# Here, There & Everywhere: Science through Metaphor, Near and Far

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## Summary

The use of metaphors in teaching and learning has a long-standing history. Metaphors can be an effective way to make something new seem less daunting by comparing it with something more familiar. This technique of equating different or disparate things can help complex concepts become more understandable and accessible. The power of the metaphor is discussed in this article, which explores a recent public science project from the Chandra X-ray Center called Here, There and Everywhere. This project attempts to utilise analogy in effective science communication, as well highlighting the dangers that come alongside the use of metaphor and analogy. The article will also look at other areas where metaphors may be usefully implemented in astronomy communication, such as for upcoming programmes, including the International Year of Light 2015.

## Introduction

A common refrain heard by those in astronomy communication, whether from students or the greater public runs along these lines: "What does space have to do with me?", "The Universe seems too complicated for me to understand", or "Why should I care about things so far away?" (Rosenberg et al., 2013).

Research strongly suggests that the knowledge and reasoning of people is situated within a context (Osborne, 2007; Brown, Collins & Duiguid, 1989; Carraher, Carraher & Schliemann, 1985; Lave, 1988). By helping to make cosmic phenomena easier to relate to by the use of metaphors, we can perhaps chip away at some of the barriers to the scientific content of astronomy and astrophysics. To that end, the Chandra X-ray Center science communications group created the project, Here, There, and Everywhere (HTE).

At the core of the HTE project is the idea of grouping familiar happenings in our day-to-day experiences on Earth with those on larger scales across the planet and ultimately with objects and events in space. A non-expert might not realise that a solid scientific connection exists between seemingly different scenes and so HTE materials attempt to convey that science can connect things across vast scales and in many different environments.

When we see a wet dog creatively twisting her body back and forth to shake off the water, our thoughts might not drift to the conversion of rotational energy into outflows. Furthermore, most of us probably do not think of how this could in turn be related to energetic winds powered by rapidly rotating pulsars. But why not? With the dog, we are observing something that we can grasp, whose underlying physics we understand from experience. However we often miss the universality of physical laws and the connection between our everyday world and the larger environment.

*Figure 1. Example of the HTE concept, from rotation to outflows: a dog, a windmill, and the Crab Nebula pulsar. Credits: Dog - Stock Photography; Windmill - Stock Photography; Crab Nebula - NASA/CXC/SAO/F. Seward et al.*

## Metaphor development

The HTE team of scientists, science communicators and educators paid particular attention to metaphor creation. Research and development was done through key stages of prototype creation, response to formative evaluation sessions with non-expert volunteers and final content refinement.

Some of the preliminary metaphors or science concepts early in the project had to be altered, diminished or discarded. Either because it became clear during content creation that the storyline was not scientifically accurate enough, or because during formative evaluation the metaphor failed to connect the dots from the non-expert perspective.

*Figure 2. Example of a more problematic HTE concept on spirals: water going down a drain, a hurricane, and a spiral galaxy. Credits: Water draining - Stock Photography; Hurricane - NOAA; M101 - X-ray: NASA/CXC/JHU/K. Kuntz et al.; Optical: NASA/ESA/STScI/JHU/K. Kuntz et al; IR: NASA/JPL-Caltech/STScI/K. Gordon - See more at: http://hte.si.edu/more_topics.html#spirals*

Take for example, Figure 2 where draining water, a hurricane and a spiral galaxy show the progression of a physical process from "here" to "there" to "everywhere". In the original concept the "here" was a nautilus as opposed to draining water. However, during the creation process this caused confusion as the processes of the three objects were not the same, and so the shell was replaced with draining water.

The spiral-based approach did not test as strongly as other metaphors, so it was not one of the main topics featured in the programme, but rather served as a further example in nature to consider.

The challenge therefore is to find the right elements for each metaphor so that together:

a) They have a strong scientific connection.
b) The scientific thread between them is easily explained in relatively few words, with clear and attractive illustrative images.
c) The science described is relevant enough to engage viewers.

The final collection of topics discusses atomic collisions, electric discharge, blocked light, lensing, bow waves, wind, and other concepts[1]. The resulting metaphors created for HTE were stronger than those originally conceived, thanks to the iterative process.

## Results and conclusion

HTE has primarily visited public science locations (Arcand, 2011), including public libraries, school libraries, and community spaces. Each hosting location, chosen from an application process that was oversubscribed by 250%, plans supplementary activities that expand on the provided content, including children's arts events, science book clubs, discussions with local meteorologists and sidewalk astronomy.

Evaluation of the HTE programme showed that the use of metaphor positively affected the learning gains and interest levels of the participants. Approximately 75% of evaluated participants self-rated their astronomy knowledge as "nothing" to "some", with the remainder rating their knowledge from "quite a bit" to a "great deal". These randomly surveyed volunteers demonstrated learning gains, increased interest in astronomy, and increased interest in attending future science events.

Further research on how best to use metaphors and the benefits of those that heavily feature visual representations of the concepts to enhance the metaphor is certainly needed. Looking ahead, we plan to implement the use of metaphors in other public science projects, including an exhibit Light: Beyond the Bulb for the upcoming International Year of Light in 2015[2].

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## Notes

[1] More information on Here, There and Everywhere: http://hte.si.edu

[2] More information on Light; Beyond the Bulb: http://iyl.cfa.harvard.edu

## Biographies

**Kim Kowal Arcand** is the visualisation lead and media coordinator for NASA's Chandra X-ray Observatory and principal investigator for the International Year of Light 2015 public science project, Light: Beyond the Bulb. She co-authored *Your Ticket to the Universe: A Guide to Exploring the Cosmos* from Smithsonian Books in 2013.

**Megan Watzke** is the press officer for NASA's Chandra X-ray Observatory and a co-investigator in such Chandra-led public science projects as From Earth to the Universe; From Earth to the Solar System; Here, There, & Everywhere; and Light: Beyond the Bulb. She co-authored *Your Ticket to the Universe: A Guide to Exploring the Cosmos* from Smithsonian Books.