



My Sky Tonight:

Inspiring and engaging activities for 3- to 5-year-old audiences

Julia D. Plummer^a, Chrysta Ghent^a, Michele Crowl^b, Maureen Callanan^c,
Suzanne Gurton^d, Anna Hurst^d, Jennifer Jipson^e, Sasha Palmquist^f

Can young children understand the complex science of astronomy? While 3- to 5-year-old children are not fluent in reasoning about astrophysics, they are keen observers of the world around them, including the changes they see in the day and night sky. How can we build children's curiosity about the sun, moon, and stars to encourage early engagement with practices of science—observing, predicting, modeling, and explaining?

Goals of the My Sky Tonight project

My Sky Tonight is a National Science Foundation-funded project with the goal of advancing efforts to engage young children in astronomy learning in informal settings. The project contributes in three key ways: by providing a toolkit of developmentally-appropriate astronomy activities for use with young children in informal settings, by supporting educators through professional development and materials, and by disseminating the results of research conducted on young children's interest and engagement in astronomy through the My Sky Tonight activities.

Our project has been broadly focused on exploring young children's capacity at engaging with astronomy concepts through well-tested activities across a multitude of settings and with educators from across the country. Our partners in developing and testing

these activities include the Lawrence Hall of Science, Children's Discovery Museum of San Jose, San Luis Obispo Children's Museum, and the Discovery Space of Central Pennsylvania.

Young children's learning often happens in the midst of play, imagination, and storytelling, rather than in explicit lessons. Teaching 3- to 5-year olds through detailed verbal instruction or by encouraging rote memorization is not effective, nor does it inspire sustained interest. Therefore, our focus in this work has included attention to the principles of "Developmentally Appropriate Practice" as outlined by the National Association for the Education of Young Children (NAEYC; www.naeyc.org). These principles acknowledge that young children learn through play and exploration as well as through verbal explanation, and that children's learning varies widely across ages, individual interests, and experience. Additional guidance was drawn from empirical research in developmental psychology and early childhood education.

The My Sky Tonight activities were designed to be used in facilitated workshops and as drop-in activity stations on the floor of museums, but we often also have members of the planetarium community attend our online professional development workshops. Planetarians have been enthusiastic participants in the workshop discussions and field-

testing of activities. Further, reception from an audience of planetarians at the 2016 International Planetarium Society meeting in Warsaw, Poland suggested a broad international interest from the planetarium community in astronomy activities that can be done with very young children.

Therefore, the goal of this article is to share some of the philosophy and research behind the My Sky Tonight activities, introduce a few activities we think may be of interest to the broader planetarium community, and suggest ways these activities can be connected to the planetarium, based on our experiences with field-testing in the planetarium at Pennsylvania State University, University Park and on feedback from the My Sky Tonight workshop participants.

Children's interest in astronomy

In several preliminary studies, we investigated the target audience's conversations about astronomy in everyday settings using three different methodologies:

- A diary study of family conversations about nature,
- Children's conversations in a preschool classroom during an astronomy unit, and
- Family conversations in several museum workshops that tested preliminary astronomy activities.

^aDepartment of Curriculum & Instruction, Pennsylvania State University, jdp17@psu.edu, cag1030@psu.edu

^bDiscovery Space of Central Pennsylvania, michele@mydiscoveryspace.org

^cPsychology Department, University of California, Santa Cruz, callanan@ucsc.edu

^dAstronomical Society of the Pacific, ahurst@astrosociety.org

^eDepartment of Psychology and Child Development, California Polytechnic State University, San Luis Obispo, jjipson@calpoly.edu

^fPalmquist & Associates, LLC, palmquist.associates@gmail.com

(Suzanne Gurton was with ASP when the article was written. She has since moved to the National Radio Astronomy Observatory as their new Assistant Director of Education and Public Outreach; sgurton@nrao.edu)





In all three settings, we found preschool children showing interest in astronomy topics. For example, in our diary study, 69% of parents reported that they had at least one conversation about astronomy with their child during the two weeks that they participated in the study. Astronomy topics (especially the sun, the moon, the stars, and day versus night) were apparent in roughly 16% of the conversations reported to us. This was true both in middle-income highly-educated families, and also in a lower-income group of Mexican immigrant families where parents had fewer years of formal schooling. In fact, in the Mexican immigrant families, astronomy conversations constituted 19% of the conversations (Jipson, Callanan, Zumbro, & Castañeda, 2016).

These results demonstrate the importance of astronomy as part of what young children are already noticing and wondering about in their daily lives. Therefore our goal, as we designed the *My Sky Tonight* activities, was to build on their own natural curiosity, rather than to spark interest.

Young children's capacity to investigate astronomy

Some might be skeptical that young children are capable of sophisticated reasoning when it comes to doing science. And yet, a significant body of research suggests that 3- to 5-year-old children are capable of scientific reasoning and problem-solving, similar to how scientists reason and investigate (e.g. Gelman et al., 2010; National Research Council, 2007). We have used this research to help us design activities that provide opportunities for young children to explore their own capacity to do science by asking scientific questions, making observations of scientific phenomena, and using evidence to make sense of their world.

Many of the *My Sky Tonight* activities have been designed around certain astronomical phenomena that allow children to do science through the same practices that scientists use. Using our research on children's conversations with their families (Jipson et al., 2016), we have included events that young children already are wondering about and are part of their everyday lives: phases of the moon, the day and night cycle, and shadows cast by the sun.

The activities also were selected to allow children to extend their ability to observe from the their own backyard to phenomena that can be observed using telescopes and spacecraft, such as craters on the moon and the landscape of Mars. Through conversations with educators and parents, children

are encouraged to notice new details that will help them notice patterns, make comparisons, and begin to construct scientific explanations.

We conducted a study of how the *My Sky Tonight* activities can provide opportunities for young children to co-construct evidence-based explanations for astronomical phenomena in museum settings (Plummer & Ricketts, 2016). We found that 3- to 5-year-old children were able to use their own observations



Students taking part in the Moon Phase Matching activity. Photo provided by authors.

of astronomical phenomena as evidence for claims that answered scientific questions.

The support the children received from adults during the program was key for their ability to demonstrate this sophisticated science practice. Educators and parents helped the children engage in science practices in several important ways, including by: asking questions which helped them notice key features of astronomical phenomena, providing materials that allowed them to explore the phenomena (directly, such as using flashlights to make shadows, or indirectly, such as observing photos of moon craters), and encouraging collaborative interactions with other children. We also found that attending to how children use gestures and manipulate models was important to understanding the ways they communicate their observations and explanations.

My Sky Tonight activities and the planetarium

The planetarium is an excellent way to help children make key observations of these astronomical phenomena as they explore, investigate, and make sense of their world. The *My Sky Tonight* activities can be used as introductions, before children come into the planetarium; as follow-up activities after a

planetarium visit; or, in some cases, integrated into the children's experience in your dome. Below, we describe some of the activities and how they can be used when children visit the planetarium.

Moon Phase Matching

The goal of the Moon Phase Matching activity is for children to begin to become more familiar with an astronomical phenomenon that interests many of them: that the moon appears to change shape and that there is a pattern to this change. The focus of the activity is a large banner showing images of the moon throughout its cycle. Children are provided with pictures of moon phases on cards and encouraged to come up to the banner, compare their cards to the images on the banner, and try to find a match.

One developmentally appropriate way to encourage children is to use process praise to focus their attention on their efforts rather than on right vs. wrong answers (e.g., "you're working really hard to find the matching image!"). Effective use of the Moon Phase Matching activity can foster many other possible conversations around observations of the phases of the moon, as well as engage them in additional follow-up activities, such as drawing pictures of the moon in salt.

Becoming more aware of the different shapes of the moon and their change over time is the first step towards more sophisticated descriptions and explanations. We are not looking for more complex explanations of why the phases change for this young age group. Rather, it is important that they practice noticing subtle differences in objects in their world, as this is part of the skill of observation that is central to being a scientist.

Using Moon Phase Matching in the planetarium

Moon Phase Matching can be set up outside the planetarium, such as in the lobby area, for children to interact with before they enter. The activity works best if there is a docent or educator present to help facilitate the interaction; this can be very open ended with a single child or with multiple children. Partic-



icipating in this activity is likely to help children be more focused on attending to what they observe and hear about the moon and its appearance in the day and night sky when they are in the planetarium.

We also recommend Moon Phase Matching as a follow-up activity to a planetarium visit, either in the museum or planetarium setting, or for a teacher to use back in the classroom. Research suggests that children learn more when provided the opportunity to build on their field trip experiences through post-visit activities (DeWitt & Storksdieck, 2008).

Bear's Shadow

The Bear's Shadow activity is based on the Frank Asch book *Moonbear's Shadow*, which tells the story of a bear who is frustrated in his efforts to go fishing because his shadow scares away the fish. Throughout the day, he un-



One little My Sky Tonight participant uses a flashlight to see where Bear's shadow falls. Photo provided by authors.

successfully attempts to hide from or get rid of his shadow until finally his shadow no longer points towards the pond (because the sun is now in the opposite side of the sky).

After listening to the story, children recreate scenes from the book using a figurine to represent the bear and a flashlight to represent the sun. This activity allows children to investigate the phenomenon of shadows, as well as how the sun's position in the sky changes the position and length of shadows throughout

the day. A developmentally-appropriate strategy that is particularly useful in this activity is that of asking open-ended questions to help children construct their own explanations for how the sun's location affects the location of bear's shadow (e.g., "What do you notice about bear's shadow when we shine the flashlight from over here?").

Using Bear's Shadow in the planetarium

The advantage of having the planetarium when teaching this activity is that you can easily demonstrate one of the central phenomena in the story: the apparent motion of the sun throughout the day. You might begin by reading the story in the planetarium, perhaps even projecting the pages of the book onto your dome for the children to more easily see. You can help children notice that the sun is low in the sky in the morning, moves slowly higher and higher throughout the day, and then moves lower again as it nears the opposite side of the sky.

We encourage the use of two strategies that help children learn about the spatial nature of the sun's apparent motion. First, use spatial language as you ask children questions about the sun's location in the sky. Is the sun higher or lower than it was before? Is the sun moving up or down? For young learners, using descriptive gestures as you talk can help them better understand the meaning, and, in turn, can help improve their spatial thinking (Newcombe, 2010). It is helpful to encourage children to use gestures themselves, such as using their arms to trace the path that the sun takes as it moves across the sky. This gesturing could also be used after the observation of the sun's apparent motion as a way for children to show what they have learned. Using this type of kinesthetic movement in the planetarium has been found to help early elementary students improve their descriptions of the sun, moon, and stars' apparent motion (Plummer, 2009).

Another way to bring this activity to the planetarium is to explore the phenomena of shadows in the dome. Provide children with flashlights and encourage them to make shadow puppets or other explorations of shadows as preliminary exploration before the more structured modeling of the bear's

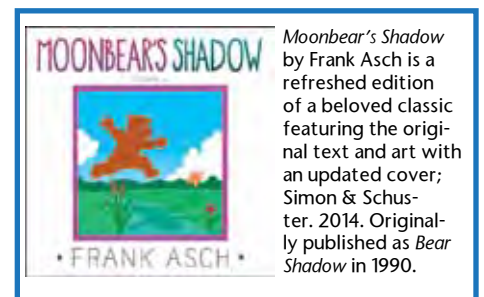


Anna Hurst works with small groups for the Day and Night and Bear's Shadow activities. Photos by Pablo, Astronomical Society of the Pacific.

shadow activity. Then, later, children can continue with the rest of the bear's shadow materials in a workshop setting or as a post-visit activity in the classroom.

Day and Night

The Day and Night activity engages young children in exploring the differences between the day and night sky. Children compare observations of the day and night sky from photographs and are guided to the conclusion that it is the sun that is important for daytime. They then observe how a bear figure on a globe facing the sun will have daytime, while a different bear on the other side of the globe will be facing away from the sun and thus have nighttime. This leads to a discussion of the Earth's rotation and how it allows for each bear to experience day and night. Children then stand and rotate like the Earth, facing towards and away from a lamp that



Moonbear's Shadow by Frank Asch is a refreshed edition of a beloved classic featuring the original text and art with an updated cover; Simon & Schuster, 2014. Originally published as *Bear Shadow* in 1990.

represents the sun, to model the Earth's rotation for themselves.

Using Day and Night in the planetarium

This entire activity worked well with 3- to 5-year olds visiting the small planetarium at Pennsylvania State University. Rather than showing children photos of the day and night sky, the planetarium's diurnal motion was used to allow the children to make observations. The next steps of the activity then can be followed as described above.

The activity write up includes images of day and night activities. Project these images onto your dome; when a daytime image is shown children should turn to face the Sun. When a nighttime image is shown, they should rotate to face away from the sun.

Conclusions

We hope that by engaging young children in astronomy activities we can extend their opportunity to explore astronomical phenomena observed in the planetarium. The planetarium is an excellent tool for helping young children learn to pay closer attention to important features of astronomical phenomena. The My Sky Tonight activities extend these observations in ways that allow for further exploration, conversation, and sense-making.

Full descriptions of these activities and associated materials can be found on our website for download: www.astrosociety.org/MySkyTonight

The activity write ups include children's ideas about astronomy found in previous research studies, questions you can ask to engage young children in these topics, and suggestions for developmentally-appropriate strategies you can use to support children during these activities.

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