NASA

Challenge

TWINKLE, TWINKLE, LITTLE STAR

The Challenge

The stars above are constantly changing, but usually these changes are too slow or too faint for the eye to see. Your challenge is to develop a learning tool to teach people about stellar variability and help them understand how dynamic the night sky really is!

Background

For thousands of years, humans have observed that the brightness of stars varies; for example, we can see stars twinkling from the ground. Stars appear to twinkle because turbulence in Earth's atmosphere interferes with the starlight as it travels to the planet's surface. But since the development of telescopes, astronomers – both amateur and professional – have been studying other subtler and slower ways the brightness of stars can vary.

Scientists have identified many thousands of variable stars and countless more are yet to be discovered. Some stars vary intrinsically – that is, their actual brightness increases and decreases. These variations can be regular: our Sun varies by about 0.1% across its 11-year Solar Cycle, while some Cepheid variables can double their brightness over the course of a week! Intrinsic variation can also be irregular or semi-regular due to flares or explosive events. Some stars vary extrinsically – that is, something external causes their apparent brightness to change. Eclipsing binary stars provide one example of extrinsic variation when one star in the binary star system passes in front of the other and blocks its light.

Thanks to satellites such as the Kepler Space Telescope and the Transiting Exoplanet Survey Satellite, NASA has monitored many thousands of stars for years and there is a rich sampling of stars whose variability has been measured. However, since these variations are typically small and slow and the stars are faint, people can't just look up in the night sky and see these changes.

Objectives

Your challenge is to develop a tool to help people learn about stellar variability—how and why the stars in the night sky change. Think about the best way to communicate this knowledge to your audience. Perhaps you'll create a game or visualizer that allows people to see star variations using data from NASA missions, or a curriculum that uses existing data and educational resources to teach students about stellar variability. Don't forget the most effective learning tools provide an enjoyable *and* educational experience for players/students!

Potential Considerations

As you design your project, you may (but are not required to) consider the following:

- The goal of this challenge is to help people understand that the stars in the night sky are always changing, but usually too slowly or by too little for the eye to see. How would *you* want to be shown this information?

- Real data are available for many stars (see Resources tab at the top of the page), but some kinds of variability–such as that due to rare explosive events–do not appear commonly. You could model such events and use a combination of real and simulated data in your solution.
- If you develop a visualizer, you could show just one star or a whole field of stars, as long as you show each star's variation.
- A visualizer could start with data from NASA satellites and produce a simulated star map, and then speed up and amplify the variations so that they are visible. The assorted kinds of stars would be noticeably different based on what kind of variations they have.
- A visualizer could allow the user to create simulated customized stars with different kinds of variability, different spectral types and colors, different amounts of variation, or different timescales of variation, etc.
- A game version of a visualizer could allow players to adjust their own personal stars and show how the resulting stars would look, or could display a field of stars and ask people to indicate the ones that vary the most, the fastest, etc.
- A curriculum solution could consist of materials that show examples of variable stars and explain *how* they vary and *why*. Building on this curriculum, a game could show a player a 'training set' of examples and then show an actual star's variations and ask the player to deduce what is causing the variation.
- For additional resources you may use your favorite search engine to search keywords such as:
    - Transiting Exoplanet Survey Satellite (TESS)
    - Stellar variability

For data and resources related to this challenge, refer to the Resources tab at the top of the page. More resources may be added before the hackathon begins.

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