Lunar Landscapes

Children create their own space helmets out of paper bags, put on special air packs, gloves, and boots, and then explore the lunar landscape (created with a sheet, pillows, and pretend "moon rocks").

30–45 minutes

Drop-in or Workshop

1 adult per 4–6 children. Children require assistance suiting up in their "astronaut gear", so more adults are better.

Content Learning Goals

- Children begin to understand that the Moon's surface has sand, rocks, and holes called craters.
- Children begin to understand that the Moon does not have air to breathe.
- Children begin to understand that visiting the Moon requires special vehicles, clothes, and instruments.
- Children consider the idea that astronauts have visited the Moon.

Science Practices

- More than simply looking, encourage children to **observe** the relevant features of the pretend Moon surface, and the video and images of the real Moon.
- Children **compare** the pretend Lunar Landscape with the video and images of the real Moon.

Materials

- Large sheet of gray fabric
- Pillows
- Foam "Moon rocks"
- Projector, screen, and computer to play video
- Moonscape banner
- Photos of astronauts
- Paper bags pre-cut into helmets (see instructions)
- Stickers & crayons
- Garden gloves
- Booties
- "Air packs" made from 2-liter plastic bottles (see instructions)

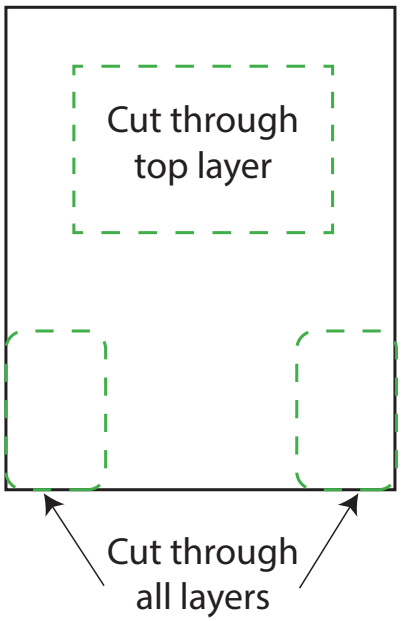
SET-UP

Set up the Lunar Landscape:

- Lay out the sheet over some pillows to make the surface soft and lumpy.
- Scatter the "moon rocks" on the surface.
- Set up the screen and play the Moon Walk video OR hang the Moonscape banner.
- Hang an Earth ball from the ceiling — you can see the Earth from the Moon!
- Optional: hang black curtains around the space to simulate dark space.

Prepare the paper bag "helmets":

- Cut the paper bags as illustrated to the right.
- Put out stickers and crayons for children to decorate their helmets.



Make the "airpacks":

- Tape together two 2-liter plastic bottles and cover them with aluminum foil.
- Attach shoulder straps made of string so that children can wear them on their backs
- An alternative is a smock with air tanks drawn on the back.

Set up stations for each type of special equipment: airpacks, gloves (size small gardening gloves), and boots (hospital booties to slip on over shoes).

ACTIVITY DESCRIPTION

1. Invite children to the activity:
   - *Would you like to take a trip to the Moon?*
   - *What do you think you'll find on the Moon?*
   - *Do you think you'll need a helmet?*
2. Invite children to design their own space helmets for their visit to the Moon. Each child receives a paper bag helmet to decorate with stickers and crayons or markers.
3. Ask: *Do you think you could wear your rain boots / flip-flops / bathing suit / baseball cap on the Moon?* Talk about what kind of special equipment you might need to visit the Moon. Let the children share their ideas. Give hints: *Could you breathe on the Moon? Is it hot or cold there?*
4. Invite children to prepare for their trip to the Moon by putting on their helmets as well as the other special equipment: air packs, gloves, and boots.
5. Blast off to the Moon! You might want to create a space to represent a rocket ship: a carboard box, or even just a hula hoop on the floor. Ask the children to step inside the rocket (If you're using one). All together, count down: *Three, two, one, BLAST OFF!*
6. Once they've landed on the Moon, encourage children to explore. Ask questions to guide their play. Help them notice in the videos and images of the real Moon: features of the Moon, how the astronauts are moving, their need to wear a space suit to breathe. Then help them compare those observations to the lunar landscape model they are part of.
   - *What can you see? What do you observe on the ground?*
   - *How is this landscape we've created like what you see on the Moon in the video?*
   - *How could you move like the astronaut in the video? Why is he moving like that?*
   - *Find a rock bigger / smaller than your hand! How does it feel compared to an Earth rock?*
   - *What is that in the distance, behind the astronaut?*
   - *How is the sky you see on the Moon different than the sky we see on Earth?*
   - *What's that up there* (indicate the Earth ball)*?*

Books & Songs

If the Lunar Landscape is part of a workshop or camp, you may want to start by reading a book. We recommend *On the Moon* by Anna Melbourne

You might also sing a song together. See *Going on a Moon Walk* on page 6.

EXTENSIONS

- Set up a tub of sand with toy astronauts, rockets, and lunar buggies. Set out photographs of actual astronauts, rockets, and the lunar landing site. Invite children to act out scenes of exploring the Moon.
- Invite children to make their own piece of the Moon's surface to take home. Give each child a small paper plate covered in a layer of modeling clay. Children can shape the clay to resemble the lunar surface, then add footprints using a doll's shoe (choose one that has treads), and add a small flag (the kind on toothpicks used for decorating baked goods).
- Try a gravity jump! Suspend a yard stick between two large blocks and let each child jump over it. Then stack up six of the blocks to show children how high they could jump if they visited the Moon. Explain that there is gravity on the Moon like on Earth, but because the Moon is smaller than the Earth, gravity is not as strong on the Moon. That's the reason we would be able to jump so much higher on the Moon.

DEVELOPMENTALLY APPROPRIATE STRATEGIES

Lunar Landscape is an activity in which children's imaginations soar! The materials set the stage for children to create pretend play scenarios that explore the theme of space travel. There are a variety of ways that adults can extend the rich learning opportunities offered by pretend play. Of importance is that adults move beyond their usual role as **facilitator** and embrace the additional role of **play partner**. An active role in children's play positions adults to use developmentally appropriate verbal and nonverbal approaches to help children enact scenarios that build knowledge and incorporate new concepts into their existing understandings. A few ideas are described below. These ideas are meant to reflect options; using all of them might detract from the spontaneous, child-initiated nature of the play and instead transform this into another adult-directed activity.

Add Challenge by introducing supporting characters to complement the more obvious "astronaut" role. By doing so, an adult play partner can introduce new imaginary situations into a pretend play scenario that has become stagnant. (e.g., *"I'll be someone at Mission Control. Astronaut Maria, tell me about what you see on the Moon. Have you been able to collect any samples of Moon rocks yet?"* or *"I'll be another astronaut who wants to leave the spaceship without putting on her gear. I'm heading out to explore the Moon. I don't want to wear my helmet and gloves. Can I go out without my special clothing on? No? Why not?"*).

While adding challenge as a play partner, an adult can also **Model** new ways of approaching the activity (e.g.,*"I'm collecting samples of Moon rocks."* Or *"I'm walking like real astronauts walk when they're on the Moon."*).

This is also an opportunity to **Provide Information** (e.g., *"I see a planet out there in space. Hey — it's the Earth. When we're on the Moon, we can see the Earth!"*)

Adults can also **Ask Questions** to encourage children's observation of the characteristics of the Moon and to provoke their thinking about what it might really be like on the Moon. Questions can be infused in the pretend play scenario, or the adult can step back to the role of a facilitator to ask children questions. Several sample questions are provided in the Activity Description above.

BACKGROUND INFORMATION

The following information about learning science and astronomy is intended for the educator who will facilitate Lunar Landscape activity. The activity is a developmentally appropriate first step toward the children eventually understanding the concepts explained below, perhaps years later. We do not intend the educator to cover most of these concepts with the children during the activity. This information is provided to give the educator a good basic understanding of the scientific concepts that the activity is moving toward and how many children think about these topics, and preparation to answer questions from very curious children or adults.

LEARNING SCIENCES

Pretend Play and Children's Learning

Researchers in developmental psychology and early education have long argued that preschool-aged children learn about the world through play. Pretend play has been seen as important for children's cognitive and social development.[1] While some recent research has questioned whether there is a direct causal link between pretend play and aspects of cognitive development[2], there is very clear evidence that young children's learning is best supported by free choice, hands-on activities rather than adult-centered instruction.[1,3,4,5] Children's pretend play, taking the role of astronauts, gives them an opportunity to use their imagination to think about the Moon and Earth from a new perspective. As *My Sky Tonight* evaluator Dr. Sasha Palmquist has shown, children vary a great deal in their interests and expertise[6]; those children who have particular interest and knowledge about space may be eager to engage in imaginative play in this domain, but even those with less expertise may think more deeply about the moon through pretend play.

Children's Understanding of Earth and the Moon

In the preschool years children are actively engaged in building an understanding of our planet and its relation to other celestial bodies, including the moon. While young children learn that the Earth is "round" their interpretations of what that means often differ from adults' understanding.[7] Research has shown us how children incorporate what they

[1] Hirsh-Pasek, K., Golinkoff, R., Berk, L., & Singer, D. (2009). *A mandate for playful learning in school: Presenting the evidence.* New York, NY: Oxford University Press.

[2] Lillard, A., Lerner, M., Hopkins, E., Dore, R., Smith, E., & Palmquist, C. (2013). The impact of pretend play on children's development: A review of the evidence. *Psychological Bulletin, 139*, 1-34.

[3] Hirsh-Pasek, K., & Golinkoff, R. (2003). *Einstein never used flashcards.* Emmaus, PA: Rodale Press.

[4] Lillard, A. (2005). *Montessori: The science behind the genius.* New York: NY: Oxford University Press.

[5] Stipek, D., Feiler, R., Daniels, D., & Milburn, S. (1995). Effects of different instructional approaches on young children's achievement and motivation. *Child Development, 66*, 209-223.

[6] Palmquist, S., & Crowley, K. (2007). From teachers to testers: How parents talk to novice and expert children in a natural history museum. *Science Education, 91*, 783-804.

[7] Vosniadou, S., & Brewer, W. (1996). Mental models of the earth: A study of conceptual change in childhood. *Cognitive Psychology, 24*, 535-585.

are told (e.g., "the Earth is round") with what they experience (a world that looks flat). For example, *My Sky Tonight* research partner Dr. Jennifer Jipson has explored young children's drawings and discussions of the Earth, and she found that 4-year-olds come up with creative solutions to the confusing discrepancy between how the Earth looks to us and how people talk about the Earth.[8] For example, some young children seem to think of Earth as a hollow sphere with people living inside and the sky as a dome overhead.

Young children also seem to engage in a similar active construction of their ideas about the Moon, including where it came from and what it is made of, how the Moon moves in space, and whether people can reach the Moon.[9,10] *My Sky Tonight* research partner Dr. Julia Plummer has published a number of articles regarding children's understanding of the apparent movement of the Moon[11,12] as well as their understanding of the Moon's surface.[13] Dr. Plummer has shown that engaging young children in conversation about these ideas can help them to ask questions and extend their understanding. Much of the research on children's (and adults') understanding of the Moon focuses on uncertainty regarding what causes the phases of the Moon. Like many adults, children seem to think the phases are caused by shadows of the earth on the Moon.[14] Some young children also might talk about the moon as being only present at night, or as being a living organism.[14] Interestingly, some variations in children's views about the Moon and the Earth may be related to their cultural or religious background. For example, children in India were more likely to think about the Earth as floating in water than were children in the US, and this idea is present in Indian folk cosmologies.[15]

[8] Jipson 2015

[9] Saçkes, M. (2015). Young children's ideas about earth and space science concepts. In K. Cabe Trundle & M. Saçkes (Eds.), *Research in early childhood science education* (pp. 35-65). New York, NY: Springer.

[10] Venville et al., 2012

[11] Plummer, J. D., (2009). A cross-age study of children's knowledge of apparent celestial motion. *International Journal of Science Education, 31*, 1571-1605.

[12] Plummer, J. D., Wasko, K., & Slagle, C. (2011). Children learning to explain daily celestial motion: Understanding astronomy across moving frames of reference. *International Journal of Science Education, 33*, 1963-1992.

[13] Plummer & Small, 2015

[14] Saçkes, 2015

[15] Samarapungavan, A., Vosniadou, S., & Brewer, W. (1996). Mental models of the earth, sun and moon: Indian children's cosmologies. *Cognitive Development, 11*, 491-521.

ASTRONOMICAL SCIENCE

Only twelve people, all men, have ever walked on the Moon. They're called the dusty dozen! Going for walk on the Moon is very different than going for a walk in a park on Earth. There are some pretty basic things missing on the surface of the Moon that we take for granted on Earth, like air, water, and plate tectonics.

Let's start with the air on Earth. It is what we breathe, but it also helps regulate temperatures and is where the weather happens. Even the weight of atmosphere pushing down on us has to be accounted for when going to the Moon with pressure suits.

Our atmosphere acts like a coat, insulating the Earth and helping moderate the temperatures. The hottest place on the surface of the Earth is Death Valley, CA, which can reach temperatures of 134 F (56.7C), and the coldest place is Antarctica, which can reach temperatures of -128 F (-89C). While these temperatures seem extreme, they are not as extreme as the airless Moon, which has temperatures ranging from -413 F (-247 C) in the dark bottoms of polar craters to 253 degrees F (123 C) in the sunshine. The difference between the hottest and coldest temperatures on Earth is 262 degrees F, but the difference on the Moon is more than 660 degrees F. The extremes on the Moon are not due to the seasons, but simply the amount of sunlight present. As hot as Death Valley gets, the Moon gets even hotter without any atmosphere to filter out any of the light and heat. The spacesuits that astronauts wore on the Moon had many layers and their own heating and cooling systems. They were white to reflect the heat of the sunlight.

The Earth's atmosphere is also important to our water cycle. Water flowing on the surface evaporates, forms clouds and rains back to Earth. Without an atmosphere, any water that was on the surface of the Moon has just evaporated out into space. Recent investigations by spacecraft of craters at the poles of the Moon indicate that there may be frozen water deep inside these craters where the Sun never shines. It is stored there as ice. There's not a lot, but enough to make a difference if we ever want to set up bases to live on the Moon. Water is heavy and it would be great if we don't have to take all our water with us in our rockets.

One key result of both water and plate tectonics is that they shape what the surface of the Earth looks like, building up and wearing down mountains. Without any wind, water, or plate tectonics, the surface of the Moon changes very little over time. Over billions of years (~4.5 billion), it has been pounded by rocks from space. Without any atmosphere, all of these space rocks, large and small, crash into the surface, pulverizing it. There are craters on top of craters on top of craters on the Moon. After just 10,000 years of pounding, you would have nearly a half inch of lunar dust on the surface. Without wind and water to wear it down and round off the edges, the dust is more like broken glass, with sharp edges.

The dust on the moon was quite intriguing. We weren't sure just what it would be like until we got there. Some thought that it might be thick and fluffy like baby powder and that the lunar landers would just sink down into it. It turns our it's not fluffy, but sharp. It smells like gun powder and gets into everything. After just a couple of hours walking around on the Moon, the astronauts were covered with it. Like a balloon that clings to your hair, the static in Moon dust makes it cling to everything, including camera lenses. It clogged several instruments, and it can act like sand paper, wearing things down. When astronauts came back into the lander, they were covered with it and some seemed to even be allergic to it, complaining of "lunar dust hay fever." If we ever go back to the Moon, we'll have to figure out how to deal with all that dust, since it could be unhealthy for instruments and people alike.

Alan Bean, one of the astronauts who walked on the Moon, has become a painter. He says that the most frequently asked question that he gets is "How did it feel to walk on the Moon?" It's a hard thing to put into words. The landscape is so desolate, the shadows are so dark, and the gravity is less, but you've got to wear all that bulky equipment. In response, he created this painting: http://www.alanbeangallery.com/howitfelt-story.html

Read more about the surface of the Moon here:
http://www.universetoday.com/62140/surface-of-the-moon/

Read about the low gravity on the Moon here:
http://www.universetoday.com/19710/gravity-on-the-moon/

Read an interview with astronaut Buzz Aldrin here:
http://teacher.scholastic.com/space/apollo11/interview.htm

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Goin' on a Moon Walk

(Based on Goin' on a Bear Hunt)

Use full body motions to illustrate each action!

(Chorus)

We're going on a moon walk. (Repeat)
Gonna see some sights. (Repeat)
We're not scared. (Repeat)
It's a beautiful day. (Repeat)

Verse 1:
Oh look, moondust!
Puffy dusty moondust
We can't go over it, we can't go under it.
Ohhh NO!
We gotta go through it.

Stumble bounce, stumble bounce.
Stumble bounce, stumble bounce.

(Repeat chorus)

Verse 2:
Oh look, a moon rock!
A big grey moon rock.
We can't go over it, we can't go under it.
Ohhh NO!
We gotta go around it.

Boing, Boing, boing, boing
Boing, Boing, boing, boing

(Repeat chorus)

Verse 3:
Oh look, a crater. A deep dark crater
We can't go over it, we can't go under it.
Ohhh NO!
We gotta go down it.

slip, slide, slip, slide
slip, slide, slip, slide

(Repeat chorus)

Verse 4:
Oh look, the crater wall.
A steep crater wall.
We can't go over it, we can't go under it.
Ohhh No!
We gotta climb back up.

Heave ho, heave ho,
Heave ho, heave ho

(Repeat chorus)

Verse 5:
Oh look, what's that? Whoosh, plop
A rock, it fell from the sky. Whoosh plop.
And another. Whoosh, plop.
It's a meteor shower!

Let's get back to our rocket!
Quick, through the crater.
Slip slide, slip slide

Around the Moon Rock.
Boing, boing, boing boing

Through the Moon Dust
Stumble bounce, stumble bounce.

Run to the rocket!
Climb up the ladder, argh!
Open the hatch.
(tap tap tap tap tap tap tap tap)
Climb inside!
OH WAIT!
We forgot to shut the hatch.

Back to the hatch!
Shut the hatch, plllunk!
Lock it, clink. Back inside.

Run up the stairs,
Another flight of stairs,
another flight of stairs
(Breathe heavy)
Another flight of stairs

Jump in the bed
Pull up the covers
And WOOHOOOSH!

WHOOO, we made it!