Name: _____ **School:** _____

Grade or Level: _____ **Lesson Plan #:** _____ **Date:** _____

Finding Supernovae Class Project

Object

The object of this classroom exercise to involve students in the actual astronomical research for significant events occurring in our galaxy. The task is to help astronomers catch exploding stars – supernovae. Data is provided by an automatic survey in California, with images from the 1.2 m Samuel Oschin telescope. Astronomers are ready to follow up on the best candidates at some of best telescopes around the world.

Related URL's:

- http://www.space-exploratorium.com/supernova.htm
- https://www.zooniverse.org/project/supernovae
- http://www.youtube.com/watch?v=l_e7n7M1ufE
- http://www.astro.caltech.edu/ptf/

Curricular Connections: (QCC/IEP/Local or National Standards):

_____

Pre-teaching for Background Knowledge and Terminology

To do this student activity students should know what the following terms mean. Students should have an adult help you search the internet, or take them to a local library to find out more!

- Supernovae
- Palomar Transient Factory
- Shane Telescope at the Lick Observatory
- W. M. Keck Observatory
- William Herschel Telescope
- Palomar Hale Telescope

Questions

1. What is a Supernova?
2. How long does the maximum light output of a Supernova last?
3. Why is it important to detect a supernova as early as possible?

Materials and Equipment Needed by the Students

Access to computer connected to the internet.

Experimental Procedure

This project is conducted by Galaxy Zoo and is a Zooniverse project. To participate the students will become a Galaxy Zoo Partner. The mission is to look for anything that's changing in the sky — whether it's the flaring of a variable star, an asteroid moving across the sky, the flickering of an active galaxy's nucleus or a supernova. Supernovae are the primary focus of this project.

The Palomar Transient Factory's wide-field 48 inch telescope at the Palomar Observatory is used to take images of the same target area repeatedly over a 5-day period. "Suspect" images are transferred via a high speed network to the National Energy Scientific Computing Center (NERSC) at the Lawrence Berkeley National Laboratory. An older "reference" image is also generated.

The two images are photometrically matched using specialized software. The "reference" image is subtracted from the "suspect" image producing an image that just shows what's different between the two images. Additional filtering is performed on the images and candidate images are passed on to the Galaxy Zoo for human classification.

These images are than sorted by students (and others) using a short decision tree and the resulting classification is sent back to the Galaxy Zoo and made available to the science team. These classifications generally occur within a few hours of the images being made available.

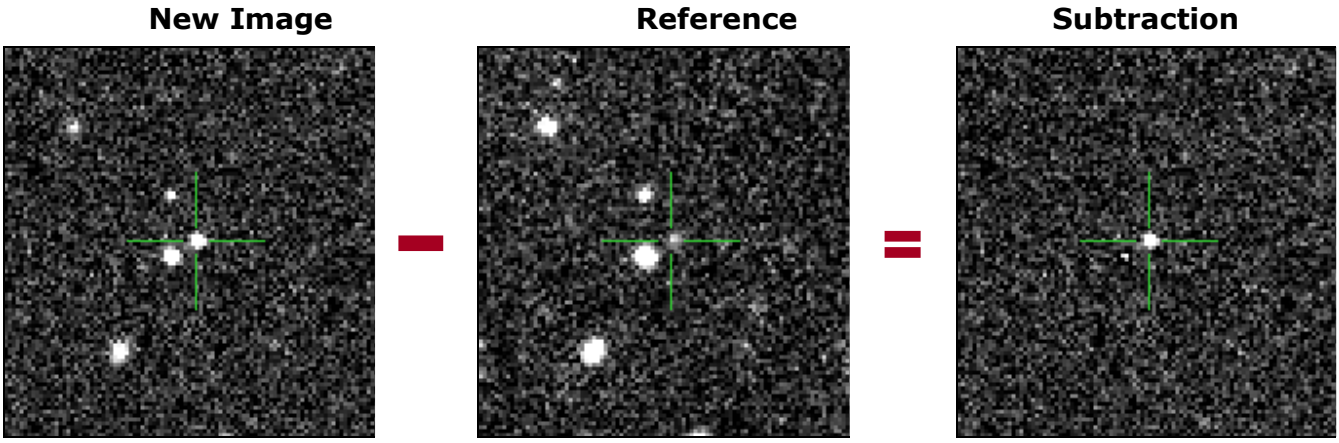
The correlation of the Galaxy Zoo volunteer classifiers vs. professional classifiers is very high.

How to Take Part: The student task is to hunt for new supernovae in images taken by the Palomar Transient Factory. They observe the same patch of sky roughly once every five days, and the student's task is to look for changes.

The student will always be given three images: a new image, a reference images and a subtraction image.

The new image is the most recent, usually taken just a few hours ago. The reference image is the result of several observations added together; this is what this bit of sky normally looks like.

The subtraction image is the new image minus the reference image. Any differences between the two - like a new supernova - will show up most clearly here.



The task is to search through the candidates found by Palomar Transient Factory (a fully-automated, wide-field survey aimed at a systematic exploration of the optical transient sky). Once your results are in, Palomar Transient Factory will organize observations on various telescopes around the world to follow up the best of our discoveries. These facilities include the 4.2m William Herschel Telescope at the Roque de los Muchachos Observatory on the Canary Island of La Palma, the Shane 3m telescope at the Lick observatory, the 5.1m Palomar Hale telescope in Southern California, and, on occasion, the mighty 10m twin Keck telescopes on the Big Island of Hawai'i. As astronomers follow-up the discoveries, they'll keep the students up to date on the galaxy zoo blogs and forum.

To see a YouTube video explaining the Palomar Transient Factory, go to:
http://www.youtube.com/watch?v=l_e7n7M1ufE

Classroom results: This project requires decisions on the student's part as to what classification the resulting subtraction images fit into. These classifications are subjective and prone to misclassification. The best way to improve accuracy is for several students to independently make their classifications and average their results into a team classification. Once this is accomplished the results should be posted to the Galaxy Zoo for further analysis by professional astronomers.

Astronomical Observers Log

Observers Name: _____ Observation Date: _____

Observation Instrument: _____ Target of Observation: _____

Significant Observations:

Type of Event:	Date and Time Range:	Observer's Comments:

Project Lesson Assessment

When this project is completed the students should be able to answer these questions:

1. What is a Supernova?
2. How long does the maximum light output of a Supernova last?
3. Why is it important to detect a supernova as early as possible?

Assessment Data:

	# at 30%	# at 30 to 70%	# at 70%+
What is a Supernova?			
How long does the maximum light output of a Supernova last?			
Why is it important to detect a supernova as early as possible?			

Teacher Assessment Results Summary:

Does this lesson need to be re-taught? _____YES _____NO

What portion of the lesson was most effective and why?

_____

_____

What portion of the lesson was least effective?

_____

_____

What would most improve the learning of that portion of the lesson?

_____

_____

_____

_____

_____

What I will do to re-teach this portion:

_____

_____

_____

When I teach this full lesson next time, I will:

_____

_____

_____

_____