William M. Staerkel PLANETARIUM

*Teacher's Guide to*

# "Dark Matter Mystery"

**OBJECTIVES:**

- To show how gravity can be used to infer objects exist in space (e.g. Neptune)
- To illustrate the case for the existence of Dark Matter from a historical perspective
- To describe current research looking to identify Dark Matter

This show conforms to the following NGSS: 5.PS2.1, MS.ESS1.2, HS.ESS1.2, HS.ESS1.4

**BRIEF SHOW DESCRIPTION:**

What keeps Galaxies together? What are the building blocks of the Universe? What makes the Universe look the way it looks today? Researchers all around the world try to answer these questions. We know today that approximately a quarter of the Universe is filled with a mysterious glue: Dark Matter. We know that it is out there. But we have no idea what it is made out of.

**PRE-VISIT ACTIVITIES/TOPICS FOR DISCUSSION:**

- Can you think of an example of something that is "there" but not visible, yet we have evidence for it? Air? Wind? Gravity? Magnetism? How do we know wind exists?
- Fill identical clear bottles or jars with tacks, change, poptops, and any other materials you wish. Fill one bottle with water so full that there's no air bubbles when you replace the cap. Ask students how do they know which bottle has water in it if they can't see it. Mass? Contents in jar move differently? Light bends differently in each? Dark Matter does similar things!

**POST-VISIT ACTIVITIES/TOPICS FOR DISCUSSION:**

- Try the Dark Matter game using a spinning plate: https://www.darkmatterday.com/wp-content/uploads/2017/09/DarkMatterPlates.pdf or https://universe.sonoma.edu/activities/dm_labsheet.html
- You can model gravitational lensing by bringing in a sheet preferably with no pattern on it (a single color works best). Have students grab the sheet on all four sides and stretch it as tight as you can. This represents space. You can have two other students roll marbles across the sheet that should travel in a straight line if the sheet is level. But now introduce a mass to the middle of a sheet. This can be a softball or bowling ball (if you can still hold the sheet!). Now note how the marbles (photons) react to the mark warping space. Light can bend the same way it does through a lens. The larger the central mass, the more the photons bend. How can observing the photons tell us about the amount of mass in the middle?

**VOCABULARY LIST:**

Big Bang
Dark Matter
Galaxy
Gravity
Mass
Matter
Radiation

**INTERNET RESOURCES:**

- Preview the show: https://shows.planetarium-laupheim.de/n64_index.php#facts
- Educator's guide for another show, "Dark Universe:" https://www.si.edu/sites/default/files/educators_guides_group_sales/dark_universe_edguide.pdf
- Resources for "Dark Matter Day (Oct. 31):" https://www.darkmatterday.com/educational-resources-dark-matter-day/
- Search for Dark Matter: https://www.businessinsider.com/dark-matter-physics-experiments-2015-11
- Good resource from learner.org: https://www.learner.org/courses/physics/courseguide/FG_Unit10.pdf
- More on the discovery of Neptune (mentioned at the beginning of the show): https://en.wikipedia.org/wiki/Discovery_of_Neptune
- Gravitational lensing from Physics Girl (video): https://illinois.pbslearningmedia.org/resource/dark-matter-universe-physicsgirl-video-1005/what-is-dark-matter-a-mystery-of-the-universe-physics-girl/
- Video done by Illinois physics: https://www.youtube.com/watch?v=VFt91mVU60E