



FROM THE DIRECTOR

TOPICS IN THIS ISSUE

Based on astrodynamics, fall began in Houston with the Autumnal Equinox on Thursday, September 22, 2016 at 9:22 AM. Traditionally the fall season brings a little cooler weather and a good time to go for a walk outside which reminds us that we are about to embark on two International Space Station space walks. Scott Kelly and Kjell Lindgren will open the Quest airlock hatch at approximately 7:15 am on Wednesday October 28 to perform a 6 1/2 hour EVA to install thermal covers on the Alpha Magnetic Spectrometer, lubricate the Space Station Robotic Arm Latching End Effector B, and route cables on the Pressurized Mating Adapter 3 in prep for installation of the Integrated Docking Adapter later in 2016 for the Commercial Crew Vehicles.

**Geological Training**

Creating explorers

**Astromaterials**

Out of this world?

**Dollars and Sense**

Spacecraft cost estimation

**The Martian**

Dinner and a movie

**People**

Excellence and outreach

On November 6, Kelly and Lindgren will perform a six and half hour EVA to restore the P6 Ammonia system to its original configuration after spending over two years in an off-nominal configuration in response to a leaking pump module. Our XX EVA Team has been working with the crew, mission control, and engineering to insure that the hardware on-orbit is ready to go. EVA is one of the most hazardous activities that is performed in space and that will not change for exploration. In fact we have teams working on suit designs to improve both mobility and safety for future exploration EVAs.

Finally, we have made a few tweaks to our EISD leadership team to optimize performance by naming Glenn Lutz as the EISD Associate Director to assist with many day to day leadership duties. Cathy Claunch will lead the Project Management and Integration Office with a wealth of experience in program management and assessment for the JSC Programs and institutional organization. Doug Terrier will served in a Strategic Integration position in the Directorate in order to insure better strategic development of technology, architecture, and policy along with his JSC Chief Technologist duties.

In closing, please remember that Americans expect NASA to do amazing things each and every day and thanks for all that you do to meet their expectations.

*Steve*

## Congratulations

awards presented as of September

### Center Director's Commendation Award

Paul Abell, XI      Michael Mankin, XX  
 Brian Dawson, XB      Jeffery Schutter, XS  
 Roger Galpin, XS      Ryan Whitley, XM  
 Pedro Lopez, XM

### Center Director's Innovation Award

Michelle Rucker, XM

**Genesis Curation Team, XI** – Kimberly Allums, Judith Allton, Carla Gonzalez

### Women@NASA

Vickie Gutierrez, XB

### Coop Education Award

Cullen Ballinski, XB

### NASA Cost Estimator of the Year

Zach Hunt, XB

### JSC Safety Action Team Award

James Brown, XP

### NASA Group Achievement Award

**Exploration Development Integration Team, XA** awardees – Christopher Adamek, Manuel Arreola, Steve Bauder, Melanie Bilski, Doug Bristol, Michael Chandler, Horatio De La Fuente, Sarah Derkowski, John Dickey, Michele DiGiuseppe, Jody Fluhr, Roger Galpin, Lisa Hammond, Philip Harris, Tracy Hom, Burt Laws, Demetria Lee, Debra Lubban, Roland Martinez, Shanna McCauley-Slack, Shana Mcelroy, Ladonna Miller, Trent Mills, Thomas Moody, Frank Moreno, Rafael Munoz, Daryl Peltier, Mary Anne Plaza, Margarita Sampson, Jeffrey Schutter, Joel Sills, Lydia Strachan, Jubee Varkey, Jeffrey Williams

**Joint Technical Working Group, XA** awardees – Adrienne Blume, David Brown, Greg Byrne, Pat Freyaldenhoven, Jack James, Kumar Krishen, Holly Kurth, J.C. Liou, Frank Moreno, Paul Niles, Kathy Packard, Steve Prejean, Andrea Richardson, Jonette Stecklein

**Mars Lite Study Team, XA** awardees – John Aitchison, Joe Caram, Bret Drake, Kent Joosten, Damon Landau, Felicia Fay McKinney, Brenda Ward, Ryan Whitley

### Superior Accomplishment Award

Joe Hamilton, XI

### On-The-Spot Award

John Aitchison, XB      Pedro Lopez, XM  
 Stephen Bauder, XS      Mark Watney-Matney, XI  
 Jessie Buffington, XX      Paul Niles, XI  
 Lisa Buswell, XA      Jonathan Miller, XX  
 Sean Carter, XP      Daryl Peltier, XS  
 Alan Davis, XI      Adam Schlesinger, XS  
 John Gowan, XP      Veronica Saucedo, XM  
 Lee Graham, XI      Lisa Vanderbloemen, XI  
 Jim Hyde, XI

## The Martian: How many stars out of 5 would you give it?

*Rotten Tomatoes is calling it a 'crowd pleaser' and the Business Insider calls it 'the most optimistic movie possible about being lost in space'.*

Across JSC there were award recipients who received an invitation to a special screening of *The Martian*...on Wednesday, September 16, 2015...here's what a couple of our EISD ticket holders had to say:

**Denise Childs, XS, gives it a 4 out of 5 stars:**

Favorite lines in the movie:

Rich: "Who are you again?"

Teddy: "I'm the director of NASA"

Rich: "Oh, yeah right... Well, you just stand over there for me..." \*steals pen\*.

**Joy Judas, XI, gives it a 5 out of 5 stars:**

"The movie is a reasonably strict adaptation of the book. Some elements had to be left out due to time constraints, but the choices made all were in favor of moving the story forward. Matt Damon did a good job in carrying his solo scenes. Overall the movie was well paced, and very enjoyable. I've been back to see it again with family."



<http://wp.production.patheos.com/blogs/moniqueocampowrites/files/2015/10/the-martian-poster.jpg>

## Congrats to Ryan Whitley

Ryan Whitley has been named as the new Deputy Systems Integration Manager within the Exploration Mission Planning Office (XM) of the Exploration Integration and Science Directorate of JSC. His primary responsibility will be to support the lead of the End-to-end Mission Performance Team (EMPT). The EMPT is an Integrated Task Team (ITT) chartered by Exploration Systems Development (ESD) Division under NASA HQ Human Exploration and Operations Mission Directorate (HEOMD) and is tasked to develop and operate an optimization tool that provides integrated analysis of the SLS and Orion performance which can draw out better expected performance from these systems as compared to current serial methodologies. This team plays a critical role in defining the mission plans for Exploration Missions (EM) 1 and 2 and missions beyond.

## We Are the Center of the Universe, Literally

Most people know that Apollo lunar samples reside at JSC. Many are unaware that JSC curates the largest and most diverse single collection of astromaterials on Earth, with materials from the Moon, asteroids, comets, interstellar dust, the solar wind, and the planet Mars.

These pieces of the universe are classified, preserved, prepared, and distributed to researchers by the Astromaterials Acquisition and Curation Office, a component of EISD and the designated caretaker of the nation's extraterrestrial samples. Their charge is to preserve and protect the scientific integrity of NASA's extraterrestrial samples, keep them safe, and provide them for world-class research on the origins of the Solar System.

JSC curation was founded to care for the samples collected by the Apollo missions from 1969-1972. Additionally, curation oversees a collection of Antarctic meteorites gathered on yearly expeditions since 1976 as a cooperative effort between NASA, the National Science

Foundation (NSF) and the Smithsonian Institution. In addition, comet grains and interstellar dust grains collected by Stardust in transit to and at comet Wild-2 in 2004 and solar wind atoms gathered at the Earth-Sun L1 location in the early 2000s by collectors on the Genesis spacecraft are at JSC. Curation also oversees cosmic dust grains collected since 1981 by high altitude aircraft.

Asteroid materials reside at JSC, representing a percentage of the samples collected in 2015 by JAXA's Hayabusa mission to asteroid Itokawa. And, space-exposed returned hardware that enables valuable extraterrestrial science, including pieces of Surveyor III, Genesis, Stardust, LDEF, Solar Maximum, and EURECA, are curated here.

The samples are a priceless resource for scientific investigations with allocation requests from researchers around the world carefully vetted by peer review panels coordinated by the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM).

CAPTEM ensures that research using NASA's extraterrestrial materials are conducted with the best talent, state-of-the-art techniques, and equipment to fuel scientific discovery.

While samples are leveraged by scientists around the world, a remarkable cohort of researchers, some of them also curators, reside here at JSC (within EISD) to take advantage of the amazing pairing of astromaterials with EISD's world-class research facilities and capabilities.

Their work feeds NASA's understanding of potential exploration destinations, including planetary toxicity, the micrometeoroid environment, UV exposure, atmospheric oxygen erosion, radiation effects, contamination issues, and charging effects to name a few. This unique insight drives spacecraft design, space suit design, landing site selection, tool design, mission objectives, and health considerations.

So next time you boast that JSC is the center of it all, know that cosmically, you are indeed correct.

### DID YOU KNOW?

- Curation is gearing up for growth of the astromaterials collection, readying facilities for **Hayabusa 2** samples that will be collected by JAXA in 2018 from asteroid (162173) 1999 JU<sub>3</sub>, as well as samples from asteroid 101955 Benu that will be collected by NASA's **OSIRIS-REx** mission that same year.
- Curation is also serving as consultants for future sample return missions including **Mars 2020**, a mission whose rover will collect and package samples for return to Earth by a subsequent spacecraft.
- To accommodate these samples as well as those from proposed missions, Curation is tackling the challenge of **cold curation**, to maintain samples at their original temperatures to avoid chemical alterations during transportation back to Earth and subsequent examination and analysis.

*L to R: Curator Cecilia Satterwhite, "The Martian" Author Andy Weir, Antarctic Meteorite Curation Lead Kevin Righter, and Curator Mitch Haller*





## Not Your Father's Spacecraft?

The Cost Analysis Division at Headquarters, responsible for improvements in Agency cost estimates, sponsors an annual NASA Cost Symposium to bring together the entire estimating and analysis community at

NASA. Participation in this event includes all Centers as well as HQ and represents an essential function to the agency. The NASA Cost Symposium advances NASA's core mission by providing a professional forum for agency analysts to present and learn results of cost research, and to participate in training sessions on methods and tools to support important agency initiatives.

NASA funded attendees are selected by their management, center leadership, and members of the NASA Executive Cost Analysis Steering Group. These individuals represent some of the finest analysts and estimators at NASA. Attendees and presenters are substantively involved in the conference through submission of professional papers, conducting briefings and presentations, completion of live demonstrations, and participation in training.

This year, the Johnson Space Center was represented by several members of the Program Management and Integration (PMI) team in EISD as well as by analysts from the Orion and Commercial Crew Programs. Last month's newsletter featured summaries of the EISD presentations made by Kendrick Glenn and Fred Kuo. Susan Bertsch (XB), the Cost Focal for the PMI group, also spoke at last month's NASA Cost Symposium.

In her paper "This Is Not Your Father's Old Spacecraft: An Examination Into Using Modern Data To Inform Manned Spacecraft Cost Estimates," she presented techniques for credibly incorporating new data within our cost estimation frameworks to better estimate costs for manned space and commercial developments. New data now available includes cost actuals from the recently completed EFT-1 flight, cost data from science and technology missions incorporated into the One NASA Cost Engineering (ONCE) database, and experience from work with various commercial space developments. These data can be used to verify estimates, calibrate our legacy tools, and revisit our "rules of thumb" in light of new concepts for ensuring reliability. She provided to the Cost Community a research framework for gathering cost data from these new manned space activities, including ISS and engineering projects, the Extra Vehicular Activity (EVA) office, and the Human Research Program.

### AES Tidbits

- The **AES End-of-Year Review** was held in Houston on September 22-24. The 26 AES projects reported on their FY15 accomplishments and their plans for FY16. In FY15, the AES program completed 56 of 73 annual milestones (77%). Nine milestones are delayed, but will be completed in the first quarter of FY16. Eight milestones will not be completed. The program goal is to complete at least 80% of the annual milestones.
- The Bigelow Expandable Activity Module (BEAM) project has set a **launch date of January 3, 2016** on the SpaceX CRS-8 resupply mission, also known as SpX-8.
- The **AES Innovation Award** was presented to the In-Space Manufacturing project for innovative collaboration with students, the public, industry, and the engineering community. This project engaged the public in numerous social media and outreach activities, and generated over 7 billion web site hits. Niki Werkheiser at MSFC leads the project.

## Geological Field Training: Los Alamos



EISD's Astromaterials Research and Exploration Science (ARES) Division has been providing geological field training since the Apollo era, preparing astronauts for planetary surface exploration. A short version of the field training has been developed for the people who support the surface explorers – mission planners, flight controllers, engineers, and managers. In September a field training exercise was conducted by ARES north of Los Alamos for managers from HQ, JSC, KSC, and Ames.

The students were teamed with experienced field geologists who act as instructors. The teams executed a field

mapping exercise with the goal of understanding not only basic geological principles, but also operational demands during surface extravehicular activity (EVA). While approaches to geologic exploration vary according to the type of planetary surface, the techniques and the operational concepts employed are the same as those used in terrestrial field geology.

Through the years, the geological field training has highly influenced the design of exploration hardware. It has also provided managers with an understanding of surface operations to make informed decisions on planetary surface infrastructure. Eileen Stansbery, a participant in the September exercise, commented, "The experience gave me a better appreciation of what orbital data can *and cannot* provide, which data is most useful, and which is misleading."

The course is designed to replicate the thought processes and decision-making challenges of a planetary explorer. "I gained a good appreciation for the changes in the plan once you get into the field and notice things you could not see in the orbital data," Eileen added. In fact, this type of insight into the dynamic nature of the exploration process has influenced operational techniques through the years too, shaping how crews and Mission Control Center interact to make the most of precious EVA time.

This particular field training was led by XI4/Dean Eppler who populated his instructor team with talent from JSC-ARES, GSFC, UT- Austin, UT-El Paso, GSFC, and Hamilton College, as well as Apollo 17 astronaut Harrison Schmitt. In discussing the September class results Dean observed, "The students certainly responded to the challenges associated with geological operations on the surface of all rocky bodies, whether they are asteroids, the Moon or Mars. In particular, they are taking away the concept that surface exploration must be based in an understanding geological context and that human exploration success is not always the execution of a highly rehearsed and preplanned timeline."



## Swedish Architecture Students Join Forces with JSC Engineers



*Lund students with Astronaut Don Pettit*

Johnson Space Center has welcomed students from Sweden every year since 1998 to work on the Space and Terrestrial Research (STAR) program. It is a one semester elective course with fourth year students. Groups of students from Architecture and Industrial Design visit JSC and work at the Lunar and Planetary Institute for two weeks to focus on individual areas of interest related to the challenges faced on a human Mars mission.



The students use their visit here to formulate the project, and then return to Lund to further develop their ideas. They then present them in mid-December at Lund. The focus areas can include life support, mobility, communication, habitation and other functional and operational areas related to a mission. The goal of the program is to expand the developmental knowledge of design in extreme environments. This year JSC hosts 15 students in Architecture and 25 students in Industrial Design. The Architecture students displayed their work on October 14th in the atrium between Buildings 4S and 4N and the Industrial Design students will display on October 21st from 10 am - 2 pm in the same location. The student displays are set up to allow JSC folks to come by and give them comments before returning to Sweden.



STAR Design has been supported by NASA and Lund for the past seventeen years. Larry Toups of XM has been the program's student contact since its conception. He gives feedback to the students and reviews their work at the end of their time at JSC. Each year the program has a fresh focus to remain up-to-date on scientific research and each student group learns from the previous year's progress.



*Michelle Rucker serves a commercial beverage containing Chlorella algae, a potential Martian beverage*

## Eat Like a Martian!

"Mars will come to fear my botany powers!" said Mark Watney in "The Martian." Perhaps you've heard that we're growing lettuce on the International Space Station...but did you know that Mars regolith contains nearly all of the nutrients needed to grow plants? Or that tilapia farming has been studied as a long-term food source for space explorers? JSC hosted the "Eat Like a Martian" public event at Center's cafeterias on October 6 featuring foods that could be grown in closed-loop exploration systems. Soil scientists were on hand to answer questions about how plants might be grown on

Mars and show samples of a Mars regolith simulant. The Engineering Directorate displayed a plant growth chamber (similar to the lettuce growing experiment on ISS) and an advanced water processing bioreactor. The Food Lab provided samples of current packaged foods, and the Astromaterials Research and Exploration Science (ARES) division displayed a Martian meteorite. Visitors were also able to sample a commercial beverage containing Chlorella algae, which has been proposed as a primary food source for Mars. The event provided an opportunity for JSC employees from all fields to engage and discuss "pioneering" Mars. The team is planning a repeat event to coincide with the upcoming R&D project poster session, so keep an eye out for announcements.

### CDR Status

The Season of CDRs continues at warp speed as the Orion CDR nears completion and the GSDO CDR kicks-off. For the Orion CDR, EISD's Exploration Development and Integration (EDI) Office coordinated and facilitated screening of **213 candidate RFAs (Requests for Action)** on behalf of HQ's Exploration Systems Integration (ESI). Of these RFAs, 145 were approved for submittal, 22 were combined with other RFAs, 39 were submitted as comments, and only 7 were withdrawn. With that complete, EDI is now supporting Technical Review Teams (TRTs) for pre-dispositioning of RFAs in preparation for the CDR Board.

## Upcoming Events

**October 27-30, 2015**

First Landing Site/Exploration Zone Workshop for Human Missions to the Surface of Mars, Houston, LPI  
<http://www.hou.usra.edu/meetings/explorationzone2015/>

**November 13, 2015**

ARES Rocks! – An Open House

**November 17-19, 2015**

SpaceCom Expo, Houston  
<http://www.spacecomexpo.com/>

**December 7, 2015**

Pumps & Pipes 9, Houston  
<http://www.pumpsandpipes.com>

## Save the Date

The Astromaterials Research and Exploration Science (ARES) Division is planning an **open house** for EISD on November 13. This event, themed as *ARES Rocks!*, will provide an unprecedented look into NASA planetary research laboratories and astromaterial collections. Keep an eye out for email with a link for tour registration.

## Reaching the Masses

### How Will We Get Off Mars?

How will we get off Mars? It's a question that's been on the minds of many people.



In early October, Mark Strauss of **National Geographic** published the article "How Will We Get Off Mars?" The article features our own Michelle Rucker and Tara Polsgrove. The article can be found here.

<http://news.nationalgeographic.com/2015/10/151002-mars-mission-nasa-return-space/>

### The Martian: Science vs. Fiction

by Doug Ming

Space Man



Doug Ming, Planetary Scientist, weighs in with **Mechanics** and **Discovery News** about the reality of the science in *The Martian*.

<http://news.discovery.com/space/private-spaceflight/the-martian-science-vs-fiction-151001.htm>



Doug Archer, Planetary Scientist, talks about perchlorate salts, a compound that absorbs water on Mars on a new **YouTube** video. Archer addresses how perchlorate can serve as a valuable resource for human exploration missions to Mars in the future.

<https://www.youtube.com/watch?v=fxnEKi7ItW4>

**Have a newsletter idea or suggestion?**

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