# Alignment of NITARP Components to Next Generation Science Standards

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## Abstract

The NASA/IPAC Teacher Archive Research Program (NITARP) provides a year-long research experience for secondary educators and their students. High school students work alongside educators and research scientists to formulate research proposals, analyze NASA archival data, and present their findings at an academic conference. NITARP is one of the few programs that allows secondary students to conduct real astronomical research in an authentic research setting. The Next Generation Science Standards (NGSS), developed in 2013, provide a national framework for forward-thinking science education in the United States. By aligning the NITARP experience and goals with the NGSS, we present how NITARP provides an authentic and engaging application of the these standards for secondary students. We show through analysis of skills used by secondary science students that through participation in NITARP, students make progress on a broad range of standards. Combined with self-reported student surveys, we are also able show that student views toward science and science research change when students have worked for approximately a year as NITARP participants.

## NGSS Standard and Link to NITARP Work

HS ESS1-3: *Communicate Scientific ideas about the way stars, over their life cycle, produce elements*
This standard is addressed by students studying and explaining how various astrophysical phenomena produce light, and for our work, how various astrophysical processes could produce an excess of energy emitted in the infrared as compared to blackbody emissions.

HS PS4-1:*Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.*
This standard is addressed in the science work we did as we worked together towards our final product as a broad team, specifically as we considered what kind follow-up work would be required to strengthen our results.

HS PS4-2: *Evaluate questions about the advantages of using digital transmission and storage of information.*
This standard is addressed while students worked with remotely collected, archival data.

HS PS4-4: *Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.*
This standard is addressed when the students had to demonstrate their understanding of the data collected by the two cameras on the Spitzer Space Telescope.

HS PS4-5: *Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*
This standard is addressed when students studied background information as well as when they were building their understanding how the Spitzer Space Telescope works to collect data.

HS PS1-8: *Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.*
This standard is addressed by students when studying the stellar-life cycle as part of background study. Students were responsible for learning concepts covered in seminal peer-reviewed articles on various objects in an effort to help them better understand what we might be looking at.

HS PS2-6: *Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.*
This standard is addressed in study of the different behavior of the two cameras' data we used for our project. Students were consistently having to evaluate whether various data were different or just detected differently as well as considered the constraints on the design of the Spitzer Space Telescope.

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## Teacher Reported Results

- Students have come to realize that science isn't just a class, it's something you do
- Teachers have incorporated new methods of running labs as well as new data analysis tools
- A student who intended to seek further involvement in STEM fields deepened his wish to do so, based on his experience at Caltech in NITARP
- Students are able to discuss scientific concepts more easily
- "NITARP has changed my life, I can't imagine not doing things like this in the future"
- A student who intended before NITARP to be involved in astrophysics professionally reported that the program confirmed for her that her goal is the right one for her
- Several students have articulated that their understanding of the breadth of STEM fields has widened
- Students have strengthened their grasp of both scientific language and concepts

## Conclusion

We conclude that the NITARP is well aligned to the goals of NGSS. Students in NITARP have exposure to a wide variety of scientific concepts and applications. Further research would include drawing deeper connections between NGSS and Common Core Mathematics concepts.