



# Meet Inquiry National Standards with High School Research Projects



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The **National Science Education Standards (NSES)\*** are a set of guidelines for science education in primary and secondary schools in the United States. They provide goals for teachers and are used to guide instruction. The inquiry standards A1 and A2 are met by the NASA/IPAC Archive Research Program (NITARP). Specifics on how NITARP meets standard A.1 is described in detail in this poster.

## National Standard A.1

### Abilities necessary to do scientific inquiry

- Identify questions and concepts that guide scientific investigations.
- Design and conduct scientific investigations.
- Use technology and mathematics to improve investigations and communications.
- Formulate and revise scientific explanations and models using logic and evidence.
- Recognize and analyze alternative explanations and models.
- Communicate and defend a scientific argument.

## The NASA/IPAC Teacher Archive Research Program (NITARP)

NITARP involves educators in authentic astronomical research. Small groups of educators are partnered with professional astronomers to conduct original research projects with their students.

- Astronomers help teachers select appropriate research questions

2012 Astronomer Advisors	Affiliation
Dr. Luisa Rebull	Spitzer Science Center
Dr. Ranga Ram Chary	Planck Science Center
Dr. Varoujan Gorjian	Spitzer Science Center
Dr. Michael W. Werner	Jet Propulsion Laboratory
Dr. David Ciardi	NExScI
Dr. Steve Howell	NASA/Ames Research Center
Dr. Don Hoard	Max Planck Institute

Websites with research projects/questions appropriate for high school students: NITARP: <http://nitarp.ipac.caltech.edu>, and ARBSE: <http://www.noao.edu/education/arbse/arpd>



- Teachers do background research, write and submit research proposals which are reviewed.

### Past Research Projects done by High School Students through NITARP (2010 – 2012)

- Categorize ultra-blue objects in the Kepler field of view
- Use infrared data to identify young stellar objects (YSOs)
- Study period vs. temperature of variable stars in the Kepler field of view
- Identify cluster members surrounding active galactic nuclei (AGN)
- Characterize mid-infrared stellar variability
- Determine the infrared luminosity of active galactic nuclei
- Characterize the dust disk obscuring the companion B star of eps Aurigae
- Identify star forming regions in dark nebulae

\*NITARP meets many more national science education standards; A.1 was chosen as the focus of this poster due to its emphasis on inquiry.

\*New National Science Standards are currently being written. The Next Generation Science Standards (NGSS) are based on the new science framework which can be viewed at [http://www.nap.edu/catalog.php?record\\_id=13165](http://www.nap.edu/catalog.php?record_id=13165). NITARP will fulfill all dimension 1 scientific practices in the NGSS.

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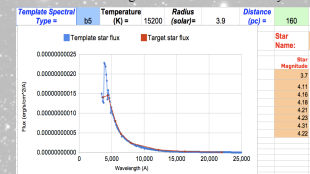
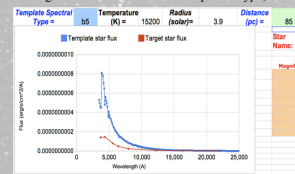
### c. Students and Teachers utilize:

- Many computer applications: Word, Excel, PowerPoint, Skype, NITARP wiki, Join.me screen sharing.
- Variety of astronomy tools: Aperture Photometry Tool, SED generator, ds9, Finder Chart, IRAF, NExScI periodogram tool.

Student and Teacher working with IRAF



SED generator used to determine spectral type, distance and radius. Online at: [collegeofsanmateo.edu/astronomy/seds.asp](http://collegeofsanmateo.edu/astronomy/seds.asp)



Poor match: incorrect spectral type, radius and/or distance

Good match: likely spectral type, radius and distance

- Myriad of Astronomy Archived Databases: SIMBAD, WISE, IRSA, Kepler, 2MASS, NASA Exoplanet Archive, MAST, Spitzer Heritage Archive, NED, GALEX, FinderChart, and Planck.



- Teams hold regular meetings via telecom during the year long program to share results, discuss progress, and determine next steps.

Teams meet for 3 days in the summer to work, refine and discuss research, to discuss what was learned, and to determine next steps.



- Rarely do research projects go smoothly; results lead to discussions, realignment and modifications.

"If I knew what I was looking for this would be much easier."

- Teams produce a scientific poster and a separate education poster that are presented at the January American Astronomical Society (AAS) meeting. All team members (students and teachers) discuss and share their results with the astronomical community.

