



# Applied Science and Innovation

- **Intro:** Martin Ratcliffe, Cohen Honors Faculty Fellow in Applied Learning
- Our Solar Siblings program – research experience for undergraduate students
- Bethel Observatory
- Connection with other college observatories
- Teaching scientific image science using astronomy

# Research Experience

## Week 1 - Introduction to the Research Experience

Goals for the week:

A) Watch the videos to get a very quick overview of 1) How research knowledge is recorded and what is important to scientists and 2) telescopes, light, colour and cameras. You are not meant to know anything in great exquisite detail at the moment, but a broad 'feeling' is enough! For the astronomy content, there are chapters in the OpenStax textbook. For the more nebulous ideas around how research is done, there are a few current articles provided.... there is lots of debate about the research, publication and review process at the moment! So it is hard to provide the 'consensus' view of how science "works".

B) Request an image (or use one of the samples provided) and make a pretty colour image using [Fits Liberator](#) and GIMP (or Photoshop if you have it). Sure, pretty colour images are not 'research' but i) you will get a feel for the data but manipulating and stretching it and ii) your actual publication will require a colour image anyway! So it is a skill that observational astronomers do have.

**PLEASE** ask questions or put up useful articles / videos / etc. in the discussion forum above OR attend the [office hours](#) where we can help you out and discuss/present any of the content.

-  [Suggested Readings/Watchings for the week](#)
-  [Introduction to the Research Experience](#)
-  [\(OPTIONAL\) Instructions to find an object to observe](#)
-  [Preparing astronomy images with Fits Liberator](#)
-  [Making the final colour image using GIMP](#)
-  [Making the final colour image using Photoshop](#)
-  [Some tutorial videos for colour imaging \(FL, GIMP/Photoshop\)](#)
-  [Online Wall to Share your Colour Image!](#)

Please share your colour image when you have completed it.

-  [Link to sample images for practice](#)



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## Online Courses for Teachers, Students and the Public

-  [Night Sky to the Universe](#)
-  [Star Cluster Depth Study](#)
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Four Students use international remote observatory network – Las Cumbres Observatory

# Las Cumbres Observatory



Las Cumbres Observatory

MANY EYES - ONE VISION

ABOUT FOR EVERYONE FOR ASTRONOMERS OBSERVING PORTALS



twenty-three telescopes  
at seven sites around the world  
working together as a single instrument

a global telescope network

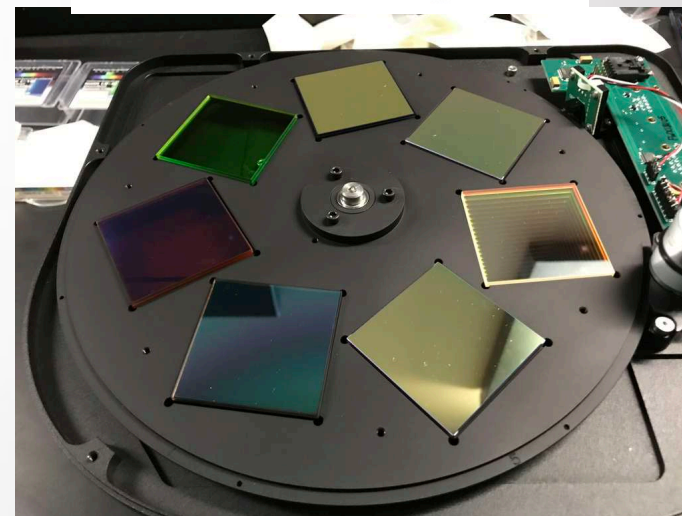
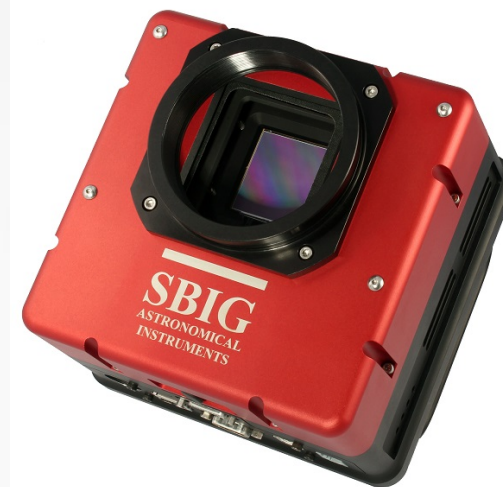


# Online learning – who knew!!!

A screenshot of a Moodle course page. The page has a dark blue header with the course title '12 Week Research Cou ...' in a white, cursive font. A search bar labeled 'Search Courses' is in the top right. Below the header is a navigation bar with icons for Home, Dashboard, Events, My Courses, and This course. On the right of this bar are 'Hide blocks' and 'Standard view' options. The main content area shows a breadcrumb trail: 'My courses &gt; 12WRC-2nd2019\_1'. The content is organized into three sections: 'Announcements', 'General Discussion Forum', and 'Office Hours'. The 'General Discussion Forum' section contains a paragraph of text. The 'Office Hours' section contains a paragraph of text. The 'General Astronomy Reference Book' section contains a paragraph of text. On the right side, there is a 'Navigation' sidebar with a list of links: Home, Dashboard, Site pages, My courses (expanded to show 12WRC-2nd2019\_1), Participants, Badges, Competencies, Grades, General, Week 0 - Orientation and Installation, and Week 1 - Introduction to the Research Experience.



# Bethel College Observatory



# Building a curriculum

- Connecting with other colleges:
  - Talk to Penn State Photography class
  - Bethel Summer Science Academy →
  - Curriculum materials from:
    - BYU Utah
    - Edith Cowan University, Australia
  - Connections through American Astronomical Society
  - Using similar telescopes and developing skills of students in imaging and photometry.





## Inviting Citizen Scientists to Observe Transiting Exoplanets

Exoplanet Watch is a citizen science project to observe transiting exoplanets, planets outside of our solar system, with small telescopes. A [transiting exoplanet](#) is one that periodically passes in front of its host star, causing the star to slightly dim (~1%). Observing exoplanet transits are important as they allow us to directly measure the planet's radius and composition. Exoplanet Watch will directly help increase the efficiency of large telescopes by decreasing the uncertainty in the predicted time of a transit event.

Exoplanet Watch will:

- **Ensure Efficient Use of Large Telescopes** - more accurately predict the next transit event for follow-up with large telescope (e.g., HST, JWST, and ARIEL)
- **Discover New Exoplanets** - using transit timing variations to infer the existence of an additional exoplanet in a Extrasolar System
- **Search for Blended Pairs** - spatially-resolve a field to confirm the radius of a newly-discovered exoplanet
- **Monitor Stellar Variability** - spots and plages of a host star can alter the observed exoplanet's signal
- **Confirm New Exoplanets** - can help confirm newly-discovered exoplanets