

Guide for “Changing Brightness” *(Teacher Resource)*

Some students may not have a great deal of experience with the concept that the brightness of an object can change over time. Low vision students are likely to understand this concept as being associated with extreme changes in brightness such as lights on or off in a room, sky brightness changing from day to night or a flashlight held at a distance. Understanding the change in the brightness of some objects in the sky, which may not be visible without the aid of a telescope, may be more difficult. IDATA is very interested in how BVI students perceive the concept of brightness so don't hesitate to send your observations to anyone on the Education Team!

Brainstorm with students the following topics related to the concept of changing brightness in astronomy:

1. Why would objects vary, or change brightness?
 - a. First, define as a group what you mean by change or vary
 - b. What sort of timescales can brightness changes occur?
 - i. A single night?
 - ii. Between different nights?
 - iii. Months?
 - iv. Years?
 - v. What about shorter than a single night? What about hours, or even minutes or seconds?
 - c. What could cause this change in light intensity? Let them come up with any idea, no matter how wild, black holes, aliens? Some possible answers are listed below but we are most concerned with generating ideas. If you have a group of students who have limited prior astronomy knowledge, start with familiar changes in brightness and ask the question “Can you imagine something similar happening to an object in space?”
 - i. Gives off different amounts of light radiation because it gets bigger and smaller (like a variable star which grows and shrinks periodically due to nuclear fusion rates of different elements)
 - ii. Has a spot in its rotation that emits a beam of energy -- think of a lighthouse. (Pulsar?)
 - iii. Has something passed in front of it (like a planet, or another star if in a binary system)
 - iv. Nova or Supernova explosion (there are different kinds)
 - v. Has some kind of eruption that happens once or irregularly

- vi. Shifts between energy emissions in different wavelengths so seem to get brighter and dimmer if you're looking at a specific color/wavelength
 - vii. Reflecting light in a non-uniform way
 - viii. Gets closer and further from earth.
2. What are some objects that could vary?
 - a. Stars
 - b. Galaxies
 - c. Planets
 - d. Asteroids
 - e. Comets
 - f. Anything else?
 3. The last question for the journal is to list ways in which this light can be measured. This will be an opportunity for them to start thinking about models, which will be more fully developed in the next Part.
 4. Additional things you might have them do:
 - a. Research - Once they have a list, have different groups do a quick research on the different objects and do a short report on each.
 - b. Image - You may want to have your students request images from Skynet of different objects. If you find yourself short of credits, please email Kate.

Credits: **Innovators Developing Accessible Tools for Astronomy (IDATA)**, officially known as *Research Supporting Multisensory Engagement by Blind, Visually Impaired, and Sighted Students to Advance Integrated Learning of Astronomy and Computer Science*, and the resulting curricular resources, Afterglow Access software, and project research were made possible with support from the U.S. National Science Foundation's STEM+C program (Award 1640131). IDATA institutional collaborators include AUI, GLAS Education, Linder Research & Development Inc., Logos Consulting Group, TERC, University of Nevada – Las Vegas, University of North Carolina at Chapel Hill, and Universidad Diego Portales. Individual consultants on the project include Kathy Gustavson and Alexandra Dean Grossi. IDATA Teacher collaborators in the U.S. include Amanda Allen, Jacqueline Barge, Holly Bensel, Neal Boys, Tim Fahlberg, Kristin Grender, David Lockett, Matthew McCutcheon, Caroline Odden, Michael Prokosch, Kara Rowbotham, Rick Sanchez, and Barbara Stachelski. IDATA Student collaborators in the U.S. include Evan Blad, Naleah Boys, Ellen Butler, Jayden Dimas, Riley Kappell, Joseph Murphy, Logan Ruby, Alex Scerba, Charlize Sentosa, Meg Sorensen, Remy Streichenberger, Trevor Warren, and others. IDATA Undergraduate Mentors include Tia Bertz, Katya Gozman, Chris Mathews, Kendall Mehling, Andrea Salazar, Ben Shafer, Alex Traub, and Sophia Vlahakis. Special thanks to the IDATA external advisors including Nic Bonne, Al Harper, Sue Ann Heatherly, Russ Laher, Luisa Rebull, Ed Summers, and Kathryn Williamson.