

Nature of Science & Math: Analyzing the Presence in Everyday Communication

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In the selected article

(<https://www.sciencenews.org/article/event-horizon-telescope-black-hole-picture>), Temming does a terrific job summarizing the work of multiple science observatory efforts to get the first detailed image of a supermassive black hole. This article excellently highlights some of the NGSS Nature of Science tenets as well as some of the Common Core Mathematics practices.

Scientific Investigations Use a Variety of Methods

This tenet is represented through the fact that evidence has existed before for black holes, but not to the extent of this current research. The author mentions that indirect evidence for black holes has existed, but there is no detail given in the article about these types of evidence. Temming, however, focuses on the Event Horizon Telescope (EHT) and the combination of radio wave images from multiple observatories. In addition, Temming (2019) quotes Geoffrey Bower about the importance of using weather data stating, “Every morning, there’s ... analyses of weather data and telescope readiness, and then we make a go/no-go decision for the night’s observing”. Without these multiple methods, the scientific community would not have the information that is now available.

Scientific Knowledge is Based on Empirical Evidence

The second chosen tenet is shown in the article because it took the information from multiple radio observatories across the globe, each with their own information, to create the image. Temming states, “On their own, the data from each observing station look like nonsense. But taken together using the very long baseline interferometry technique, these data can reveal a

black hole's appearance" (2019). The empirical data are combined to produce the image that made the news in April.

Science Addresses Questions about the Natural and Material World

The final science tenet chosen is conveyed in the fact that black holes have theoretically existed for a long time before scientists had an actual, direct image of their existence. This information will be important for understanding events in this solar system and others. Temming (2019) even states two questions that these data can help explain:

The EHT's black hole observations are expected to help answer questions like how some supermassive black holes, including M87's, launch such bright plasma jets.

Understanding how gas falls into and feeds black holes could also help solve the mystery of how some black holes grew so quickly in the early universe

Temming goes on to state how this information could help find pairs of black holes and even detect gravitational waves given off by black holes. All of these questions help better understand that natural world.

Model with Mathematics

In addition, to the Nature of Science tenets, several Common Core Mathematics Practices are shown. It's "important for educators to ensure that students' science learning coheres well with their learning in mathematics" (Next Generation Science Standards, 2013, p.

1) The first practice is shown with the use of weather mapping and then using the data to, as Temming describes, "work backwards" to make the image (2019). Temming (2019) states, "once

the EHT had enough telescope pairs collecting data in 2017, imaging software could fill in the gaps in the telescopes' observations to produce a full image of a black hole" which required the use of mathematical modeling to fill in those gaps. Temming also describes how mathematical rules and guidelines are used for this modeling software.

Use appropriate tools strategically

This practice is demonstrated through the use of the EHT, long baseline interferometry, previously mentioned weather analysis, and the practice of paired telescopes in paired orientations (such as East-West) to get finer details. However, even "old" tools can be appropriate for a particular task. Due to the extremely large file size, sending data digitally is not an option. Temming explains, "So the researchers use the next best option: snail mail" (2019).

Attend to precision

The above practices are two of the three Common Core Standards For Mathematics practices "most directly relevant to science" (Next Generation Science Standards, 2013, p. 3), but precision is also very important to the practice of science as well. Evidence for this practice is shown that the first attempt of combined telescopes in 2009 did not have enough precision needed, but with increased radio observatory stations in 2017, an image was able to be produced. For all of this data from multiple stations to make sense, it could not be recorded sloppily. Temming (2019) writes, "In order to braid together the observations from each observatory, researchers need to record times for their data with exquisite precision", which provides a real emphasis on this practice.

This article shows that the NGSS Nature of Science Standards, as well as the Common Core Mathematics Practices were well selected. These Standards and Practices truly show what real science and real math are about, and they emphasize important cross-cutting concepts that can be applied far beyond the classroom.

References

- Next Generation Science Standards. (2013). APPENDIX L – Connections to the Common Core State Standards for Mathematics [PDF file]. Retrieved from https://www.nextgenscience.org/sites/default/files/resource/files/Appendix-L_CCSS%20Math%20Connections%2006_03_13.pdf
- Temming, M. (2019, April 27). How scientists took the first picture of a black hole. *Science News*, 195(8), 7–7.