Reach for the Stars: Authentic Astronomical Research in Middle School

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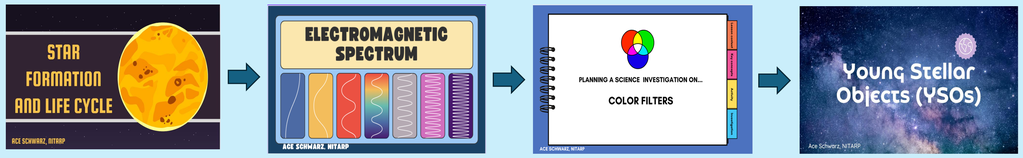
What are NITARP and BINAP?

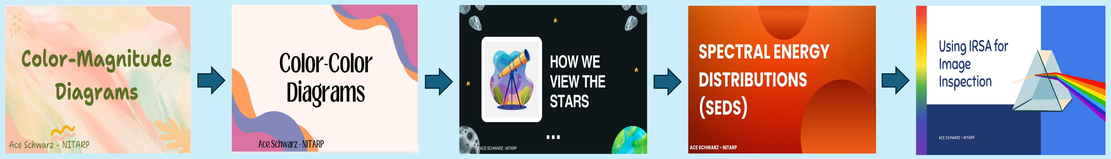
The NASA/IPAC Teacher Archive Research Program (NITARP) pairs middle and high school educators with a mentor astronomer to complete an astronomical research project. While students can be involved in the research, this program is designed for teacher professional development and growth. Previous research indicates that participation in NITARP contributes to positive impacts in science education in participants' schools and outside environments as well (Rebull et al., 2018).

After participants finish the program, they have the option to join the Big NITARP Alumni Project (BINAP). The goal is to provide deliverable, "bite-sized" NITARP lessons that are accessible for teachers who don't necessarily participate in the program but would benefit from authentic astronomical data/research. These lessons and other resources are housed on NITARP's Cool Wiki page (see QR code below). They are free to access and share to our diverse pool of alumni and non-NITARP educators.

Scope and Sequence of Lessons



When planning the scope and sequence, we used backwards mapping to identify the end goal. For students to complete a small-scale project about YSOs, students must understand star formation, the electromagnetic spectrum, and color filters. Each lesson has lab activities to scaffold the content for middle school level.



This second set of lessons focuses on the application of the lessons above to help find and understand characteristics of YSOs. Once students complete these lessons, they can interpret various diagrams and use the IRSA suite of tools to explore regions of the sky. Rather than create color-magnitude, color-color, or SED diagrams, the emphasis for middle school is on analysis of these components.

Our Project Goals

During the 2023 cohort, Rebull et al. completed research on identifying young stellar object (YSO) candidates in five obscure Sharpless regions. To help other teachers replicate smaller versions of this project, BINAP created a suite of lessons for high school. This poster explores the work of "translating" the high school lessons to a middle school level. We wanted middle school students to have a similar experience, but we needed to provide more scaffolding and labs to help them grasp challenging content in an age-appropriate way. There is often a noticeable gap in access to middle school level materials within astronomical research and projects. The majority of curriculum focuses on basic concepts like star formation, objects in the universe, etc., but does not engage students in complex research. Students learn best when they can interact with authentic data because it allows them to draw their own conclusions and apply concepts in real-world contexts (NSTA).

Considerations taken:

- Lengthening presentations to fully explain vocabulary
- Include more examples of SEDs, color-color, and color-magnitude diagrams
- Additional lab and writing activities to concretize concepts
- Step-by-step modeling of color filter lab and IRSA image inspection
- Bright, engaging presentation backgrounds

Samples of the Rebull 2023 research poster (Kuper et al.).
Left: Sharpless regions researched.
Right: Data table for YSO candidates in each region.

Region (Sh 2-xxx)	# YSO lit candidates	# YSO candidates we identified	# YSO candidates to check	# YSO candidates surviving checks
192/3/4	12	5	16	8
163	0	37, +12 more based on optical CMDs	49	31
306/309	138	110	193	119
135	177	108	236	130
187	0	51, +11 more based on optical CMDs	62	45
137	0	33	33	2

What's Next?

The lessons have been published on the NITARP Cool Wiki Page along with a feedback form. BINAP will meet to review the feedback and adjust the lesson content as needed. There are also plans to meet during the summer of 2025 to create lessons about active galactic nuclei, which is based on the work of another NITARP team lead by Dr. Varoujan Gorjian of JPL.

To get the word out about the lessons, NITARP and BINAP educators are presenting at various science education conferences including the National Science Teacher Association's (NSTA) national conference in March 2025.

Scan the QR code to access both high school and middle school lessons. There is also a Google Form to give us feedback!

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