot scale evaluations from mixed waste streams; implement/evaluate treatment resource recovery processes.

- Have hired a team of undergraduate students and started training in the laboratory, with a focus on operations and analysis of biological resource recovery systems that are part of the targeted pilot-scale systems. The undergraduate team, combined with 2-3 graduate students, will operate the UI scale model systems in 2019.
- Conducting hypothetical re-configuration of the Twin Falls wastewater treatment plant to integrate proximate waste streams and achieve resource recovery. Analyses are being conducted using SUMO process modeling software by Dynamita. Results will be used to inform 2019 scale model operations.
- As noted above the outcome of these pilot scale assessments and modeling will inform decisions about which types of algal cultivation systems to couple with the AD/PHA aspects of our integrated system and which algal cultivars/species to employ in our bench and pilot-scale tests. The pilot scale algal cultivation systems will be operated in 2019 in collaboration with the Coats and McDonald labs at UI.

Sub-task iii: Produce prototype products (bioplastic mulch film, biochar, biofuel) for evaluation.

- Ordered laboratory blown-film extruder system for preparing bioplastic films and expected to be installed February-March 2019.
- Hired 1 graduate student and will start spring semester 2019 to characterize the bioplastic generated and prepare and evaluate the bioplastic films.

Note on partnerships inherent in Task A: Partnerships with producers, processors and municipal treatment personnel are fundamental to all of these tasks. Team will build on existing relationships with Twin Falls wastewater treatment facility, Food Northwest, Chobani, Amalgamated Sugar, J.R. Simplot, Idaho Dairyman's Association, and Glanbia, and expand to new partners throughout this project.

Task B) Decision-support tools for industry and community leaders to quantify and visualize trade-offs among water, energy, land use and municipal growth

Team: Jae Ryu, UI, systems dynamics modeling, water resources; Karen Humes (UI, water/energy nexus, geospatial analysis)

Accomplishments this period:

- Began the process of upgrading the existing Stella system dynamics model from an older version to the new Stella Architect, which has more features and is more user friendly.
- Reviewed the data that was included in the original version and identified data needs in order to make the model more current and representative of climate changes and drought that have occurred during the past ten years. Examples of these data include: precipitation, groundwater pumping, spring discharges, evapotranspiration, etc.
- Made a formal request for these data to the Idaho Department of Water Resources (IDWR) and are currently working with them on data needs.
- Completed a literature review of recent published research related to water resources, system dynamics modeling, etc. in preparation for completing the tasks.
- Team began brainstorming about potential scenarios for integrating energy components into the updated Stella Architect model.
- Initial meeting with irrigation expert to begin developing module that would describe energy use in irrigation based on key variables
- Attended Energy Policy Institute meeting at Boise State University in September to connect with regional energy experts
- Explored data sources and availability for information on energy use in irrigation

Plans for next reporting period:

- We plan to incorporate new features that are available in Stella Architect into the system dynamics model and user interface.
- We plan to perform a quality analysis of the most recent data available from IDWR and complete the integration process to bring the model up to date.
- We will begin exploring management options to incorporate into the model, such as water conservation, managed recharge, etc.
- We will be developing system evaluation criteria associated with new data inputs and potential uses for the expanded and update model, such as system reliability, vulnerability, resilience, etc.
- We will acquire and analyze data on energy use in irrigation
- We will complete the development of a module for the system dynamics model that quantifies energy use in irrigation for two meteorological scenarios (average and above average demand in a growing season) and number of acres with other key variable combinations (eg., crop type, irrigation source/type)
- We will begin incorporating supply side scenarios to quantify and address the uncertainty of the water/energy nexus in the Eastern Snake Plain Aquifer.

Task C) Technical innovations/sensing systems to reduce water/energy/nutrient use in targeted production systems:

Primary team members: Donna Delparte, (ISU, drone and satellite-based sensing systems) and grower partners.

Accomplishments this period:

Progress in the following task area has been made through the subcontract award to Idaho State University and included:

- Innovative thermal Unmanned Aerial System (UAS) platform assembled and tested for spring data collection
- Programmer/Decision Support Analyst hired (mid-Dec) for development of online interactive website sustainable decision support tool to facilitate growers access to satellite and drone imagery and associated products.
- Private sector participation has been established with several growers and crop inventory has been provided by ProGrow Consulting for building the above-described decision support tool for producers

Plans for next reporting period:

For the next reporting period, the team will focus on the continued development and testing of UAS platform and sensor combinations for data collection in the 2019 growing season. These integrated sensor data collection systems will be utilized in field-based pilot projects with our participating growers to provide rapid decision-making information to reduce water and nutrient loads through an online interactive decision support tool.

Task D) Engaging the present and future workforce in the adoption of new technologies

Team members for training (primary): Karen Humes, Erik Coats and partners at CSI, UI Idaho Falls and professional organizations such as Food Northwest, *Primary team member for drone outreach activities:* Jae Ryu (Idaho Drone League (I-Drone), Founder).

Accomplishments this period:

- Although significant engagement with food processors and producers has already begun (see more reporting on this in Task E below), the workforce training aspects of this task were intended (and resourced in our budget) to take place primarily in Yrs 2 and 3 of our project. However, the PI worked in this reporting period to design a survey to be made available to participants at the annual expo of our key partner (Food Northwest) in Portland, OR in January 2019 designed to solicit input on workforce training needs in the food processing industry.
- Co-I Jae Ryu began developing plans for his three I-Drone outreach events (high school students and general public) in the spring/early summer of 2019.

Plans for next reporting period:

- Implement survey at Food Northwest Expo in Jan 2019 on workforce needs in food processing, collate results and discuss/vet with stakeholder advisory committee in March 2019, described in more detail in the next task.
- Implement I-Drone outreach events in Moscow, Boise and Pocatello (possibly add Twin Falls if funds permit).

Task E) Overall Project Management

Accomplishments this period:

- Team meetings established, three held via videoconference (in addition to separate coordination by multiple Co-Is under individual tasks)
- Planning for stakeholder advisory committee meeting to be held in March in conjunction with annual team meeting, with Twin Falls as target location. The goal of these initial meetings will be to enhance existing relationships, build new ones, and importantly to build a sense of collaboration and shared vision with regard to the specific nature of the research capabilities we are developing and the outputs and products we target.
- First draft of stakeholder advisory committee list formulated and consists of representatives from producer and processing groups, contract engineers for municipal waste water treatment (including Idaho Dairyman's Association, J.R. Simplot Corp., Amalgamated Sugar, Food Northwest and others who wrote letters of support for the proposal), as well as key state agency representation (such as Idaho Dept of Water Resources) and at least one municipal representative.
- Team began draft of a project-wide prospectus to provide concise explanation of project goals, make clear the genuine desire to better understand stakeholder needs and "value proposition" to stakeholders for their engagement with our project.

Plans for next reporting period:

- Complete plans and issue invitations (Jan 2019) for first annual in-person stakeholder advisory committee meeting to be held in Twin Falls (Mar 2019) with additional quarterly progress meetings to be held by videoconference (beginning Jun 2019)
- Complete project-wide prospectus document described above (Jan 2019) and distribute widely to Idaho producers and processors
- Attend the annual expo of one of our key partners (Food Northwest) in Jan 2019 (Portland, OR) and participate in activities to further disseminate project goals and understand stakeholder needs in energy, water, and waste (see section below on potential Tri-State funding opportunities for continuation and expansion of work).
- Continue to hold monthly team meetings to monitor progress and facilitate coordination of all project tasks and stakeholder engagement activities.

2. Summary of budget expenditures for period just completed – report through Dec 20, 2018.

Note about burn rates at all three institutions: Burn rates for all three institutions are considerably lower for these first 5 months than they will be in the next reporting period for several reasons. Most importantly, the notification of the award in late July and then lag times in setting up subcontracts to ISU and BSU made for less than 6 full months of activity, although this will not impact our ability to utilize all the resources and meet all deliverables in Year 1. Additionally, due to the holidays and report due date of Jan 1, expenditures are reported only through those posted by Dec 20; full expenditures through Dec 31 will not post until the first week in January. Going forward, the burn rate at all 3 universities will be considerably higher in the last quarter of the next reporting period (eg., late March through the end of June 2019) because of these factors:

- Late spring/early summer field work
- Travel by team and for stakeholder participants to our annual meeting and first annual stakeholder advisory meeting in Twin Falls in late March 2019
- Summer salary for faculty members in May/June 2019
- Increased hours for graduate and undergraduate participants in May/June 2019

Expenditures at the UI – posted through Dec 20, 2018:

\$ 40,853.00 Salaries (faculty summer and grad students summer/fall)
\$ 9,563.25 Temp Help (undergraduate students)
\$ 4,779.38 Fringe Benefits
\$ 6,517.20 Travel
\$ 24,920.11 Operating Expenses, including research supplies for bench scale studies
\$ 10,134.29 Small equipment (<\$5K) – computer and drones/cameras
\$ 8,350.00 Tuition Remission (UI graduate students)

\$ 105,117.23 Total UI Expenditures through Dec 20

Expenditures in subcontract to BSU:

Due to processing time (both setting up the subcontract in Aug/Sept and invoicing lag), BSU has not yet invoiced for expenses incurred to date, but this will not impact the timeline of project deliverables. Please see note under Task A about proposed modification in type of personnel to be hired at BSU.

Expenditures in subcontract to ISU:

Due to processing time (both setting up the subcontract in Aug/Sept and invoicing lag, ISU has not yet invoiced for expenses incurred to date), but this will not impact the timeline of project deliverables. An informal reporting from the ISU Co-I reports these expenditures:

\$ 2,416.80 – student salaries
\$ 202.54 – fringe
\$ 1,760.08 – OE, including UAS supporting mounts, hardware, software, tablets, etc.
\$11,867.75 – UAS platform, GPS and thermal camera

\$16,247.17 – Total ISU expenditures through Dec 20

3. Demonstration of economic development/impact

- Patents, copyrights, Plant Variety Protection Certificates received or pending

Although not a direct outgrowth of the funding received on this grant beginning in July 2018, there was a patent filed by ISU in our reporting period on behalf of Co-I Donna Delparte and her collaborator on work of a similar nature to that being done by Dr. Delparte in this grant. The previous work on which the patent was based involved the detection of infected plants in potato fields; the work in this grant will be of similar methodology (detecting plant stress with the use of high spatial and spectral resolution sensors on drones and satellites), but the focus in this investigation is slightly different (the detection of nutrient and moisture stress with remotely sensed imagery). The patent is included here as an example of the likely future outcome of Dr. Delparte's work on this grant and her success in working with stakeholders to develop useful products and methodologies.

Patent filed on Nov 30, 2018 entitled: "Method and system for detecting and managing infected plants" Donna Delparte, L. Michael Griffel, Idaho State University. Cross reference - U.S. Provisional Patent Application No. 62/597,636 (ISU-001 PROV)

- Private sector engagement

Because every aspect of our work involves considerable private sector engagement, we have noted those engagements in each of our five tasks described in Section 1 (Accomplishments Plans for next reporting period).

- Jobs created

Programmer/Decision Support Analyst hired on Dec 16, 2018 (starting date) at Idaho State University

4. Numbers of faculty and student participation

Through Dec 20, the numbers of faculty, students and other researchers participating are as follows:

Faculty:	6 (4 UI, 1 BSU, 1 ISU)
Graduate Students:	4 (3 UI, 1 ISU)
Undergrad Students:	8 (all UI)
Research Scientists:	2 (1 UI, 1 ISU, both partially supported by this grant)

5. Description of future plans for project continuation or expansion

- The team is coordinating closely with the newly forming CAES entity (led by the UI but including other CAES partners) referred to as the Food Processing Innovation and Education Center (FPIEC). The vision for the center is for it to be a mechanism for collaboration between universities and private industry to develop next-generation technology and education programs for the Pacific Northwest food processing industry, with private industry eventually contributing to research driven by their needs. The collaborations between Idaho institutions, Idaho food processors and Idaho communities that are being supported by this IGEM grant, and

the beneficial results it will produce, should provide excellent examples to encourage more stakeholders to become involved in partnerships through the FPIEC in the future. Likewise, the FPIEC provides a mechanism to continue and expand upon the work begun in this IGEN.

- Some members of the team are also part of an ad-hoc working group organized by the VPRED at the UI to network with other land grant institutions in the Northwest (i.e., Washington State University and Oregon State University) to be mindful of collaborative opportunities for research funding in the arena of sustainable food production and processing and food/energy/water nexus, particularly from the USDA, DOE and NSF. Some of the largest grants awarded at the University of Idaho have been through these types of inter-institutional collaborations. This is one of many reasons that we highly value and are working to continue to build our partnership with Food Northwest, which represents processors in all three states.

6. Expenditure report

As noted in the Budget Summary section above, due to lags in setting up and invoicing from subcontracting institutions, the detailed expenditure report provided below is available at this time only on the portion of total spending at the University of Idaho.

'Process'

FWRITEM

'Output Line'

FWRITEM

University of Idaho

Itemized Expenditures by Grant Code

From 01-JUL-2018 To 20-DEC-2018

Grant: SG2836 -

20-Dec-2018 09:21 AM

Salaries

E4108 Summer Salary

Coats, Erik 5395.20

80.00 hours

Ryu, Jae 7219.80

126.00 hours

E4109 IA/GA Salary

Mellin, Jason 13032.80

360.00 hours

Thompson, Emily 8000.00

320.00 hours

Walters, Riveraine 7205.20

160.00 hours

\$40,853.00

Temporary/Irregular Help

E4135 Temporary Student

Alfaro Salmeron, Glenda	825.00	
75.50 hours		
Brouillard, Nicolas	1753.50	
146.25 hours		
Dolph, Kirsten	1957.50	
189.00 hours		
Gibson, Joseph	528.00	
48.00 hours		
Shaber, Jonathon	541.75	
49.25 hours		
Smoot, Lindsey	1050.50	
96.00 hours		
Tompkins, Nicole	2445.00	
206.00 hours		
Watabe, Shion	462.00	
44.00 hours		
	-----	\$9,563.25

Fringe Benefits

E4280 Faculty CFR Benefit Expense	3342.98	
E4282 Student CFR Fringe Expense	1436.40	
	-----	\$4,779.38

Travel

E5360 Personal Vehicle - In-State			
07-SEP-18	I2024562	Ryu, Jae H.	367.01
16-NOV-18	I2038986	Coats, Erik Robert.	332.77
16-NOV-18	I2038986	Coats, Erik Robert.	21.00
E5365 Personal Vehicle - Out-of-State			
09-NOV-18	I2037420	Coats, Erik Robert.	25.00
E5367 Rental Vehicles - In-State			
25-SEP-18	J1218430	V00349140 Ryu, Jae H.	337.90
25-SEP-18	J1218430	V00349140 Ryu, Jae H.	28.05
04-OCT-18	I2030060	Ryu, Jae H.	67.02
08-OCT-18	J1219824	V00733798 Humes, Karen S.	149.76
E5380 Airfare - In-State			
18-SEP-18	I2027040	Humes, Karen S..	521.11
E5381 Airfare - Out-of-State			
02-NOV-18	I2035887	Coats, Erik Robert.	485.60
E5392 Ground Transportation-Out-of-State			

09-NOV-18	I2037420	Coats, Erik Robert.	205.12
E5396 Per diem - In-State			
07-SEP-18	I2024562	Ryu, Jae H.	81.00
18-SEP-18	I2027040	Humes, Karen S..	447.00
18-SEP-18	I2027040	Humes, Karen S..	90.00
03-OCT-18	J1219330	V00096579 Coats, Erik R.	756.60
04-OCT-18	I2030060	Ryu, Jae H.	126.00
16-NOV-18	I2038986	Coats, Erik Robert.	56.25
E5397 Per diem - Out-of-State			
06-SEP-18	J1216134	MC, from 820928 to 820922	840.52
13-SEP-18	J1217141	V00096579 Coats, Erik R.	1260.78
24-SEP-18	F0148395	GRT227262-Civil Envmntl Engin	-453.96
27-SEP-18	F0148659	GRT227263 Civil & Environ ENGR	-783.35
03-OCT-18	J1219329	V00096579 Coats, Erik R.	1175.02
09-NOV-18	I2037420	Coats, Erik Robert.	255.00
E5399 Other Employee Travel			
26-OCT-18	I2034588	Mellin, Jason James.	102.00
09-NOV-18	I2037420	Coats, Erik Robert.	24.00

			\$6,517.20

Operating Expenses

E5045 Photocopy Service

03-DEC-18	J1225771	DS; UIB copier charges Nov 2018	162.54
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E5060 Subscriptions

29-OCT-18	I2034722	Ryu, Jae H.	129.00
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E5070 Conference/Registration Fees

12-SEP-18	Z0839536	0826 PACIFIC NORTHWEST CLEAN W 208-	530.00
25-SEP-18	Z0840303	0905 ACT*UNIV OF IDAHO 877-551-5560	135.00
25-SEP-18	Z0840303	0905 ASSN OF AMER GEOGRAPHERS 202-2	165.00
08-OCT-18	J1219824	V00733798 Humes, Karen S.	250.00
09-OCT-18	Z0840975	0924 WEF EVENT 703-684-2400 VA	725.00
31-OCT-18	J1222316	NR, CT to correct budget	179.00

E5152 All Other Services

25-SEP-18	Z0840189	0910 MISTER CAR WASH #502 BOISE ID	7.00
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E5199 Other Professional Service

10-SEP-18	BKCK0818	\$47.20-Smoot 820922	47.20
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E5310 Technology - Services

11-SEP-18	J1216650	ec; August18 Net Services	80.00
04-OCT-18	J1219448	ec; September18 Net Services	60.00
18-DEC-18	Z0844107	1204 DELL SALES & SERVICE 866-393-9	61.50

E5345 Testing/Grading/Inspecting

28-AUG-18	Z0839291	0816 PAYPAL *BOISEAREARA 402-935-77	92.91
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E5350 Other Technical Services

12-SEP-18	Z0839536	0817 OETC 503-6250501 OR	149.02
E5410 Office and Administrative Supplies			
12-SEP-18	Z0839536	0822 VANDAL STORES MOSCOW MOSCOW ID	86.94
E5465 Gasoline			
25-SEP-18	Z0840189	0906 SHELL OIL 57444639603 GARDEN C	80.58
25-SEP-18	Z0840189	0907 EXXONMOBIL 47851928 IDAHO F	40.88
25-SEP-18	Z0840189	0907 PILOT_00350 MOUNTAIN HOME ID	19.10
25-SEP-18	Z0840189	0907 PILOT_00350 MOUNTAIN HOME ID	71.77
E5528 Resale - Computer Software			
04-DEC-18	Z0843209	1113 OETC 503-6250501 OR	58.09
E5560 Technology - Supplies			
12-SEP-18	Z0839536	0817 CDW GOVT #NTW9785 800-808-4239	39.31
E5650 R&M Sup - Other			
04-DEC-18	Z0843545	1115 PAYPAL *PGNINTERNAT 402-935-77	6.08
04-DEC-18	Z0843545	1119 PAYPAL *ZORO.COM 402-935-7733	5.48
E5720 Educational Supplies			
09-OCT-18	Z0840866	0914 THE HOME DEPOT #1806 BOISE ID	32.94
18-DEC-18	Z0844337	1124 AMZN MKTP US*M03012NW1 AMZN.CO	
149.95			
18-DEC-18	Z0844337	1202 AMAZON WEB SERVICES AWS.AMAZON	1.64
18-DEC-18	Z0844337	1203 AMZN MKTP US*M02PW3BH1 AM AMZN	
29.83			
18-DEC-18	Z0844337	1206 AMZN MKTP US*M08P72690 AMZN.CO	13.76
E5724 Research Supplies			
24-AUG-18	I2021934	Coats, Erik Robert.	1669.70
24-AUG-18	I2021943	Coats, Erik Robert.	1174.50
24-AUG-18	I2021946	Coats, Erik Robert.	838.78
24-AUG-18	I2021980	Coats, Erik Robert.	742.00
24-AUG-18	I2021995	Coats, Erik Robert.	549.21
28-AUG-18	Z0839116	0810 QIAGEN INC 800-426-8157 MD	594.22
28-AUG-18	Z0839291	0812 AMZN MKTP US AMZN.COM/BILL WA	9.73
28-AUG-18	Z0839291	0812 AMZN MKTP US AMZN.COM/BILL WA	62.70
28-AUG-18	Z0839291	0813 AMAZON.COM AMZN.COM/BILL WA	5.28
28-AUG-18	Z0839291	0813 AMAZON.COM AMZN.COM/BILL WA	72.70
28-AUG-18	Z0839291	0813 AMZN MKTP US AMZN.COM/BILL WA	113.20
28-AUG-18	Z0839291	0813 GRAINGER 877-2022594 IL	33.98
28-AUG-18	Z0839291	0814 AMAZON.COM AMZN.COM/BILL WA	5.28
28-AUG-18	Z0839291	0814 AMZN MKTP US AMZN.COM/BILL WA	14.63
28-AUG-18	Z0839291	0815 AMZN MKTP US AMZN.COM/BILL WA	14.84
28-AUG-18	Z0839291	0816 AMZN MKTP US AMZN.COM/BILL WA	99.98
28-AUG-18	Z0839291	0816 AMZN MKTP US AMZN.COM/BILL WA	170.76
28-AUG-18	Z0839413	0804 TFS*FISHERSCI ECOM HUS 800-766	37.62
28-AUG-18	Z0839413	0807 TFS*FISHERSCI ECOM HUS 800-766	12.54
28-AUG-18	Z0839413	0808 PAYPAL *FUZHOUHUIJU 402-935-77	285.00

28-AUG-18	Z0839413	0810 SP * FILTROUS HTTPSFILTROUS CA	253.25
28-AUG-18	Z0839413	0813 PAYPAL *COL INT GRP 402-935-77	483.34
28-AUG-18	Z0839413	0814 FILABOT 802-505-6772 VT	84.77
28-AUG-18	Z0839413	0814 TFS*FISHERSCI ECOM HUS 800-766	224.51
28-AUG-18	Z0839413	0815 TFS*FISHERSCI ECOM HUS 800-766	228.20
28-AUG-18	Z0839413	0815 TFS*FISHERSCI ECOM HUS 800-766	101.90
28-AUG-18	Z0839413	0815 TFS*FISHERSCI ECOM HUS 800-766	54.96
28-AUG-18	Z0839413	0816 DRI*WAVEMETRICS IGOR PRO ELEME	275.00
28-AUG-18	Z0839413	0816 TECHNICAL GLASS PRODUCTS 440-6	174.40
28-AUG-18	I2022816	Coats, Erik Robert.	292.70
28-AUG-18	I2022831	Coats, Erik Robert.	192.91
29-AUG-18	I2023038	Coats, Erik Robert.	160.06
30-AUG-18	I2023162	Coats, Erik Robert.	62.15
30-AUG-18	I2023260	Coats, Erik Robert.	61.89
30-AUG-18	I2023268	Coats, Erik Robert.	215.64
06-SEP-18	J1216079	TNUM 324543 Walmart	14.42
07-SEP-18	I2024658	Ryu, Jae H.	465.99
12-SEP-18	Z0839996	0817 PAYPAL *CHENGUOQING 402-935-77	28.99
12-SEP-18	Z0839996	0818 TFS*FISHERSCI ECOM HUS 800-766	75.24
12-SEP-18	Z0839996	0820 PAYPAL *NEXTDAYAUTO 402-935-77	25.00
12-SEP-18	Z0839996	0822 PAYPAL *9265823 402-935-7733 C	17.00
12-SEP-18	Z0839996	0823 PAYPAL *JMEJAK 402-935-7733 CA	15.00
12-SEP-18	Z0839996	0823 PAYPAL *MAJINNA 402-935-7733 C	13.60
12-SEP-18	Z0839996	0823 TFS*FISHERSCI ECOM HUS 800-766	88.51
12-SEP-18	Z0839996	0825 TFS*FISHERSCI ECOM HUS 800-766	74.00
14-SEP-18	I2026110	Coats, Erik Robert.	426.81
19-SEP-18	I2027222	Ryu, Jae H.	147.12
19-SEP-18	I2027309	Coats, Erik Robert.	18.15
19-SEP-18	I2027325	Coats, Erik Robert.	60.22
25-SEP-18	Z0840195	0904 AMAZON.COM AMZN.COM/BILL WA	336.40
25-SEP-18	Z0840195	0906 AMZN MKTP US AMZN.COM/BILL WA	44.37
25-SEP-18	Z0840195	0908 THE HOME DEPOT 1806 BOISE ID	368.43
25-SEP-18	Z0840195	0909 THE HOME DEPOT #1806 BOISE ID	3.75
25-SEP-18	Z0840195	0909 THE HOME DEPOT #1806 BOISE ID	-3.15
25-SEP-18	Z0840355	0910 HACH COMPANY 9706631377 CO	61.57
25-SEP-18	Z0840613	0901 TFS*FISHERSCI ECOM HUS 800-766	63.17
25-SEP-18	Z0840613	0911 PAYPAL *DVBARGAINZ 402-935-773	299.00
02-OCT-18	I2029573	Ryu, Jae H.	115.82
02-OCT-18	I2029587	Coats, Erik Robert.	43.80
09-OCT-18	Z0840975	0919 QIAGEN INC 800-426-8157 MD	1173.35
09-OCT-18	Z0840975	0920 HACH COMPANY 9706631377 CO	2137.68
09-OCT-18	Z0840975	0927 AMZN MKTP US*MT96Y1XGO AMZN.CO	15.99
09-OCT-18	Z0841185	0916 PAYPAL *9265823 4029357733 CA	-17.00
09-OCT-18	Z0841185	0917 PAYPAL *INDUSTRIALH 402-935-77	10.98

09-OCT-18	Z0841185	0918 PAYPAL *ALBERTFILTE 402-935-77	27.20
09-OCT-18	Z0841185	0921 PAYPAL *FRANKBACONM 402-935-77	761.00
23-OCT-18	Z0841490	1002 PALOUSE HABITAT FOR HUMAN MOSC	30.00
23-OCT-18	Z0841490	1004 AIREKASCIENTIFIC WAN CHAI	238.00
23-OCT-18	Z0841490	1005 GRAINGER 877-2022594 IL	149.20
23-OCT-18	Z0841490	1005 PAYPAL *ADVANCE OPS 402-935-77	125.00
23-OCT-18	Z0841490	1009 HACH COMPANY 9706631377 CO	572.62
23-OCT-18	Z0841490	1011 TFS*FISHERSCI ECOM HUS 800-766	292.70
23-OCT-18	Z0841490	1011 TFS*FISHERSCI ECOM HUS 800-766	151.40
23-OCT-18	Z0841862	1003 AMZN MKTP US*MT3JB0820 AMZN.CO	207.69
23-OCT-18	Z0841864	0928 PAYPAL *RQ SURPLUS 402-935-773	22.40
23-OCT-18	Z0841864	0930 PAYPAL *STRADEFAREA 402-935-77	14.08
23-OCT-18	Z0841864	1001 PAYPAL *MARCHOFFMAN 402-935-77	98.81
23-OCT-18	Z0841864	1008 PAYPAL *MS AND A 402-935-7733	11.10
23-OCT-18	Z0841864	1009 PAYPAL *MROSUPPLY 402-935-7733	12.90
23-OCT-18	Z0841864	1009 PAYPAL *SCOTTDOCTEU 402-935-77	10.86
23-OCT-18	Z0841864	1011 PAYPAL *MOLLYJAMIE 402-935-773	15.49
02-NOV-18	I2035694	Coats, Erik Robert.	43.80
06-NOV-18	Z0842037	1011 TRI STATE OUTFITTERS MOSC MOSC	9.96
06-NOV-18	Z0842037	1013 TFS*FISHERSCI ECOM HUS 800-766	161.30
06-NOV-18	Z0842484	1014 PAYPAL *MORNINGHILL 402-935-77	81.40
06-NOV-18	Z0842484	1022 PAYPAL *SOLANOTRADE 402-935-77	133.94
08-NOV-18	J1223342	331082 PAYPAL *METALREMNNAN 402-935-	17.75
08-NOV-18	J1223342	331083 PAYPAL *TUNDRASPECI 402-935-	20.30
20-NOV-18	Z0842648	1101 TFS*FISHERSCI ECOM HUS 800-766	420.33
04-DEC-18	Z0843350	1112 AMZN MKTP US AMZN.COM/BILL WA	-62.70
04-DEC-18	Z0843545	1112 PAYPAL *FRANKBACONM 402-935-77	479.70
04-DEC-18	I2041603	Coats, Erik Robert.	278.93
18-DEC-18	Z0844147	1203 HACH COMPANY 9706631377 CO	565.99
18-DEC-18	Z0844147	1206 TFS*FISHERSCI ECOM HUS 800-766	355.50
18-DEC-18	Z0844337	1123 AMZN MKTP US*M00LJ9FR2 AMZN.CO	172.28
E5725 Field Supplies			
28-AUG-18	Z0839291	0811 MY VINYL DIRECT 12089326803 ID	8.32
E5741 Med Lab & Tech Supplies			
04-SEP-18	U0129294	Chemstores/Alayat	12.51
14-SEP-18	U0129478	Chemstores/McDonald	29.14
24-SEP-18	U0129560	Chemstores/Asghar	2.26
25-SEP-18	U0129581	Chemstores/Asther	9.79
26-SEP-18	U0129593	Chemstores/Alayat	13.34
05-OCT-18	U0129714	Chemstores/Asghar	15.12
23-OCT-18	U0129878	Chemstores/Wang	4.36
06-NOV-18	Z0842484	1014 PAYPAL *LI YUN 402-935-7733 CA	8.64
06-NOV-18	Z0842484	1015 PAYPAL *HONGKONGYEE 402-935-77	15.76
08-NOV-18	J1223342	329408 PAYPAL *PHR INC 402-935-7733	176.00

04-DEC-18	Z0843545	1120 PAYPAL *GD5357117SH 402-935-77	24.88
E5749 Other Specific Use Supplies			
20-NOV-18	Z0842725	1102 FS *WEBODM.ORG 877-3278914 CA	47.00
E5920 Rent - Motor Vehicles			
18-SEP-18	J1217504	EA; Fleet vehicle rental 9/6-9/10	228.00

			\$24,920.11

Small Equipment (<\$5K)

E7815 <5K Technology Equip - Enterprise			
27-AUG-18	I2022204	Ryu, Jae H.	2543.98
E7830 <5K Computer Equipment Other			
16-NOV-18	I2038975	Ryu, Jae H.	3372.68
E7996 <5K Photographic Equipment			
07-SEP-18	I2024658	Ryu, Jae H.	2097.63
29-OCT-18	I2034722	Ryu, Jae H.	2120.00

			\$10,134.29

Tuition Remission and Training

E7140 Tuition and Fees - Grad Assistants			
13-AUG-18	J1213446	G1GB for 171-55579	744.00
13-AUG-18	J1213446	SHI1 for 171-55579	899.00
13-AUG-18	J1213446	T1GB for 171-55579	3932.00
10-OCT-18	J1220157	G1HD for 142-24168	415.00
10-OCT-18	J1220157	MPX1 for 142-24168	175.00
10-OCT-18	J1220157	T1HD for 142-24168	2185.00

			\$8,350.00

Total Expenses \$ 105117.23

7. Commercialization revenue - None to report at this time