Alaska Aerospace Corporation Internships

By Jeremiah Schrock

For two mechanical engineering students, an internship with the Alaska Aerospace Corporation (AAC) offered two different — but positive — learning experiences.

While her days began early, Sarah Hoffman enjoyed going to work every morning. “I got to work on projects that were interesting and helped the company,” she said. “Not by making coffee and filing papers,” she was keen to point out.

As part of the internship, Hoffman learned how to operate Satellite Tool Kit (STK) software, a astrodynamics-based program used for studying basic orbital mechanics. She learned about the space launch industry and what areas they are often concerned with, including environmental assessments and competition from other launch sites.

For Carl France, a big part of his internship with AAC was understanding the nature of the aerospace business. “The most important thing I learned was how companies work,” he said.

“I saw on a daily basis that all work gets done by people, and those relationships between people are what allow the company to do what it does,” France said.

According to Hoffman, the team at AAC were a great bunch to work with. “They treated me with respect; as an equal with less experience,” she added.

While she tackled projects and studied the technical details of aerospace development, the most important thing she learned was what she is capable of accomplishing. “I can be an engineer and succeed,” she said.

The internship, in a significant way, was a confidence builder for Hoffman. “Sometimes I’ve wondered if I’m going into the right field and if I am even capable of doing all that is required of an engineer,” she said.

“This internship gave me confidence in myself by giving me projects that I completed well.”

Both Hoffman and France were based at AAC’s corporate office in Anchorage. However, the interns were sent to the launch complex on Kodiak for two weeks where they toured the facilities and gained valuable hands-on experience with the site’s technicians.

Hoffman’s favorite experience was her time working on Kodiak Island. “That place is very beautiful, and the Launch Complex is amazing,” she said.

“The part I enjoyed the most was the time I spent in Kodiak,” France agreed. He particularly enjoyed the recreational opportunities that Alaska’s largest island made available.

“That island is magical,” he said, “and I feel fortunate to have been able to experience it.”

Would Hoffman and France recommend the internship to other students?

“Definitely,” said Hoffman. “This was a fun and great learning experience. The people there are very understanding, kind, thoughtful, respectful, knowledgeable, and encouraging.”

“The people there are fantastic and the organization as a whole is very welcoming to interns and really takes the time to make sure the experience is beneficial,” France said.

But a word of caution: An intern can’t just sit back and expect to be taught, France said. They need to hungry to learn and willing to jump in feet first. “I would caution anyone thinking about interning that your attitude is crucial,” he said.
From the Director

Denise Thorsen

Change is always exciting, except when it is not! This year Alaska Space Grant has gone through an excessive amount of change in its Affiliate Representative and Board of Directors. Cathy Conner (University of Alaska Southeast—UAS), our longest serving affiliate representative, decided to retire from the university last year to pursue other interests. Cathy’s dedication to our program and the students at UAS was inspiring. She will be sorely missed. We would like to welcome Dr. Jason Amundson as UAS’s new affiliate representative. UAS also had a turnover of the representative on our Board of Directors. Marsha Sousa has chosen to leave Juneau and come back to Fairbanks where she is now working with the honors students at UAF. With luck she will be able to encourage the UAF honors students to apply for ASGP fellowships. Taking over for Masha is Dr. Karen Schmitt. Dr. Schmitt is returning to UAS where previously she served as dean of the schools of Management and Career Education. I’m looking forward to welcoming Dr. Schmitt personally this fall and discussing the pathway for ASGP to expand their reach into the Ketchikan and Sitka campuses.

University of Alaska Anchorage (UAA) has also had a 100% change in their Alaska Space Grant representatives. Last year we welcomed Dr. Sam Siewert. This year we are saying good-bye as Sam moves south to warmer climes. In one year, Sam worked tirelessly to increase the number of student applicants from UAA. He was hugely successful! We are sorry to see him go. Taking his place is Dr. Utpal Dutta, faculty in Civil Engineering. UAA has also changed their representation to the Board of Directors. We would like to welcome Dr. Bart Quimby, Interim Dean to UAA College of Engineering.

Finally, both the Challenger Learning Center of Alaska (CLCA) and the Juneau Economic Development Council (JEDC) have changed their affiliate representatives. We welcome back Marnie Olcott at CLCA and Rebecca Parks at JEDC. Both have participated in Alaska Space Grant projects in the past. I am looking forward to working with both of them to develop a coordinated Pre-college program.

This year’s newsletter highlights student engagement through NASA internships (Thomas Edwards — Langley; Jonathan Klein — JPL), Alaska Aerospace internships (Carl France, Sarah Hoffman), and University internships (Nathaniel Cox — UAA). Each student had a unique experience that has strengthened their interest and motivation in their chosen discipline. These stories really illustrate the power of Alaska Space Grant to positively impact our students.

UAF Researcher Applies Thermochronology from Glaciers to Hot Springs

by Jeremiah Schrock

“My interest in thermochronology was heated up by Dr. Paul Layer when I was an undergraduate at UAF,” said Jeff Benowitz, a Geochronology Lab Manager at the Geophysical Institute. He took a course with the — as he put it — “oh so boring title” of 40Ar/39Ar Geochronology. From that moment on, his passion for the subject took off.

Thermochronology, at its core, is the study of the thermal histories of rocks. The farther from the earth’s core a rock is, the cooler it becomes. The age of a rock can be determined based off of the presence of certain radioactive isotopes with a known half-life like Uranium-238.

What attracted Benowitz to the science of thermochronology was that the only limit to its applications and uses lay with the creativity of the scientist. While thermochronology is a hard rock geology tool, it has been applied to studying erosion processes, mountain building, sediment transport, and geothermal resource development. Benowitz’s studies took him from the field’s basics all the way to the Alaska Range where he studied the mountains uplift. “Since then I’ve been trying to find other applications for what is basically a rock thermometer,” he said.

In 2013, Benowitz undertook a thermochronology research project around Pilgrim Hot Springs, Alaska, located on the Seward Peninsula in eastern Alaska. He and fellow scientist Christian Haselwimmer — himself an expert in remote sensing — collaborated on the endeavor. It was a natural fit: Haselwimmer leveraged his understanding of remote sensing tools to evaluate the modern thermal anomaly of the hot springs, while Benowitz focused on capturing the thermal anomalies past extent and temperature. Their project was part of a larger Alaska Center for Energy and Power (ACEP) ongoing study of the region as a future geothermal resource.

While the use of thermochronology with the field of resource evaluation isn’t new, one aspect of his project was. “This might be the first project using thermochronology as a tool to evaluate the tectonic regime of a geothermal resource,” Benowitz said. In short, thermochronology can be used to understand the specific geological environment responsible for a geothermal resource. It is important research to say the least, because different geological origins for hot springs have varying geothermal resource potential.

At the end of the project, Benowitz and Haselwimmer came to several conclusions: the hot springs is a young thermal anomaly (most likely) less than 50,000 years old, is likely the result of slow continental rifting and has likely reached temperatures of... Continued on page 4
Algae on Alaska’s glaciers live all winter beneath the snow, then swim to the surface in the spring as the snow melts, deepening the color of the snow surface, hastening its melt. Increases in algae population may be spurred by our warming climate.

“These algae reproduce in a potential positive feedback loop with snow melt,” said Professor Roman Dial of Alaska Pacific University. “More algae, more melt. More melt, more algae. By melting the snow near the snow line and doing it sooner, algae expose bare ice to the sun’s rays, melting the ice faster than if it were buried beneath snow. So these small, single-celled organisms are hastening the glacier melt and in an accelerating way.”

In addition to the algae’s impacts on glacial melting, Dial wondered how the other organisms on glaciers might be affected by changes in their habitat. Ice worms, cyanobacteria, and collembola (often called “ice fleas”) also live on glaciers. Comparatively little research had been completed so far on glacial ecosystems. Dial’s observations and questions led to the development of a new, Space Grant-funded course in cryobiota and glacial ecology at APU.

Fourteen students, including undergraduates, graduate students, and even recent alumni, participated in lab and field activities as part of the course in its first year. They helped plan activities, handled equipment on the ice field, collected data, analyzed results, and even performed experiments on campus. One key field experiment involved removing or blocking algae from sections of the glacier to analyze melt with and without the algae present.

Space Grant funding not only helped students get out in the field, it allowed connections with NASA programs like LANDSAT, which provides long-term satellite records of land masses on Earth.

“It has been extremely helpful in getting students to connect what they see in the real world with what is seen from space, with the analytic tools to connect the two and the communication skills to deliver their findings,” Dial said.

Results from the field work in the new cryobiota course are still in the early stages. It’s possible that earlier snow melt from algae may limit the overwintering capabilities of the ice worms — the “charismatic megafauna” or “grizzly bears of the ice fields,” Dials calls them — because they are left unprotected from cold nights before snowfall. More experiments might also investigate the idea that more melted snow could help algae and cyanobacteria reproduce even more quickly — the dangerous potential positive feedback loop. Research on these and other questions will continue in the future, with the course being taught every other year.

“Small organisms are the most important in all ecosystems,” Dial said, “But because we can’t see them, we tend to discount them. Losing them to climate change would make the world a small bit less wondrous.”
Alaska Students Experience New Space Mission Simulation at Challenger

by Ana Nelson Shaw

NASA-affiliated crews attempting to conduct experiments and gather data on their planned mission this year encountered solar flares necessitating emergency evacuation of their spacecraft. Space personnel worked with mission control staff to solve problems and get the mission back on track.

But the crew on this mission wasn’t the usual highly trained NASA personnel — they were Alaska middle and high school students attending the Encounter Earth program at the Challenger Learning Center of Alaska (CLCA) in Kenai. Twenty Encounter Earth missions during the 2013-14 school year brought in up to 32 students each. All participating students got to experience the simulation both as space personnel and as members of the mission control crew. In the simulated mission, they used current, relevant data provided by NASA.

Only three centers worldwide got the chance to implement this new simulation, including a new software platform, Sim3, used by students on the mission. Although being an early implementer of Sim3 had its challenges, CLCA staff worked with software and curriculum developers to solve problems and provide feedback.

“It had such a positive impact on students’ and teachers’ attitudes regarding STEM education,” said Summer Lazenby, Director of Educational Operations for CLCA. “Alaska’s kids got an opportunity to be part of the development of a piece of educational software that is going to be available nationally at other Challenger Learning Centers.”

Lazenby joined the center in January 2014, replacing former director Chantelle Rose, who originated the grant that funded Encounter Earth.

In addition to writing the grant and starting up the student program, Rose recruited teachers from around the Kenai Peninsula and from as far away as Anchorage and Wasilla to attend summer professional development workshops last year that prepared them to bring their students to Encounter Earth. Rose reached the teachers through social media, email listservs, word of mouth, and on-the-ground networking at the Alaska Math And Science Conference in Anchorage. Her efforts paid off.

“Seeing the possibilities that Challenger Learning Centers can offer students gets teachers very, very excited,” Rose said. “The CLCA staff and the teachers were thrilled to experience a simulated space mission using this new software platform.”

“Space exploration is a topic in science education that’s often in the news and relevant in today’s climate,” Lazenby added.

The final version of the Sim3 software and the new mission is slated for release to the entire Challenger network in Spring 2014.

CLAC is a statewide, nonprofit STEM education center that aims to get Alaska’s youth excited about STEM fields through fun, engaging, hands-on activities. They offer four missions — Earth, Moon, Mars, and Comet — numerous workshops, and camps in spring and summer for K-12 students.

Thermochronology from page 2

150 °C (302 °F) in the past. Pilgrim is also not likely in thermal equilibrium, which means the possibility exists of warmer water deep within the hot springs reservoir.

Has Benowitz made a connection between Pilgrim’s potential as an energy source for rural Alaskan communities and the possible astrobiology exploration and settlement of other planets? The answer is nuanced.

It is known that thermal springs are environments conducive to the formation of life, providing both building block elements and energy sources and are also sites where fossils are preserved. Thermochronology can be used to discern the location of ancient thermal springs on other planets, like Mars, and hence assist with the continued search for evidence of life elsewhere in our solar system.

While a natural resource base would also be important to any future extraterrestrial settlement, Benowitz stuck to Earth. “I’ve learned that low temperature geothermal resources have the potential to provide important energy resources for rural Alaskan communities,” he said, adding that it takes a multidisciplinary approach in order to evaluate any areas geothermal resources.

“Knowing both the modern extent of the thermal anomaly, combined with the geological history, makes for a stronger resource evaluation,” he said. The more we know, the better we can understand our natural resources.
The Monster Lobe
by Jeremiah Schrock

Apart from a few isolated classrooms, curriculum that focus on science, technology, engineering and math (STEM) are hard to come by in Alaska. For a pair of professors at the University of Alaska Southeast, that’s a problem.

Enter “The Monster Lobe.”

While something christened the Monster Lobe might sound bizarre and otherworldly to some, to Lori Sowa and Chip McMillan, it sounds like the perfect learning project for middle school students. In lay-speak, the Monster Lobe is a frozen debris flow that threatens both the Dalton Highway and the Trans-Alaska Pipeline. The lobe is a sign that climate change is all too real, with the potential for costly consequences.

Sowa hopes to increase student interest in STEM through the hands-on project. “The Monster Lobe problem is truly an integrated STEM problem,” she said. This integration makes it the perfect primer for students. It allows students to learn about the engineering design cycle and is loaded with plenty of relevant math and science.

Sowa is the principal investigator on the ASGP-supported project.

Another facet to the project — and one near-and-dear to Sowa’s heart — is the emphasis on engineering. “Engineering is not a topic typically covered in the K12 curriculum,” she said, “but is a great vehicle to deliver integrated math, science, and technology education.” If one tries to design a solution to a problem, as engineers do, they’ll likely need to employ all four fields do it, she added.

“Engineering allows students to be both thoughtful and creative, and promotes research about and application of concepts in a way that is immediately relevant to the solution they are creating,” Sowa said.

One way the class is helping students engineer solutions to a real-world Alaska problem is through the use of MinecraftEdu, a popular world-building video game. The game helps students model their solution to the Monster Lobe. “We’ve received a number of calls wondering when we are offering ‘that Minecraft class’ again,” she said.

If the Monster Lobe can get middle school students excited about STEM, then they’ll be more likely to tackle more difficult subjects and potentially choose a career in STEM fields later on, Sowa said. “Even if students don’t decide to be engineers, working on STEM projects helps them to apply knowledge in new contexts and helps develop critical thinking skills that are important for everyone.”

Students in Lexie Razor’s 9th grade algebra class use Minecraft to create three dimensional scale models of plant cells.

Fellowship Recipients

Thomas Edwards (Summer ’13)
Physics
University of Alaska Fairbanks

Carlton France' (Summer ’13)
Mechanical Engineering
University of Alaska Fairbanks

Trevor Golden (AY13-14)
Liberal Studies
Alaska Pacific University

John Harriss (AY13-14)
Electrical Engineering
University of Alaska Anchorage

Jennifer MacDougall (AY13-14)
Education
University of Alaska Fairbanks

Max Martell (AY13-14)
Petroleum Engineering
University of Alaska Fairbanks

Lowell Perry (AY13-14)
Electrical Engineering
University of Alaska Anchorage

Jamie Pierce (AY13-14)
Environmental Science
University of Alaska Southeast

Alexandra Ravelo (AY13-14)
Marine Biology, Graduate
University of Alaska Fairbanks

Jacquelyn Smith (AY13-14)
Geological Engineering,
Graduate
University of Alaska Fairbanks

Space Systems Engineering Program

*Students sponsored by Alaska Aerospace Corporation

Jesse Frey (AY13-14*)
Electrical Engineering
Graduate, University of Alaska Fairbanks

Morgan Johnson (AY13-14*)
Electrical Engineering
University of Alaska Fairbanks

O’Dell (AY13-14*)
Electrical Engineering
University of Alaska Fairbanks

Patrick Wade (AY13-14*)
Mechanical Engineering
University of Alaska Fairbanks

Fellowship & Scholarship Recipients

Jochante Johnson (AY13-14)
Biology
University of Alaska Anchorage

Nathanael Kingland (AY13-14)
Electrical Engineering
University of Alaska Fairbanks

Anna McKay (AY13-14)
Civil Engineering
University of Alaska Anchorage

Vanessa Muhlenbruch (AY13-14)
Biological Sciences
University of Alaska Anchorage

Jesstin Patterson (AY13-14)
Petroleum Engineering
University of Alaska Fairbanks

Forest Walker (AY13-14)
Civil Engineering
University of Alaska Anchorage

Clarissa Zeller (AY13-14)
Biology
University of Alaska Anchorage
When life gets tense down here on Earth — climate change, civil unrest, the next election cycle — Alaskans can take comfort knowing one of their own is hard at work discovering what our future houses on Mars and the moon might look like. That would be Nathaniel Cox, a May civil engineering graduate from UAA doing research this summer on a fellowship provided by NASA's Alaska Space Grant Program. His mission: Mix, pour and test the strength of a unique formula for concrete that could potentially shape the walls and ceilings of our extraterrestrial homes.

Scientists and engineers actually call it lunarcrete. One NASA video I watched explained that during the Apollo era's manned space missions, the agency accumulated a half ton of lunar soil. Even then, scientists realized that space travelers would one day be residents off of planet Earth. What would they live in? How would those structures be built? Hauling everything from planet Earth would be too expensive. Could building blocks be made on the moon?

Back in 1986, scientists at a technology institute in Illinois got 40 grams of moon dust and used it to make some concrete. The moon soil, called lunar regolith, replaced the more familiar sand, gravel and crushed stone typically churned together with water and cement to cure into good old reliable concrete here on Earth.

Humans have been building with concrete since the Romans. The Colosseum in Rome is made of it, and the Pantheon has the world's largest unreinforced concrete dome. Over time, the recipe has changed. Along with water, the Romans used lime, volcanic ash and pumice. They even added horse hair to help keep it from cracking. In the 1800s, an Englishman patented Portland cement, made by mixing and heating limestone and clay and then grinding it up into a fine powder. When you add water, the cement paste glues all the rocks and sand together into concrete — something you can shape into buildings and bridges and roadways.

All Nathaniel Cox is doing, along with a number of other scientists and engineers around the world, is mixing with the recipe. On other planets, what will replace the water, sand and gravel and cement we use on Earth? Scott Hamel, a civil engineering professor at UAA, is the official mentor on the project. That means he and Cox have thrown around ideas about what might work. Cox did all the literature review, checking out what anyone else has tried, and Hamel has applied his accumulated professional knowledge as a civil engineer.

One reason Cox and Hamel were picked for this project is their ongoing work on thin-shelled, latex-modified barrel units that could become safer roofing material for rural Alaska or in underdeveloped countries like Haiti. There, a 2010 earthquake flattened poorly constructed buildings and killed hundreds of thousands of people. Hamel was inspired to create this new roof design during a tour with Engineers Without Borders in Haiti back in 2004.

Designing lightweight strong concrete roofs that can be built in Third World countries isn't that far off from figuring out how you could build them on the moon or Mars. Of course, there are extraterrestrial challenges, but one of NASA's directives for research is developing new materials that make life better on Earth as well as in space. With their barrel units, Hamel and Cox had that nailed. So what is their extraterrestrial recipe? No, they aren't buying any lunar dust to work with. Instead, a company funded by NASA has developed a substitute, called lunar regolith simulant, with enough of the same properties that scientists and engineers can practice with it here on Earth.

Cox, on a budget of $5,000 from NASA and another $5,000 from UAA's Innovate fund, is watching his pennies. Fifty-five pounds of lunar regolith simulant will cost $650. The recipe he and Hamel have settled on uses the imitation moon dirt, powdered latex, water and calcium aluminate cement. They are also substituting lightweight fiberglass fabric to add strength, instead of the metal mesh they used in the roof units made with Haiti in mind. Cox is busy building the molds for his lunarcrete and designing at least six strength tests. Those are the results he'll report to NASA, with a deadline of September 30.

He says he's thrilled to apply a passion for structures to something as novel as living on another planet. He credits a high school physics teacher (Bill Ennis at East High) and a calculus professor at UAA (Larry Foster) for giving him the passion to go deep and stick with solving complex problems. NASA quoted a visionary computer scientist in that video I mentioned at the beginning. "The best way to predict the future," said Alan Kay, "is to invent it." Who would have guessed that some of that might happen right here at UAA.
The best learning experiences are the ones that teach us something new about ourselves. For Thomas Edwards, a physics student and UA scholar, his internship at NASA during the summer of 2013 proved to be just such an experience.

During his internship as part of the Langley Aerospace Research Student Scholars (LARSS) project, Edwards worked alongside Dr. Daniel Weimer, a space physics expert. While the project Edwards worked on was small and in a sub-field of physics he lacked experience in, he was able to take the project and make it his own. “It was a real confidence booster,” he said. Over the summer, Edward’s had the opportunity to see how NASA worked from the inside, as well as what research was being actively pursued. The internship gave Edwards the chance to be a fly-on-the-wall at one of the nation’s great research institutes, while also getting his hands dirty in the heady world of physics.

Edwards was also impressed with the LARSS program staff, adding that they were fantastic and supportive. They were also understanding, allowing him to enter the program a few weeks later to accommodate Edwards’ early summer plans. He meshed well with his roommates and made sure to have fun outside of NASA on the weekends. Overall, he was floored by the internship. “The experience was great!” he said.

For Edwards, the internship was a summer-long field test of his skills and research ability. He jumped into an unknown research environment and landed skillfully on the other side. “I came out of it feeling accomplished and confident,” Edwards said.

In addition to studying physics, Edwards is also minoring in computer science and mathematics. With most of Edwards’ work being in numerical simulation, he often has the chance to bring all three fields together. At the end of the day, Edwards takes pleasure in solving problems. “There’s a certain rush you get when you finally get a simulation working and producing results no one has ever seen before,” he said.

In the near future, Edward’s will finish a research project with UAF professor Dr. Channon Price, while also applying for graduate school. He intends to work toward a PhD in either physics or engineering. Staying true to his passion, Edwards hopes to find a program with a heavy numerical modelling focus. Edwards will graduate from UAF in May 2014.

When something is easy, we joke and say “it isn’t rocket science.” For one UAF student however, rocket science is no laughing matter.

Jon Klein is a masters student in Electrical Engineering at UAF. In 2012, he took part in an internship at the Jet Propulsion Laboratory in California.

Managed by Caltech — and funded by NASA — the laboratory specializes in designing and operating robotic spacecraft. JPL also runs the Deep Space Network (DSN), a worldwide network of radio transceivers that are used to communicate with deep space probes. At JPL, Klein interned with the Radio Science Systems Group. As part of the group, Klein worked on a feasibility study concerning the use of CubeSats for interplanetary radio science applications. A CubeSat is a miniaturized satellite that is often built using off-the-shelf commercial electronics. Students and staff at the Alaska Space Grant Program have worked with developing CubeSats since 2009.

In addition to interning with the radio group, Klein also worked with the Communications Ground Systems Group. As part of their group, he worked on creating a potential new beam waveguide antenna. Such antennas transport signals between transmitters or receivers and a movable satellite dish by means of a beam. Rocket science, indeed. The engineering requirements of deep space probes sometimes demand unconventional technologies uncommon in other fields, Klein said. As part of the internship, he was exposed to cutting edge science and engineering, gaining experiences unavailable elsewhere. Interns in the radio group had the opportunity to sit in the control room and watch Deep Space probes during real-time operations. One such day included the chance to see DSN’s antennas receive a signal from the Cassini probe as it flew behind Saturn’s rings. That event helped better map the structure of the planet’s rings.

JPL also held weekly seminars for interns that showcased research happening around the lab. These seminars helped keep interns and staff up-to-date on the progress made by the lab’s multiple research groups. The interns were also invited to attend general technical talks. “I got to attend many talks about the landing and operation of the Curiosity rover,” said Klein. His intern group was also fortunate enough to be in the control room for the Mars Science Laboratory Curiosity landing.

Klein praised the internship program, adding that is was “very well run” by JPL and Caltech. “Being an intern at JPL was a great experience,” he said.
**Calendar of Events 2015**

**JANUARY**  
- NASA Summer Internships through SOLAR due

**MARCH**  
- Spring National Space Grant Directors Meeting in Washington DC  
- ASGP project proposals due  
- Graduate Research Fellowships due

**APRIL**  
- Alaska Space Grant Symposium in Fairbanks, Alaska April 23–24, 2015.

**SEPTEMBER**  
- Undergraduate Fellowship/Scholarship applications due

**OCTOBER**  
- Fall National Space Grant Directors Meeting in Tucson, Arizona October 1–3, 2015

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The fifth annual Education and Research Symposium will take place in Fairbanks, Alaska April 23–24, 2015