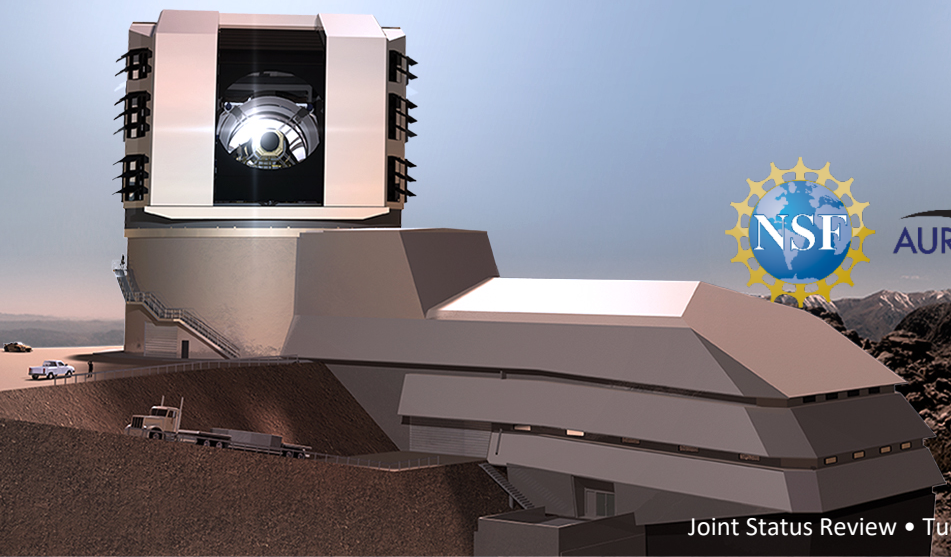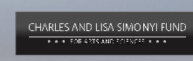# Education and Public Outreach (EPO)

Amanda Bauer
Head of LSST EPO (AURA/LSST)
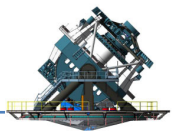
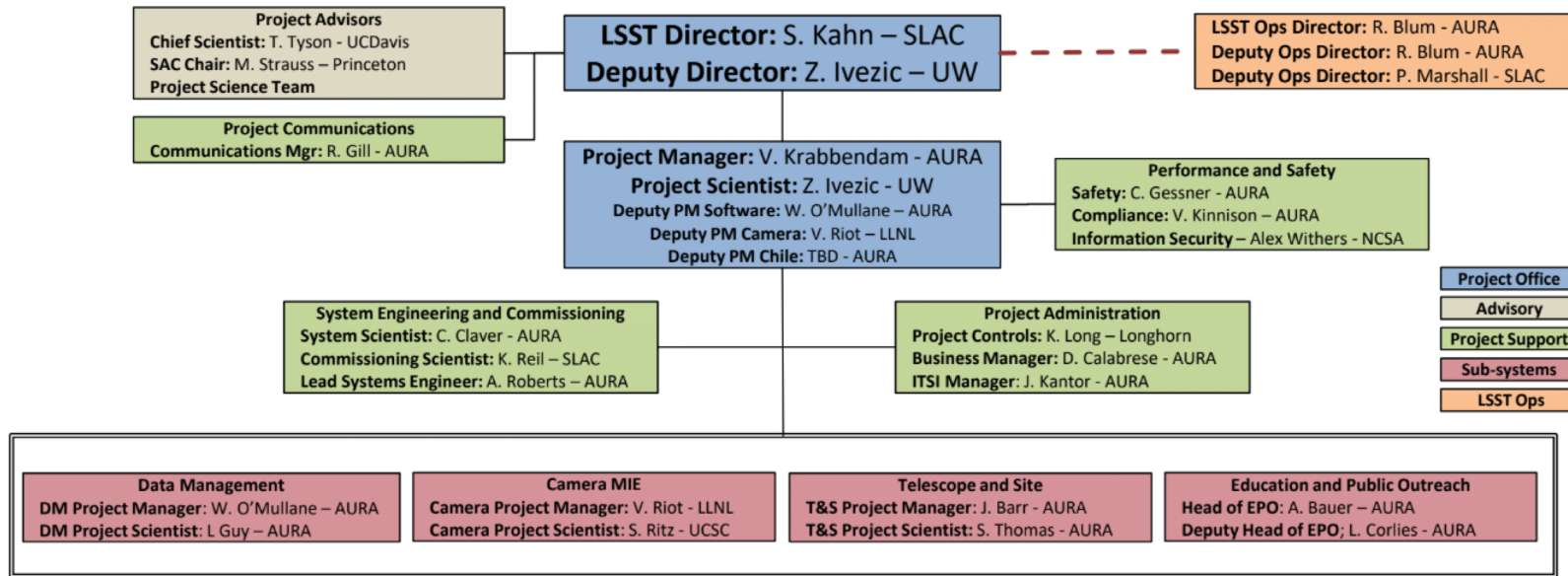## NSF/DOE Joint Status Review
August 27, 2019

Outline

- Overview
- Achievements + Remaining Work
- Cost and Schedule
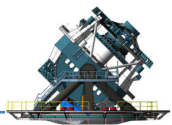- Risks and Opportunities
- Conclusions

Photo: LSST Project/NSF/AURA

LSST Organization – where EPO fits in

Project Advisors
Chief Scientist: T. Tyson - UCDavis
SAC Chair: M. Strauss – Princeton
Project Science Team

Project Communications
Communications Mgr: R. Gill - AURA

LSST Director: S. Kahn – SLAC
Deputy Director: Z. Ivezic – UW

LSST Ops Director: R. Blum - AURA
Deputy Ops Director: R. Blum - AURA
Deputy Ops Director: P. Marshall - SLAC

Project Manager: V. Krabbendam - AURA
Project Scientist: Z. Ivezic - UW
Deputy PM Software: W. O'Mullane – AURA
Deputy PM Camera: V. Riot – LLNL
Deputy PM Chile: TBD - AURA

Performance and Safety
Safety: C. Gessner - AURA
Compliance: V. Kinnison – AURA
Information Security – Alex Withers - NCSA

System Engineering and Commissioning
System Scientist: C. Claver - AURA
Commissioning Scientist: K. Reil – SLAC
Lead Systems Engineer: A. Roberts – AURA

Project Administration
Project Controls: K. Long – Longhorn
Business Manager: D. Calabrese - AURA
ITSI Manager: J. Kantor - AURA

Project Office
Advisory
Project Support
Sub-systems
LSST Ops

Data Management
DM Project Manager: W. O'Mullane – AURA
DM Project Scientist: L Guy – AURA

Camera MIE
Camera Project Manager: V. Riot - LLNL
Camera Project Scientist: S. Ritz - UCSC

Telescope and Site
T&S Project Manager: J. Barr - AURA
T&S Project Scientist: S. Thomas - AURA

Education and Public Outreach
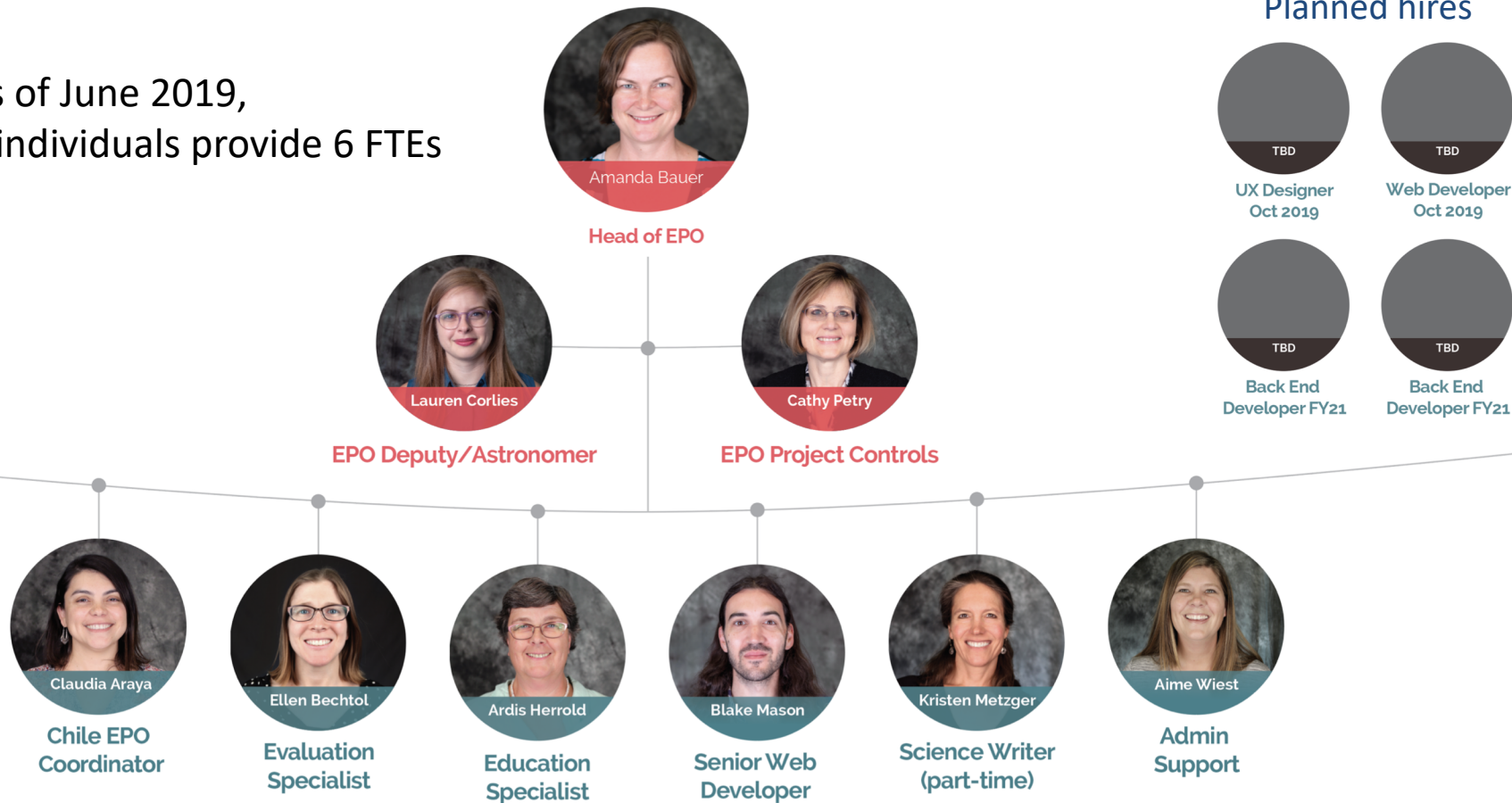Head of EPO: A. Bauer – AURA
Deputy Head of EPO; L. Corlies - AURA

- EPO is integrated as a major component of the Project
- New EPO Deputy appointed – Lauren Corlies
- As the Construction Project, EPO is separate from Communications
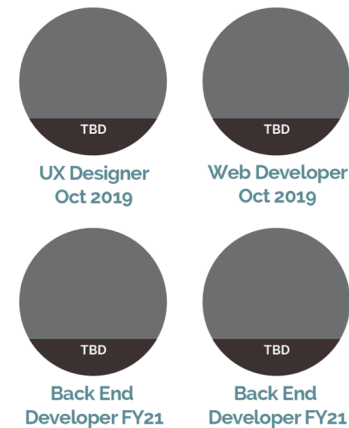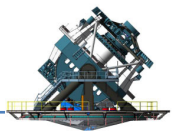 - Ongoing planning for transition to Operations

EPO Construction Staffing

As of June 2019,
9 individuals provide 6 FTEs

Planned hires

Amanda Bauer
Head of EPO

Lauren Corlies
EPO Deputy/Astronomer

Cathy Petry
EPO Project Controls

TBD
UX Designer
Oct 2019

TBD
Web Developer
Oct 2019

TBD
Back End
Developer FY21

TBD
Back End
Developer FY21

Claudia Araya
Chile EPO Coordinator

Ellen Bechtol
Evaluation Specialist

Ardis Herrold
Education Specialist

Blake Mason
Senior Web Developer

Kristen Metzger
Science Writer (part-time)

Aime Wiest
Admin Support

Integration with Project

- EPO Deputy, Lauren Corlies, presented at Community Broker Workshop

- Liaise with DM to incorporate EPO needs for Operations

- Plan for Citizen Science integration within Science Platform

- Kristen Metzger on both EPO and Communications Teams

- Leading sessions at Project and Community Workshops

- Head of EPO on Senior Management Team

- Head of EPO on Operations Executive Council

LSST EPO's mission is to offer accessible and engaging online experiences that provide non-specialists access to, and context for, LSST data so anyone can explore the Universe and be part of the discovery process.

Total Solar Eclipse over Cerro Pachon, July 2, 2019
Photo: K. Reil LSST/DOE/SLAC

Formal Education

Online, data-driven investigations for students in advanced middle school through college, teacher support materials, and professional development opportunities.

Citizen Science

Support for researchers to create citizen science projects using LSST data, including a project-building tool on the Zooniverse platform.

General Public

Online opportunities for a diverse audience to interact with and explore LSST data. News about discoveries, and profiles of LSST scientists and engineers and their work.

Science Centers & Planetariums

An easy-to-use gallery of high-quality multimedia assets that can be downloaded and integrated into exhibits and presentations.

LSST Education and Public Outreach activities begin in 2022 with the start of LSST Operations
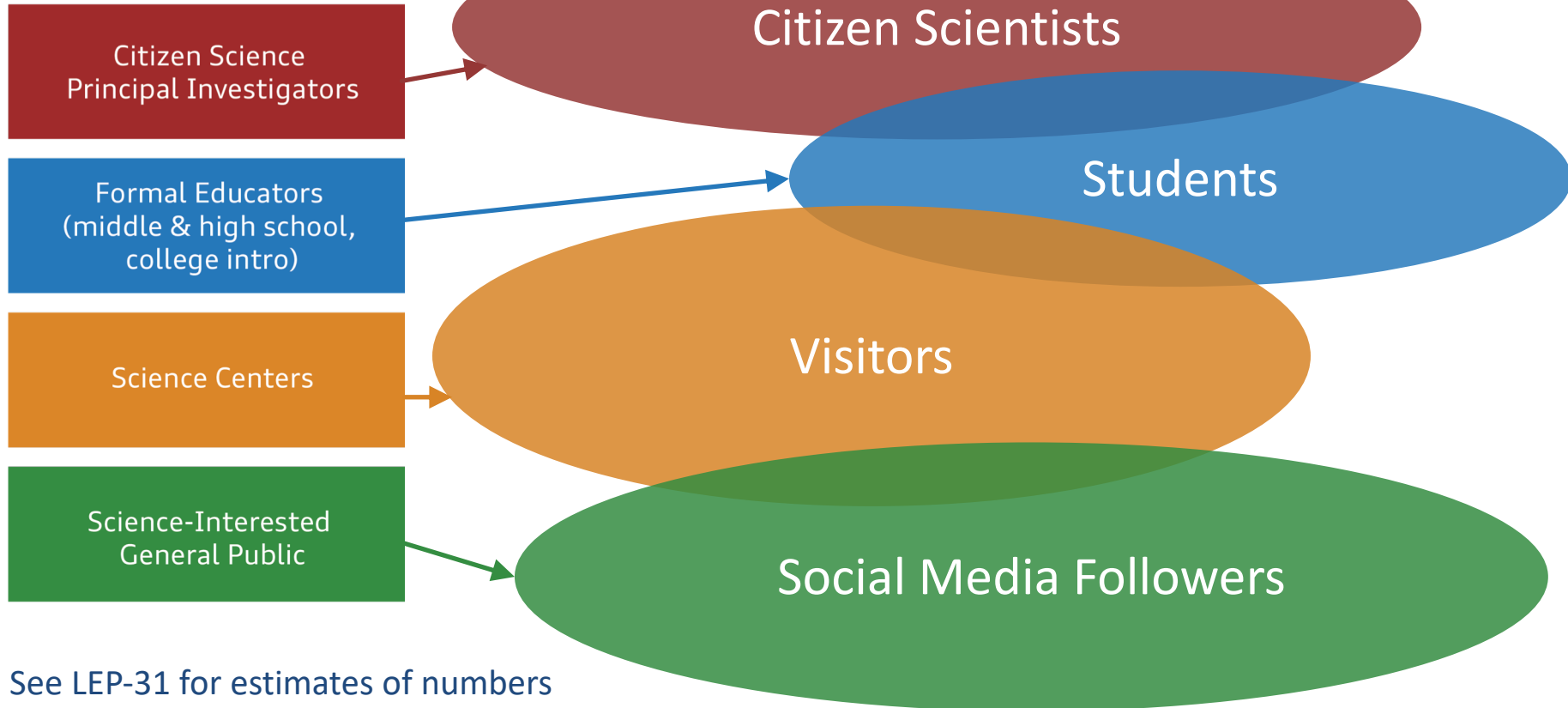
Key Audiences

Citizen Science
Principal Investigators

Formal Educators
(middle & high school,
college intro)

Science Centers

Science-Interested
General Public

Key Audiences

Base Audiences

- Citizen Science Principal Investigators → Citizen Scientists
- Formal Educators (middle & high school, college intro) → Students
- Science Centers → Visitors
- Science-Interested General Public → Social Media Followers

See LEP-31 for estimates of numbers

LSST Education and Public Outreach Deliverables

Audience

**Citizen Science
Principal Investigators**

**Formal Educators
(middle & high school,
college intro)**

Science Centers

**Science-Interested
General Public**

LSST Education and Public Outreach Deliverables

Audience | Deliverables

Citizen Science Principal Investigators	Infrastructure to initiate CS projects through the LSST Science Platform	Promotion of CS projects on the LSST website	PI support materials
Formal Educators (middle & high school, college intro)	A suite of online investigations available through the Education Hub	Educator support materials	Professional development
Science Centers	Multimedia assets in universal (Data2Dome) format	Alert Stream highlights	
Science-Interested General Public	Operations website in Spanish and English	Science news highlights via traditional and social media	Interactive visualization tools

Outline

- Overview
- **Achievements + Remaining Work**
- Cost and Schedule
- Risks and Opportunities
- Conclusions

LSST Education and Public Outreach Deliverables

Audience   Deliverables
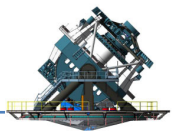
Citizen Science Principal Investigators	Infrastructure to initiate CS projects through the LSST Science Platform	Promotion of CS projects on the LSST website	PI support materials
Formal Educators (middle & high school, college intro)	A suite of online investigations available through the Education Hub	Educator support materials	Professional development
Science Centers	Multimedia assets in universal (Data2Dome) format	Alert Stream highlights	
Science-Interested General Public	Operations website in Spanish and English	Science news highlights via traditional and social media	Interactive visualization tools

LSST Education and Public Outreach Deliverables

Audience

Deliverables

| Citizen Science Principal Investigators | Infrastructure to initiate CS projects through the LSST Science Platform | Promotion of CS projects on the LSST website | PI support materials |

Phase 1: Complete

- Set up PI Workflow
- Zooniverse can accept data directly from LSST Science Platform
- Developed Spanish language capability

Citizen Science (Zooniverse) Project Builder

Phase 1: Complete

- Set up PI Workflow
- Zooniverse can accept data directly from LSST Science Platform
- Developed Spanish language capability

LSST Education and Public Outreach Deliverables

Audience   Deliverables

| Citizen Science Principal Investigators | Infrastructure to initiate CS projects through the LSST Science Platform | Promotion of CS projects on the LSST website | PI support materials |

Phase 1: Complete
- Set up PI Workflow
- Zooniverse can accept data directly from LSST Science Platform
- Developed Spanish language capability

Phase 2: FY 21
- Implement package for aggregating data in LSST Science Platform
- Develop LSST templates for CS projects
- Organize *Citizen Science Data Policy Committee*

Phase 3: FY22
- Commission 2 PI-led CS projects following full workflow
- Develop PI support materials
- Incorporate into website design

LSST Education and Public Outreach Deliverables

Audience   Deliverables

Citizen Science Principal Investigators	Infrastructure to initiate CS projects through the LSST Science Platform	Promotion of CS projects on the LSST website	PI support materials
Formal Educators (middle & high school, college intro)	A suite of online investigations available through the Education Hub	Educator support materials	Professional development
Science Centers	Multimedia assets in universal (Data2Dome) format	Alert Stream highlights	
Science-Interested General Public	Operations website in Spanish and English	Science news highlights via traditional and social media	Interactive visualization tools

| Formal Educators (middle & high school, college intro) | A suite of online investigations available through the Education Hub | Educator support materials | Professional development |

FY19

- Choose technologies
- Develop Formal Education investigations: copy, data, development
- Produce Teacher Guides
- Begin User Testing
- Prototype Intro and Assessment videos

FY19

- Choose technologies
- Develop Formal Education investigations: copy, data, development
- Produce Teacher Guides
- Begin User Testing
- Prototype Intro and Assessment videos

LSST INVESTIGATIONS

Teacher-Friendly
Developed and tested by educators
Designed for use with Next Generation Science Standards (NGSS)
Options for differentiated assignments and assessment
Ready-to-use or fully customizable versions
Minimal prep time
Comprehensive support tools

Engaging for students
Authentic data from a leading-edge telescope survey
Minimal learning curve for interactive tools
Visually appealing data sets
English and Spanish versions available
Appropriate for student-directed inquiry

Low stress technology
Accessed via a web page
No special software or data downloading rquired
Data exploration tools minimize tedious tasks
Totally free

SCIENCE THEMES

Galaxies
Mapping the Milky Way

Cosmology
The Expanding Universe
Exploring the Observable Universe

Solar System
Surveying the Solar System
Hazardous Asteroids

Stars
A Window to the Stars

Light
Coloring the Universe

Dynamic Universe
Exploding Stars
Leavitt's Law

Formal Education Timeline
- NOW - Development
- 2020 - User testing
- 2021 - Professional development begins
- 2022 - Investigations ready to use

Designed 9 investigations
Developed 4 so far

Constructing an Astronomical Color Image
To practice this technique, let's use images taken with the six LSST filters to create a color image with the Astronomical Image Coloring Tool. It works in a similar way to the RGB mixing tool. We will use it to explore an image of M33, a spiral galaxy.

Astronomical Image Coloring Tool

Filter on/off		Colors
☑ g		Violet ⬍
☑ i		Green ⬍
☑ r		Orange ⬍
☑ y		Red ⬍
☐		Color ⬍
☐		Color ⬍

Thank you for helping us test this workspace, which is in development. Please submit feedback to education@lsst.org

Filtro Rojo Filtro Verde Filtro Azul Compuesta

Figura 4: Comparación de los diferentes tipos de luz que pasan a través de los filtros.

4. En la tabla a continuación, registra si la polera de un color en particular se ve luminosa u obscura en el filtro correspondiente. Por ejemplo, en la celda superior izquierda, selecciona "luminosa" u "obscura" para describir como se ve la polera roja al ser observada a través del filtro rojo. En la celda inferior izquierda, selecciona "luminosa" u "obscura" para la polera roja observada a través del filtro azul.

¿Luminosa u obscura?	Polera roja	Polera verde	Polera azul
Filtro rojo			
Filtro verde			
Filtro azul			

Exploring Star Cluster A

Use the H-R Diagram to complete the table of observations

Select the hottest Main Sequence Star
[CHANGE ANSWER] The selected star has a temperature of **5318 K**

Select the coldest Main Sequence Star
[CHANGE ANSWER] The selected star has a temperature of **3876 K**

Draw a circle around all of the Giant Stars

Draw a circle around all of the White Dwarf Stars

Star Cluster A	Values
Main Sequence Temperature Range	5318 K - 3876 K
Total Giant Stars	
Total White Dwarf Stars	

← BACK   CONTINUE →

Colors approximate star colors ◯

Temperature: 3876K
Luminosity: 0.1188⊙
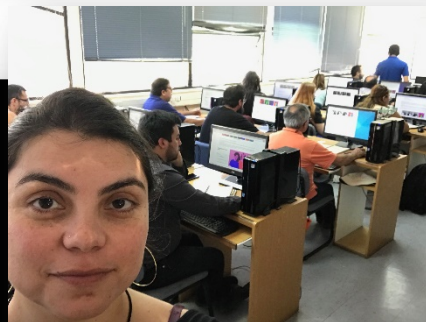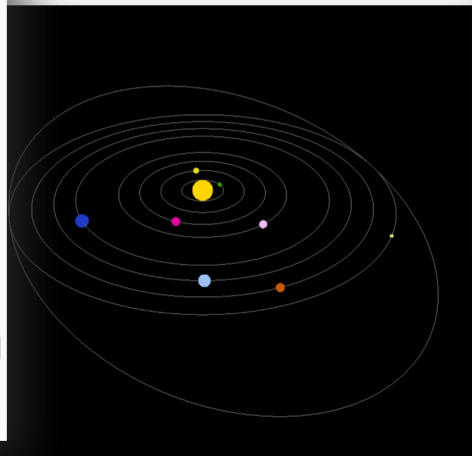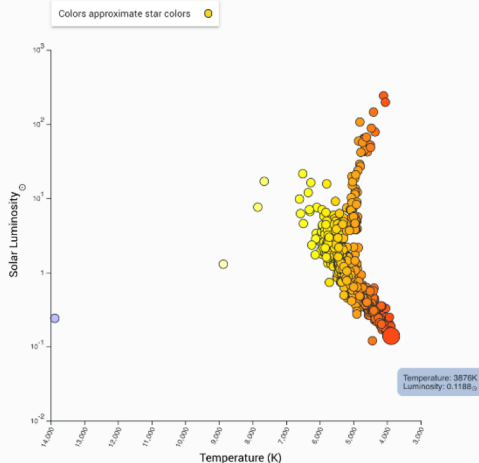
First Spanish-language
user testing
at Chile summer school

Formal Educators (middle & high school, college intro) → A suite of online investigations available through the Education Hub → Educator support materials → Professional development

FY19

- Choose technologies
- Develop Formal Education investigations: copy, data, development
- Produce Teacher Guides
- Begin User Testing
- Prototype Intro and Assessment videos

FY 20

- Investigation development
- Implement design/branding
- Expand user testing
- Incorporate User Testing results
- Begin development of Education Hub/website to host content

FY21/22

- Produce video materials
- Finalize educator support materials
- Pilot testing, networking, begin professional development
- Populate with LSST commissioning data when available

LSST Education and Public Outreach Deliverables

Audience | Deliverables

Citizen Science Principal Investigators	Infrastructure to initiate CS projects through the LSST Science Platform	Promotion of CS projects on the LSST website	PI support materials
Formal Educators (middle & high school, college intro)	A suite of online investigations available through the Education Hub	Educator support materials	Professional development
Science Centers	Multimedia assets in universal (Data2Dome) format	Alert Stream highlights	
Science-Interested General Public	Operations website in Spanish and English	Science news highlights via traditional and social media	Interactive visualization tools

Science Centers → Multimedia assets in universal (Data2Dome) format → Alert Stream highlights

FY19

- Completed 16 short videos in planetarium format
- Complete Promo Video (120 sec)
- 6000 assets uploaded to digital asset management system
- Storytime Domain interviews collected, assembled
- Completed prototype for 360º virtual tour of facility
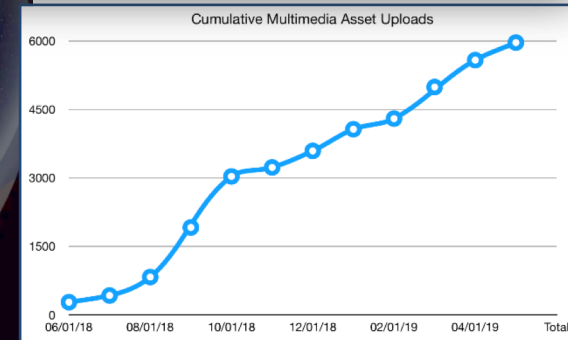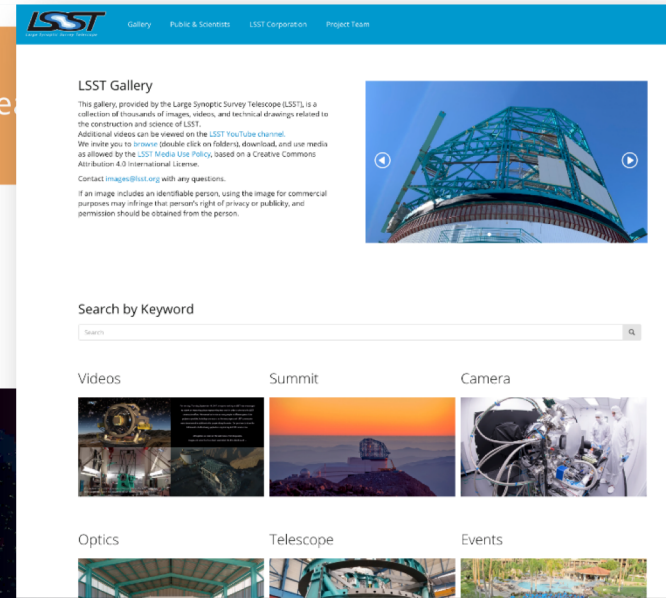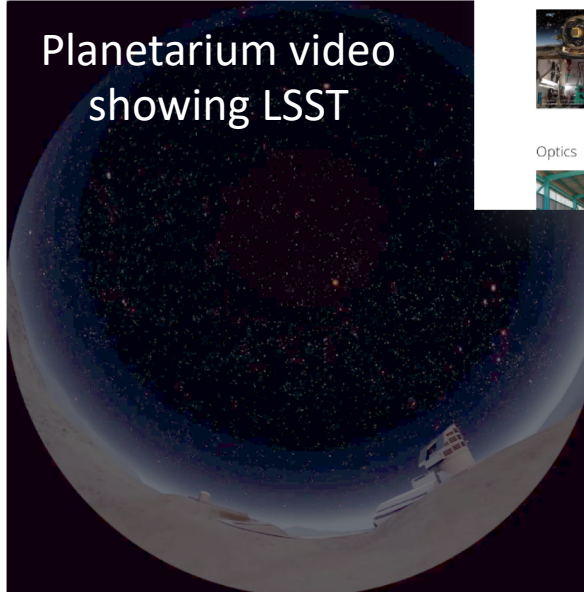
Planetarium video showing LSST

Science Centers → Multimedia assets in universal (Data2Dome) format → Alert Stream highlights

FY19

- Completed 16 short videos in planetarium format
- Complete Promo Video (120 sec)
- 6000 assets uploaded to digital asset management system
- Storytime Domain interviews collected, assembled
- Completed prototype for 360° virtual tour of facility

FY 20/21

- User testing of planetarium resources
- Storyboard education videos
- Decide digital asset management system for Operations

FY22

- Produce video materials
- Develop pipeline for timelapse videos
- Alert Stream Highlights

LSST Education and Public Outreach Deliverables

Audience | Deliverables

|			
Citizen Science Principal Investigators	Infrastructure to initiate CS projects through the LSST Science Platform	Promotion of CS projects on the LSST website	PI support materials
Formal Educators (middle & high school, college intro)	A suite of online investigations available through the Education Hub	Educator support materials	Professional development
Science Centers	Multimedia assets in universal (Data2Dome) format	Alert Stream highlights	
Science-Interested General Public	Operations website in Spanish and English	Science news highlights via traditional and social media	Interactive visualization tools

| Science-Interested General Public | Operations website in Spanish and English | Science news highlights via traditional and social media | Interactive visualization tools |

FY19/20

- Website Architecture
- User Testing
- Develop Operations Communications Strategy
- Design interactive visualization tools for static data and alert stream highlights
- Finalize Transition to Operations planning

Number of Evaluation Participants
Fall 2016 - Spring 2019
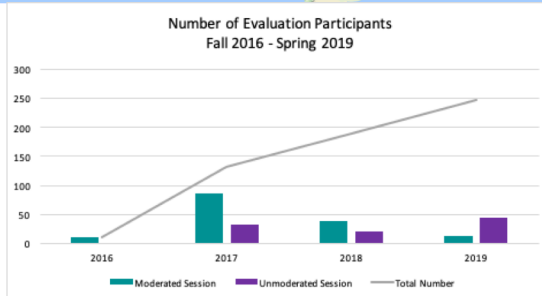
So far 248 people from 27 US states, Chile, and the UK have shared feedback and insights on EPO program plans and prototype deliverables.

EPO recruited for diverse individuals and viewpoints to take part in evaluation and prototype testing sessions.
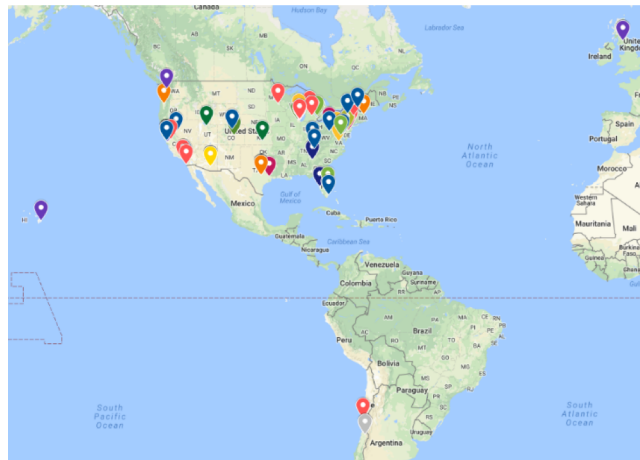
| Science-Interested General Public | Operations website in Spanish and English | Science news highlights via traditional and social media | Interactive visualization tools |

FY19/20

- Website Architecture
- User Testing
- Develop Operations Communications Strategy
- Design interactive visualization tools for static data and alert stream highlights
- Finalize Transition to Operations planning

FY 21

- Develop EPO Data Center with cloud-based infrastructure
- Ongoing development of website and interactive viz tools
- Social Media campaign planning

FY22

- Implement Transition to Operations Plan, focus on communications
- Activate web analytics
- Incorporate LSST Commissioning data
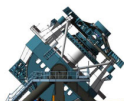
High Level Milestones

|	Citizen Science	Education	Multimedia	Website	General
2020 (8 FTE)		Ongoing dev (3 FTE)		Interactives Architecture (4 FTE)	Comms Strategy (1 FTE)
2021 1st half (9.5 FTE)	LSP package (1 FTE)	User Testing Support Materials (3 FTE)	Digital Asset Management System (1 FTE)	Architecture+ Content (4 FTE)	Branding (0.5 FTE)
2021 2nd Half (9.5 FTE)	LSP package (1 FTE) Templates (0.5 FTE)	User Testing Support Materials (2 FTE)	Video Production (1 FTE)	EPO Data Center Ongoing Dev (4 FTE)	Transition to Operations (1 FTE)
2022 (9.5 FTE)	Commissioning (0.5 FTE)	Pilot Testing Prof Develpmnt (2 FTE)	Timelapses (1 FTE)	Transition to Operations (3 FTE)	Transition to Operations (3 FTE)

Staffing

Percent of total FTE
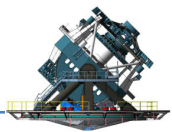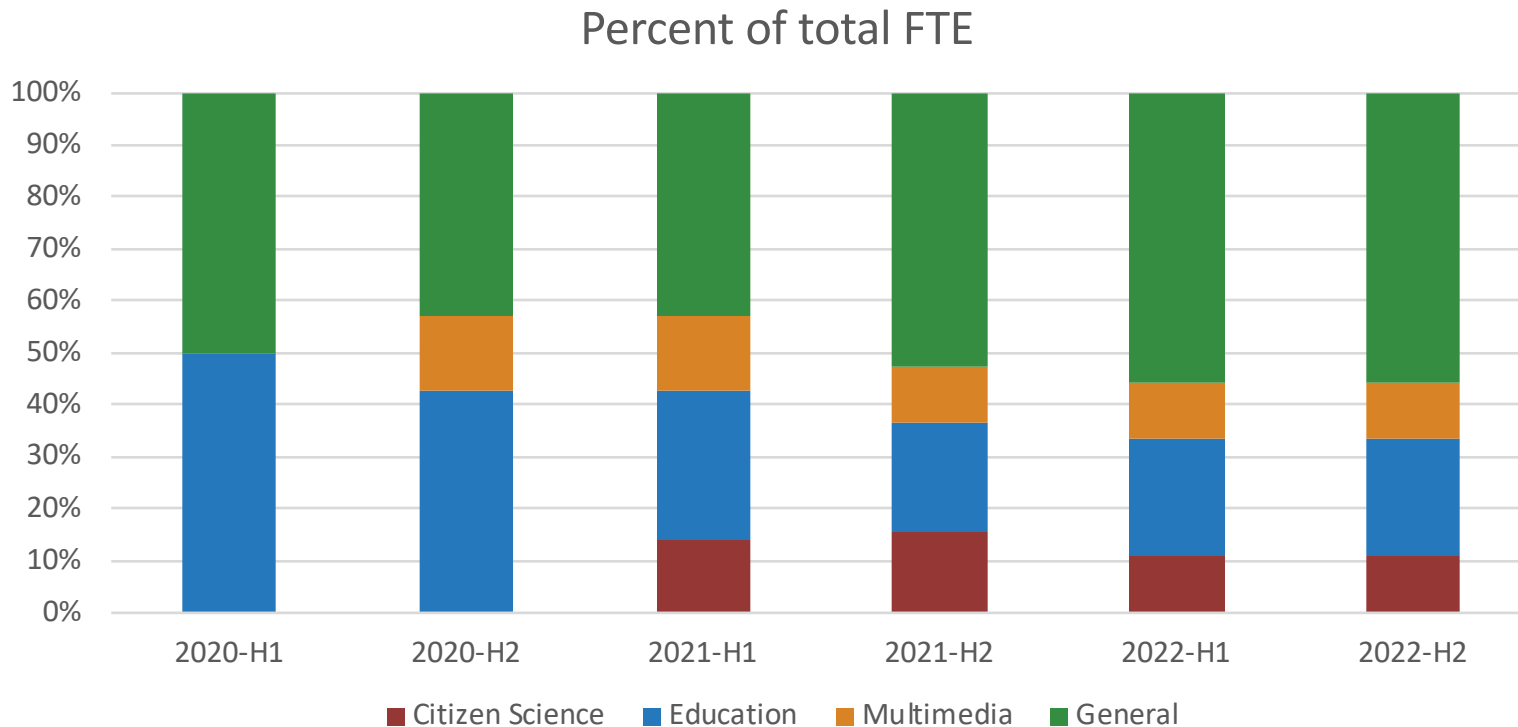
General = Technical Infrastructure + Communications

Outline

EPO Cost and Schedule
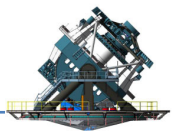

1.05C Education and Public Outreach Construction
SPI and CPI

Healthy CPI and SPI
Budget ~ $9.2M
44% Complete

WBS	DESCRIPTION	CUMULATIVE TO DATE ($k) 31 May 2019									
		BUDGETED COST		ACTUAL	VARIANCE		PERFORMANCE		AT COMPLETION		
		WORK SCHEDULED	WORK PERFORMED	COST OF WORK PERFORMED	SCHEDULE	COST	SPI	CPI	BAC	EAC	% COMP
1.05C	Education and Public Outreach Construction	$ 4,131	$ 4,049	$ 3,988	$ (82)	$ 61	0.98	1.02	$ 9,185	$ 9,223	44%
1.05C.01	System Management	$ 1,991	$ 1,991	$ 1,888	$ -	$ 103	1.00	1.05	$ 3,334	$ 3,245	60%
1.05C.02	EPO Database and Data Access Services	$ 474	$ 474	$ 468	$ -	$ 6	1.00	1.01	$ 526	$ 520	90%
1.05C.03	Infrastructure for Citizen Science	$ 125	$ 124	$ 154	$ (1)	$ (30)	0.99	0.80	$ 282	$ 311	44%
1.05C.04	Classroom / Online Research Toolkit	$ 579	$ 562	$ 486	$ (18)	$ 75	0.97	1.15	$ 2,057	$ 2,015	27%
1.05C.05	Visualization including Science Museums	$ 460	$ 410	$ 488	$ (50)	$ (78)	0.89	0.84	$ 856	$ 976	48%
1.05C.06	User Interfaces	$ 502	$ 488	$ 503	$ (14)	$ (15)	0.97	0.97	$ 2,130	$ 2,156	23%

Outline

– Overview

– Achievements + Remaining Work

– Cost and Schedule

– **Risks and Opportunities**

– Conclusions
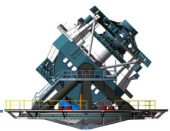
Risk & Opportunities

Risk Management / Rich Filter Controller

Risk Management / Risks

Exposure   Response   Dates   People

T	LR	Key	Components	Summary	Status
⚠	< 30 DAYS	RM-805	Education and Public Outreach	Loss of key EPO personnel	ACTIVE RISK/OPPOR...
⚠	< 30 DAYS	RM-808	Education and Public Outreach	EPO software development effort underestimated	ACTIVE RISK/OPPOR...
⚠	< 30 DAYS	RM-804	Education and Public Outreach	EPO and DM Integration Incompatibilities	ACTIVE RISK/OPPOR...
⚠	< 30 DAYS	RM-803	Education and Public Outreach	EPO user interface too complex	ACTIVE RISK/OPPOR...
⚠	< 30 DAYS	RM-806	Education and Public Outreach	Required EPO software packages not available	ACTIVE RISK/OPPOR...
⚠	< 30 DAYS	RM-807	Education and Public Outreach	EPO security vulnerabilities discovered late	ACTIVE RISK/OPPOR...
⚠	< 30 DAYS	RM-802	Education and Public Outreach	EPO external standards change	ACTIVE RISK/OPPOR...

7 filtered issues (900 hidden)

Risk Management / Triggering Soon

Risk Management / Current Filter Risk Exposure

7
Issue Count

530.3
Σ Probability Weighted Exposure (Current K$)

456.35
Σ Probability Weighted Exposure (Current K$) After Mitiga...

7 filtered issues (242 hidden)

Risk Management / Risk Review Dates

0	**0**	**7**
> 60 DAYS	30-60 DAYS	< 30 DAYS

- There are a total of 7 Risks
- EPO follows same risk procedure/policy as rest of project

Outline

- Overview
- Achievements + Remaining Work
- Cost and Schedule
- Risks and Opportunities
- **Conclusions**

Conclusions

- EPO is functioning well

- We are making good progress with development schedule

- Healthy CPI and SPI

- Looking forward to user testing of educational investigations

- Ongoing integration with DM, Commissioning, Operations Planning

- Upcoming effort towards hiring will maintain EPO team at the right size and with the right skills to continue executing plan.

M1M3 approaching Cerro Pachon
Photo: LSST Project/NSF/AURA
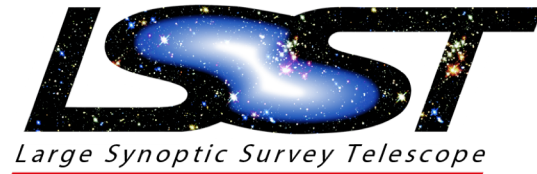
Amanda Bauer
Head of LSST EPO (AURA/LSST)
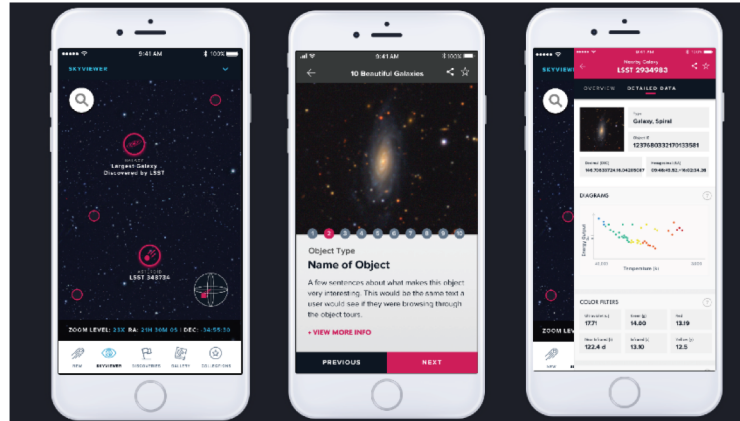
Thank you!

EPO Recommendations from JSR2018

Seat an advisory group that includes elementary and middle school education specialists and/or curriculum developers and explore with them LSST EPO products targeting elementary and traditional middle school students that can be developed and integrated into the EPO work plan.

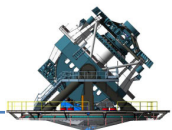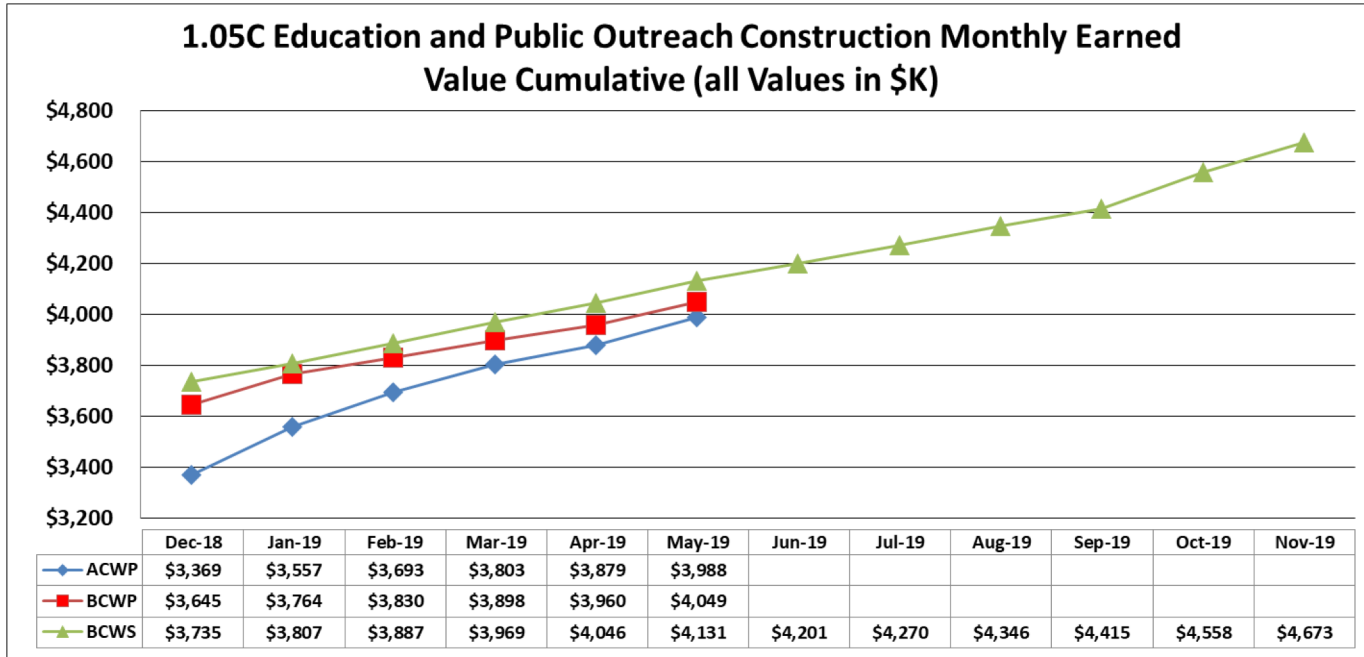- We agree that an advisory committee is a potential benefit to the EPO effort and we are preparing to set one up. We feel that including elementary and traditional middle school education specialists on the panel would not be an appropriate use of the time of those individuals. Those student group are not part of our target audiences and any activities focused on them that are distinct from what we are already planning would be adding scope to the EPO Project, which we cannot do at this time.
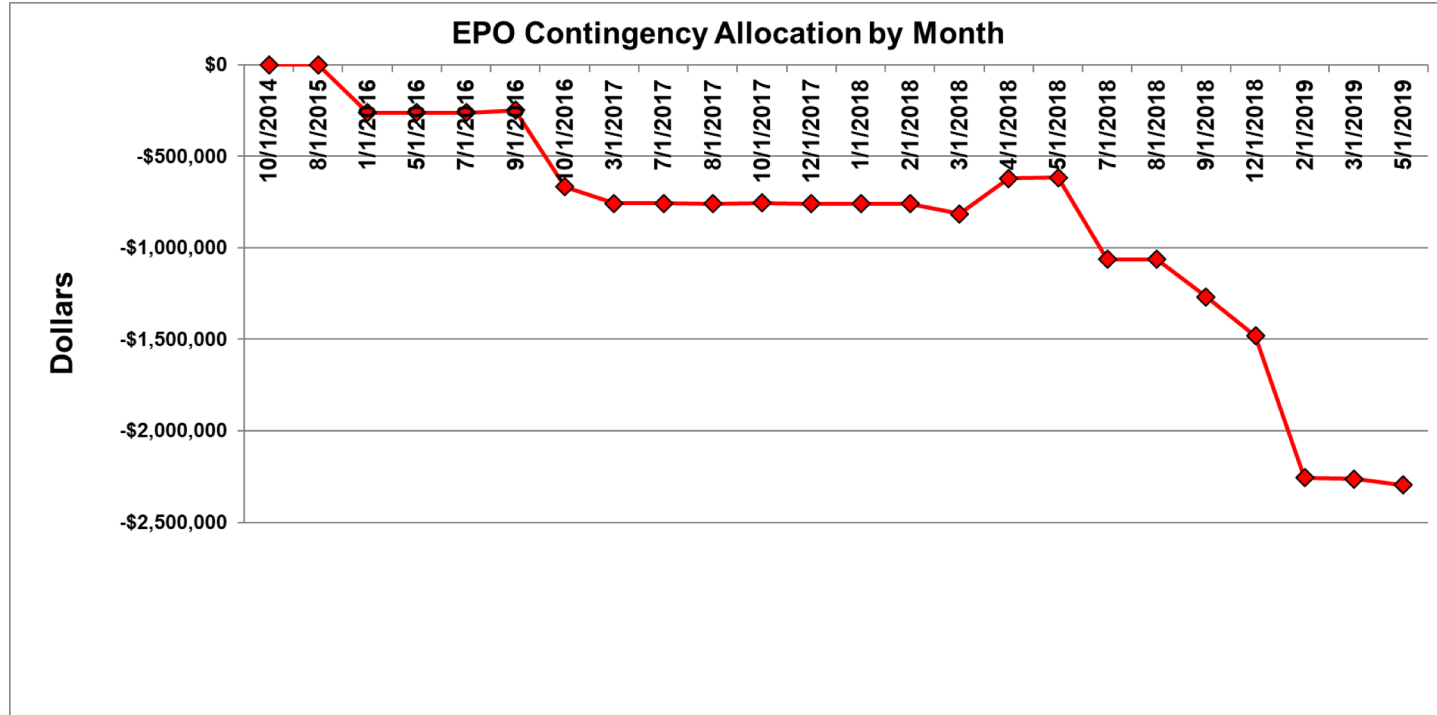
Understanding user needs and characteristics is critical to LSST EPO success. The EPO team should engage with education researchers focused on teaching and learning with big data to inform the construction of EPO data collection infrastructure, and analysis practices.

- We agree that the field of education research and the emergence of teaching with big data is important and that LSST may have potential to be part of this. Prior to Operations, EPO will engage in discussions with education researchers to understand more about their work and needs and then evaluate the appropriate way, if any, to be involved. EPO is committed to evaluating deliverables and components. The purpose of evaluation is to determine the extent to which program outcomes are achieved and improve program functioning (National Science Foundation; W.K. Kellogg Foundation; Pell Institute). EPO recognizes that this is different from the purpose of education research which uses rigorous methods and "seeks to describe, understand, and explain how learning takes place throughout a person's life and how formal and informal contexts of education affect all forms of learning" (American Education Research Association).

EPO SPA Chart

1.05C Education and Public Outreach Construction Monthly Earned Value Cumulative (all Values in $K)

	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19
ACWP	$3,369	$3,557	$3,693	$3,803	$3,879	$3,988						
BCWP	$3,645	$3,764	$3,830	$3,898	$3,960	$4,049						
BCWS	$3,735	$3,807	$3,887	$3,969	$4,046	$4,131	$4,201	$4,270	$4,346	$4,415	$4,558	$4,673

EPO Contingency Allocations

EPO Cost Summary WBS Lvl 4

| WBS | DESCRIPTION | CUMULATIVE TO DATE ($k)   31 May 2019 | | | | | | | | | | |
| | | BUDGETED COST | | ACTUAL | VARIANCE | | PERFORMANCE | | AT COMPLETION | | | |
		WORK SCHEDULED	WORK PERFORMED	COST OF WORK PERFORMED	SCHEDULE	COST	SPI	CPI	BAC	EAC	% COMP
1.05C	Education and Public Outreach Construction	$ 4,131	$ 4,049	$ 3,988	$ (82)	$ 61	0.98	1.02	$ 9,185	$ 9,223	44%
1.05C.01	System Management	$ 1,991	$ 1,991	$ 1,888	$ -	$ 103	1.00	1.05	$ 3,334	$ 3,245	60%
1.05C.01.01	System Management	$ 1,991	$ 1,991	$ 1,888	$ -	$ 103	1.00	1.05	$ 3,334	$ 3,245	60%
1.05C.02	EPO Database and Data Access Services	$ 474	$ 474	$ 468	$ -	$ 6	1.00	1.01	$ 526	$ 520	90%
1.05C.02.01	EPO Database and Data Access Services	$ 474	$ 474	$ 468	$ -	$ 6	1.00	1.01	$ 526	$ 520	90%
1.05C.03	Infrastructure for Citizen Science	$ 125	$ 124	$ 154	$ (1)	$ (30)	0.99	0.80	$ 282	$ 311	44%
1.05C.03.01	Infrastructure for Citizen Science	$ 125	$ 124	$ 154	$ (1)	$ (30)	0.99	0.80	$ 282	$ 311	44%
1.05C.04	Classroom / Online Research Toolkit	$ 579	$ 562	$ 486	$ (18)	$ 75	0.97	1.15	$ 2,057	$ 2,015	27%
1.05C.04.01	Classroom / Online Research Toolkit	$ 579	$ 562	$ 486	$ (18)	$ 75	0.97	1.15	$ 2,057	$ 2,015	27%
1.05C.05	Visualization including Science Museums	$ 460	$ 410	$ 488	$ (50)	$ (78)	0.89	0.84	$ 856	$ 976	48%
1.05C.05.01	Visualization including Science Museums	$ 460	$ 410	$ 488	$ (50)	$ (78)	0.89	0.84	$ 856	$ 976	48%
1.05C.06	User Interfaces	$ 502	$ 488	$ 503	$ (14)	$ (15)	0.97	0.97	$ 2,130	$ 2,156	23%
1.05C.06.01	User Interfaces	$ 502	$ 488	$ 503	$ (14)	$ (15)	0.97	0.97	$ 2,130	$ 2,156	23%