Family Space Day Overview - Moon

Family Space Day is a three hour event. The activities are set up so that children and parents can select the order in which they undertake activities. Parents and children are encouraged to learn, play, and explore *together*.

The activities presented for exploring the Moon were part of multiple Family Space Day events. Facilitators are encouraged to select the activities that will appeal to their audience.

Objectives of the Day

Children Will:

- Learn about the environment and surface features of the Moon.
- Learn what it might be like to live on the Moon.
- Learn the different phases of the Moon that we see from Earth.

Activities

A Moon event is an ideal time to have a lunar viewing
in partnership with your local astronomy society.
Consider having your event during a lunar eclipse
or when the Moon is not quite full.

- Station 1: Moon Pie Posters
  Children and their parents view nine posters with information about the Moon and collect “Moon Pie” pieces at each poster.

- Station 2: Moon Pie Activity
  Children create an image of the Full Moon using the pie pieces collected at the posters.

- Station 3: How Big and How Far Away is the Moon?
  Children learn about the size and distance of the Moon.

- Station 4: Passport to the Moon
  Children and their parents look at the Moon and locate the different features listed on their passport.

- Station 5: What Do You See in the Moon?
  Children use their imagination to identify a character or object on the Moon.

- Station 6: Moon Phases Investigator Guide
  Children create an investigation journal to record their nightly observations of the Moon.

- Station 7: Moon Flip Book
  Children learn the phases of the Moon by creating a flip book.

- Station 8: Oreo Moon Phases
  Children learn the phases of the Moon by using Oreo cookies and singing a song

- Station 9: Lunar Eclipse Demo
  Children and their parents learn about lunar eclipses through a simple hands-on demonstration.

- Station 10: Recipe for a Moon
  Children learn about the Moon's inside layers.

- Station 11: Build a Lunar Base
  Children and their parents will create and build a habitable lunar base using craft items.

- Station 12: Coloring Sheets
  Children color pictures and play games related to the Moon.

- Station 13: Reading Room
  Children and their parents browse and read a selection of books about the Moon (refer to book list for suggested reading).

Other Materials

- *Facilitator Information* – Moon
- *Explore the Moon* – Book and Website References
- *All About the Moon* – A Moon Fact Sheet
- *Chain of Phases* – A Take-Home Activity

Facilitator Information

(All you need to know about the Moon to survive the day)

Why does our Moon shine?

Just like the planets, our Moon does not produce its own light. It “shines” because it reflects the Sun's light. At times, our Moon reflects so much light that it makes viewing parts of the night sky challenging!

Why does our Moon's shape change?

Our Moon's shape doesn't really change — it only appears that way! The “amount” of Moon that we see as we look from Earth changes in a cycle that repeats about once a month (29.5 days). The relative positions of our Sun, Earth, and Moon, cause these changes.

As our Moon orbits around Earth, the side facing the Sun is always illuminated, just like Earth's daylight side is illuminated by the Sun.

What we see *from Earth*, however, is a different story. Starting with the dark new Moon, we see the light part of the Moon “grow” from a sliver to a half to a full Moon — and then the illuminated part decreases, becoming thinner until there is no visible Moon in the sky and we are at the new Moon part of the cycle again.

We have a “new Moon” when our Moon's orbit around Earth moves it between Earth and the Sun. From Earth, the Moon's surface looks dark because the illuminated side is facing away from Earth. As our Moon continues its orbit counterclockwise around Earth (viewed from above the north pole), more and more of the illuminated part of the Moon becomes visible to us, until it reaches the “full Moon” stage. A full Moon occurs when the Moon has moved in its orbit so that Earth is “between” the Moon and the Sun.

Between the new and full Moon, the amount of Moon we see grows — or waxes from its right side toward its left side. As it passes the full Moon stage, the amount of illumination decreases — or wanes — from right to left. Finally, the Moon returns to its position between the Earth and the Sun, and on Earth we observe the new Moon again.

In the southern hemisphere, illumination of the Moon increases from the left to the right side in the waxing phase and the dark part increases in coverage from left to right in the waning phase, which is opposite of the northern hemisphere. No matter where on Earth an observer is, however, the phases of the Moon occur at the same time.

What is our Moon like?

tively young dark smooth lowlands (mare), ough highlands (terrae). The highlands are rs from asteroid and comet impacts; there n the younger lowlands.

The surface is covered with crushed rock material called regolith — in some cases deeper than 15 meters (50 feet). Regolith is rock that has been pulverized by the impacts.

The Moon has no atmosphere, so there is no wind and the sky is dark — like the Earth's sky on a clear night extreme temperatures: 130°C (265°F) during the 155°C (–250°F) at night. There is no flowing wat surface of the Moon; any existent water is frozen areas that are permanently shadowed; these are areas not exposed to the Sun's heat during part c day.

Space is filled with radiation, primarily from our Sun; this radiation is deadly to humans unless they are protected from it. While Earth's atmosphere and magnetic field offers us protection from incoming solar radiation, the Moon has virtually no magnetic field and so the radiation levels are very high.

Because it is less dense and smaller than Earth, the Moon has less gravity. The surface gravity is 1/6 Earth's gravity. Our Moon is tilted on its axis only a tiny amount, so there essentially are no seasons. The Moon orbits Earth once every 27 days — and turns on its axis once every 27 days. This means that the lunar "day" is equal to a lunar "year." It also means that the near side faces Earth constantly. Astronauts would experience daylight for almost two Earth weeks and then darkness for the same time.

How did the Moon form?

How Did Our Moon Form?

Most scientists now believe that about 4.5 billion years ago, shortly after the planets in our solar system formed, a planetary body - half the size of Earth - collided with Earth. The impactor broke apart and pieces of the impactor and Earth's outer layers were blown out into orbit around Earth. Over a short time — perhaps a hundred years or less, these pieces collided and stuck together — accreted — to form our Moon.

The heat from accretion caused the Moon, or at least its outer layer, to melt, creating a magma ocean. Eventually the crust cooled. For the first 600 million years of its existence, large asteroids continued to strike the Moon and the planets in our solar system, creating the large basins and craters we see on the Moon. After about 3.9 billion years, much of the "debris" in the solar system had been swept up into the planets and their Moons, and impact strikes were smaller and less frequent.

While cool on the outside, the interior was still hot. Molten rock would still rise to the Moon's surface and break through cracks or erupt at volcanos. The lava filled the basin and crater floors — the low areas on the Moon. It cooled quickly, forming fine-grained dark, volcanic rocks called basalt; basalt is the most common type of volcanic rock we find Earth. When you look at the Moon, you can see the large, somewhat circular, dark basins. These are the basalt-filled ancient impact basins. In spite of this exciting beginning and history, the Moon has been geologically inactive for at least the last billion years.

What will it be like to live and work on the Moon?

If humans are to live on the Moon, even for brief periods, they will need a wide range of support systems. They'll need a place to work, rest, and live that protects them from the cold and dangerous radiation of the space environment. They will need power, light, air, food, water, and heat. They'll need robust transportation and equipment able to operate in low temperatures and the hostile environment of space. They will need to be able to communicate with Earth, other colonies, and shuttles.

They will also need to deal with health issues. Reduced gravity is a challenge to people living on the Moon with one-sixth Earth's gravity. Under reduced gravity conditions, there is less "load" on bones and muscles, so living organisms lose bone mass, muscle tissue, and fluids. Even the heart — a muscle — loses mass because it does not have to work as hard. Humans on the Moon must exercise to maintain their bone and tissue mass so that they can return to Earth's gravity and function well. More research is needed to understand the effects of reduced gravity on the human body — and how to counter these effects.

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Any habitat would have to provide shelter from the extreme temperatures and from incoming radiation. Moon bases may include subsurface buildings to increase protection from radiation and micrometeorites.

There probably would be three basic types of modules: habitation, laboratory, and support modules. The habitat would have sleeping quarters, a kitchen (or galley), and bathroom facilities. Windows would have to be small and made of multiple thick glass sheets to block cosmic radiation. Laboratory modules would be used for conducting experiments. A colony would also need several types of support modules and facilities, including a greenhouse to grow food; a power plant — either solar or nuclear; a place to store construction equipment and do maintenance; a central control, life support, and communications center; resource utilization facilities for processing mined materials; and a landing/launch pad.

The colony team would initially include scientists and engineers. These individuals would probably have many other capabilities, such as medical training and construction training. As the colony grew, other personnel would need to be added. They would conduct research and experiments in the laboratories, work on colony construction, maintain the base, and mine resources. Medical specialists, cooks, safety specialists, administrative staff, and cleaning crews would be needed to support the efforts. These crews would be replaced on a regular basis in the same way as teams who work at Antarctic bases on Earth.

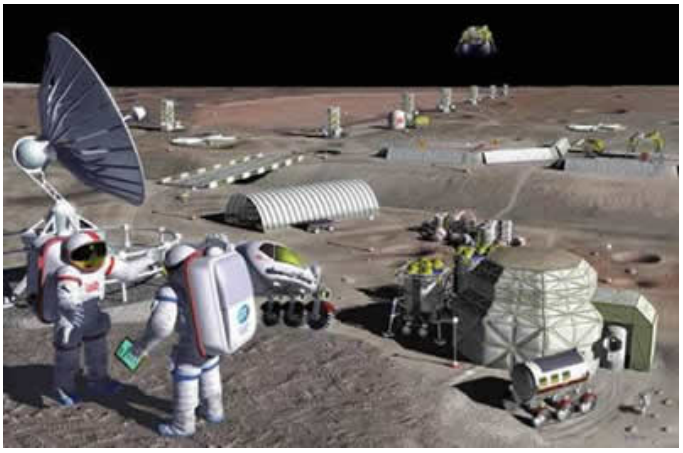

Image by Pat Rawlings
(http://www.patrawlings.com/)
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Host a Lunar Viewing Night

Partner with your local astronomical society to host a lunar viewing event. They can provide the telescopes and some wonderful expertise. Find local resources:

NASA's Night Sky Network http://nightsky.jpl.nasa.gov/

Sky and Telescope http://skytonight.com/community/organizations

A Few Tips:

- Set the telescopes up an hour before dark so that it is easy to see the process.
- Reduce the lighting in the area where the telescopes will be set up.
- Place glowsticks on the ground to guide the audience safely around the telescopes.
- Consider projecting the view of one of the telescopes onto a large wall using an LCD projector; the entire audience can then observe the Moon while waiting for a peek through the telescopes.
- Have water, insect repellant, and spare flashlights (with red filters) on hand.
- Provide families with the Passport to the Moon viewing guide
- Provide each child with a Moon Phases Investigator Guide.

Possible viewing events

The Moon - Pick a night during which the Moon is not quiet full so that the terrain really stands out.

Lunar Eclipses - Find dates for eclipses between now and 2020
http://www.mreclipse.com/Special/LEnext.html

The Moon: International Year of Astronomy Featured Object (February 2009)
http://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=301

100 Hours of Astronomy: International Year of Astronomy Event (April 2009)
http://www.100hoursofastronomy.org/

The Lunar Reconnaissance Orbiter / Lunar Crater Observation and Sensing Satellite Launch (Spring 2009)
http://lro.gsfc.nasa.gov/
http://lcross.arc.nasa.gov

Lunar Crater Observation and Sensing Satellite Impact!
http://lcross.arc.nasa.gov/observation.htm (Fall 2009)

Moon Pie Posters

In this activity, children and their parents view posters and collect a pie piece at each poster. The pieces will be used in the Moon Pie Activity.

What You Need:

- 9 brightly colored poster boards
- Print-outs of text, enlarged and in color
- Print-out of different Moon images
- Tape
- Scissors
- 9 9x12" envelopes for pie pieces
- Several print-outs of Moon Pie Answers printed double-sided
- Area to display posters

What to Do:

Cut out the Moon Pie Answers. Separate the answers into individual piles; each pile should have numerous pieces with the same answer. Place each pile of answers into a separate envelope.

Place the text and images on the poster boards. Attach an envelope to eight of the posters so that the children can retrieve the answers.

Poster 1:

We're going back to the Moon!

In 15 years we'll have people living and working on the Moon for weeks to months at a time!

Learning how to live on the Moon will help us prepare to explore other places in our solar system – like Mars!

How old will you be?
What will your job be at a Moon base?

We need to learn more about the Moon before we can build a base.
What is the Moon like?

Poster 2:

Long Days and Long Nights

Earth spins once every 24 hours
The Moon takes 27 days to spin once!
The Moon's "day" is almost two weeks long –
and then it's dark for two weeks!

Poster 3:

The Moon does not have an atmosphere!

Atmospheres are important because they protect us from harmful solar radiation and help to keep temperatures stable.

Poster 4:

The Moon's temperatures range from **really hot** (+224 F) in the sunlight to **really cold** (–243 F) in the shade or darkness.

The temperature changes so much because there is no atmosphere to stabilize it.

Poster 5:

There is **no liquid water** on the Moon.

There may be frozen water – ice – in deep craters near the poles.

Poster 6:

Solar radiation levels on the Moon are dangerously high. There is no atmosphere or magnetosphere to block incoming radiation.

Poster 7:

The Moon is smaller than Earth, but because it has mass, it **DOES HAVE GRAVITY!**

The Moon's gravity is ~1/6 of Earth's.

Because there is less "pull" on you, you will weigh less and jump higher on the Moon!

Poster 8:

On its surface, the Moon's rocks have been smashed into a fine powder by lots and lots of asteroid impacts.

This lunar "soil" - regolith - can be 45 feet thick!

Poster 9:

We're going back to the Moon!

We need more information to help us prepare for our Moon base!

Several spacecraft are sending back information about the surface of the Moon – what it's made of, how hot it is, where good landing sites might be…

Some of the spacecraft going around our Moon right now are the Chandrayaan-1 from India, and the Kaguya spacecraft from Japan.

The America's Lunar Reconnaissance Orbiter will launch soon!

Poster Images

Possible images for posters:

http://www.patrawlings.com/default.cfm

http://photojournal.jpl.nasa.gov/index.html

http://nssdc.gsfc.nasa.gov/imgcat/hires/a11_h_40_5880.gif

http://lunar.gsfc.nasa.gov/gallery.html

http://lcross.arc.nasa.gov/

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Moon Pie!

This activity reviews what your child learned about the Moon while viewing the posters with you!

What You Need:

- 8 Moon Pie pieces from the poster; each should be different.
- Moon Pie Questions (below)
- Moon Pie Game Board
- Glue stick

What to Do:

Once your child has viewed all the posters, invite him/her to assemble their Moon slices!

- Mix the pieces up. Have your child lay out the pieces with the answer side up.
- Read each question and help your child match the question with the answer.
- Put glue on the answer side, turn the answer piece over, and glue it to the space with the number that corresponds to the number of the question.

When you and your child are finished, you should have a picture of the full Moon!

Moon Pie Questions (and Answers!)

1. Why did astronauts have to take air with them? (There is no atmosphere on the Moon)

2. How long is a day on the Moon? How long is a night? (14 Earth-Days Long)

3. Why would fish be very unhappy on the Moon? (There is no liquid water on the Moon)

4. Will you weigh less or more on the Moon? (Less)

5. The Moon's temperatures are _____ in the sunlight and _____ in the dark. (very hot and very cold)

6. Why did the astronaut's suits get so dirty? (The Moon is covered in regolith – smashed rock)

7. Why do we want to learn more about the Moon? (To help us plan for future Moon bases)

8. Who will live and work on the Moon? (You!)

How Big and How Far is the Moon?

In this activity, children will determine the size and distance of the Moon.

What You Need:

- 2 poster boards
- Masking tape
- Different types of balls including a basketball and tennis ball. Others can include a marble, softball, beach ball, etc.

What to Do:

- Adhere text to poster boards covering the answer with a piece of cardstock that has printed on it, “Answer.”
- Place different balls with the “How Big is the Moon?” poster.
- Place masking tape at 4 different distances from the “How Far is the Moon?” poster and mark them A – D. The correct distance is 23.5 feet away from the poster.

Poster 1:

How Big Is the Moon?

If the Earth were the size of a basketball, which ball would be the size of the Moon?

Pick your choice!

Answer: A tennis ball

Poster 2:

How Far Is the Moon?

If the Earth were the basketball, where would the Moon be?

There are marks on the floor: A, B, C, or D?

Answer

The one that is 23.5 feet away

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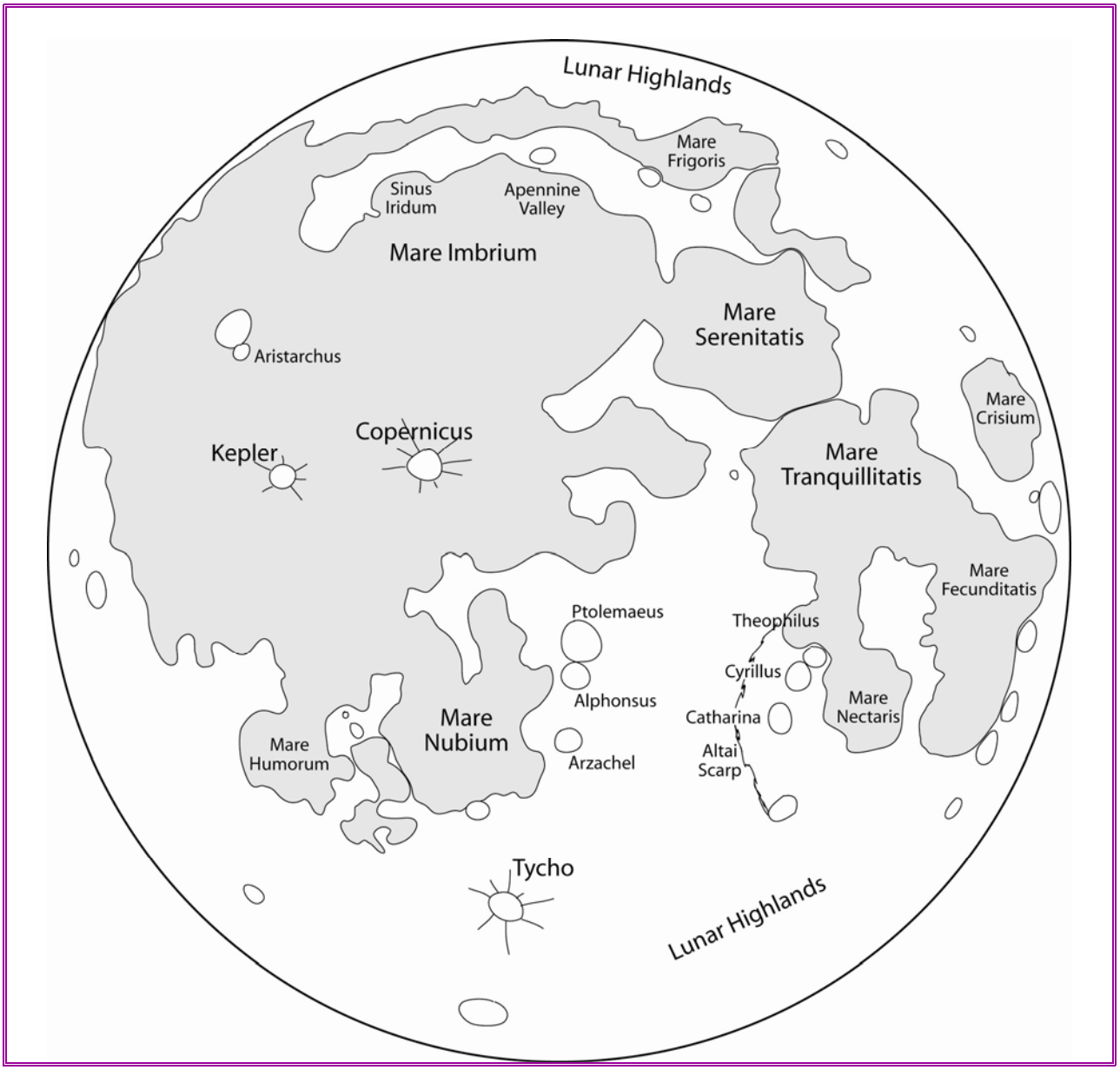
Passport to the Moon

On a night when the Moon is almost full to full, invite your family to go and view the Moon! Take some binoculars, snacks, a blanket to sit on, and some insect spray if the bugs are out at night. Or better yet, contact your local astronomy club to collaborate a night viewing session!

How many of the geographic features can you find on the surface of the Moon? You will not need the binoculars to spot many of them!



Passport to the Moon

A quick look at the Moon in the night sky – even without binoculars - shows light areas and dark areas. Can you find these features? Use the Moon map (above) to help!

Where you see  means that the feature is smaller and you will need binoculars or a telescope.

____ I have seen it!	**Sea of Tranquility** (Mare Tanquilitatus) – Formed when a giant asteroid hit the Moon almost 4 billion years ago, this 500-mile wide dark, smooth, circular basin is the site of the Apollo 11 landing in 1969.
____ I have seen it!	**Sea of Rains** (Mare Imbrium) – Imbrium Basin is the largest basin on the Moon that was formed by a giant asteroid almost 4 billion years ago.
 ____ I have seen it!	**Appenine Mountains** (Montes Apenninus) – Did you know there are *mountain ranges* on the Moon? The rims of the craters and basins rise high above the Moon's surface. Apollo 15 astronauts worked in the shadow of Mons (Mount) Hadley, one of the peaks of the Montes Apenninus. Mons Hadley is over 2 and a half miles high!
 ____ I have seen it!	**Copernicus Crater** – A small, bright circle south of Imbrium Basin, with rays spreading up to 500 miles in all directions, marks Copernicus Crater.
____ I have seen it!	**Sea of Serenity** (Mare Serenitatis) – Apollo 17 astronauts sampled some of the oldest rocks on the Moon from edges of the Sea of Serenity. These ancient rocks formed in the Moon's magma ocean.
 ____ I have seen it!	**Tycho Crater** - A bright star of material stands out on the light-colored lunar highlands of the Moon's southern half. This is Tycho Crater, a 50 mile wide crater with ejecta rays stretching over 1200 miles.
____ I have seen it!	**Lunar Highlands** – The lighter areas on the Moon are the lunar highlands. These are the oldest regions on the Moon; they formed from the magma ocean. Because they are so old, they have been hit by impact craters many times, making the highlands very rough.

What Do You See in the Moon?

Many cultures through time have developed stories about the features they observed on our Moon. One is the story that rabbits live on the Moon with a Katsura tree. Some people see an outline of a rabbit on the Moon, others see a dog, and still others see a man in the Moon, a crab, a lady knitting or reading a book, a man resting under a tree, a frog, a lizard …

The Moon is covered with light and dark areas. The light colored areas are the oldest part of the Moon's surface – they have many craters and are called the "cratered highlands." This part of the Moon's crust formed from a cooling magma ocean soon after the Moon formed 4.5 billion years ago! The basins were formed by BIG impacts early in the Moon's history. Later, lava filled these basins and cooled. The dark-colored plains we see are made of a fine-grained, dark, volcanic rock called basalt – the same rock type as found on Earth's ocean floors and the same type that makes up the islands of Hawaii.

In this activity, your child will use his or her imagination to discover an object or character in the Moon.

What You Need:

- Books that share stories about the Moon and what different cultures see when they look at the Moon. For example:
  Moontellers: Myths of the Moon from Around the World
  Lynn Moroney, 1995, Northland Publishing Company, ISBN 0873586018
- Images of features that different cultures see in the Moon (optional)
- Large photographs of the Moon
- Sheet of tracing paper to overlay on the Moon image (one per child)
- Tape
- Crayons and other craft items such as glue sticks, glitter, yarn, ribbon

What to Do:

- Share a story with your child about what a different culture sees in the Moon, and how that feature came to be.
- Using crayons, and other various craft items, invite your child to trace out the features to show their own representation of what they see on the Moon.

Parent Prompts:

What do you see when you look at the Moon?

What are the dark areas on the Moon?

What are the light areas on the Moon?

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Moon Phases Investigator Guide

The Moon is an easy object for young scientists to study. One of the best places to start is by making simple observations of the Moon on different days, drawing its shape, and noticing that the shape changes over time, and that there is a pattern to those changes. This is an appropriate activity for children ages 4 to 10; only when they are older will they be ready to understand the *reason* for phases.

In this activity, you and your child will put together a booklet that you can use at home to record regular observations of the Moon over one to 3 months.

What You Need:

- Moon Phases Investigator Guide printed double-sided, folded in half and stapled to create a small book
- A pencil
- About 5 minutes daily over a month

What to Do:

- On each clear day, go outside with your children and look at the Moon.
- Ask your children to draw the Moon inside their Investigator Guide, and to write down the date.
- After several observations, ask you children how the Moon is changing—is it getting bigger (waxing) or smaller (waning)?
- After a month, examine what your child has observed. Ask your children if there is a pattern to the Moon's shape. Invite them to predict what they will see for their next observation.

Parent Prompts:

What happens after a Moon is full (completely round)? (It begins to get smaller, or wanes.)

Does the Moon ever repeat the same shape? (Yes, it returns to the same shape after a month.)

Can we see the Moon during the daytime? (Yes, most phases of the Moon can be seen in the daytime and at night. The only phase that is unlikely to be seen in the daytime is the Full Moon.)

Moon Flip Book

Does the Moon always look the same? Of course it doesn't! We call these changing shapes the Moon's PHASES. The Moon appears a little different every day or night, and then begins to repeat its changes of shape or phase each month. In fact, the month is based on the changing Moon—it's a "Moon-th."

In this activity, your child will put together his or her own flip-book of the Moon's phases.

What You Need:

- Moon Phases template
- Scissors
- Stapler
- Crayons
- Various craft items

What to Do:

- Cut along the dotted lines of each Moon phase.
- Put them in order according to the picture. (Start with the "Moon Phases Flip Book")
- Align the right side of the book and staple the cover page and the phases together to create a flip book.
- Flip through the images to view the changing phases!

Parent Prompts:

Which phase is the Moon in today?

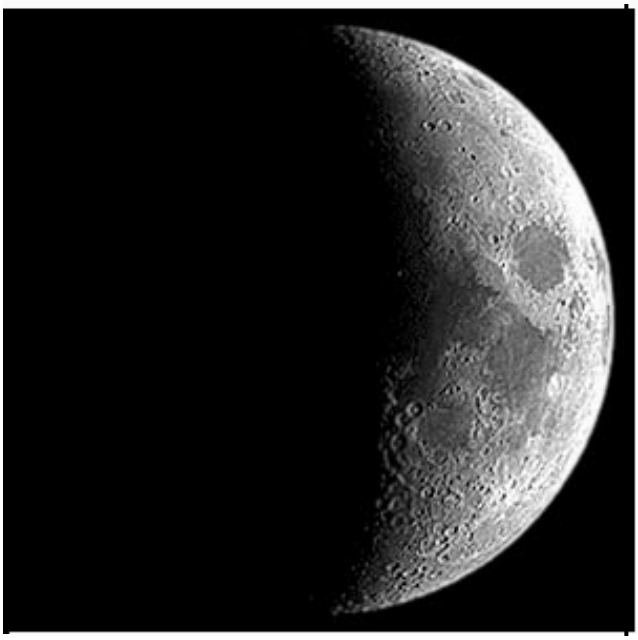
Invite your child to name the phases in order and to describe them.

Waxing Crescent

Waxing Crescent

Waxing Crescent

Waxing Crescent



Waxing Crescent

First Quarter

Waxing Gibbous

Waxing Gibbous

Waxing Gibbous

Waxing Gibbous

Waxing Gibbous

Waxing Gibbous/ Full

Full Moon/ Waning Gibbous

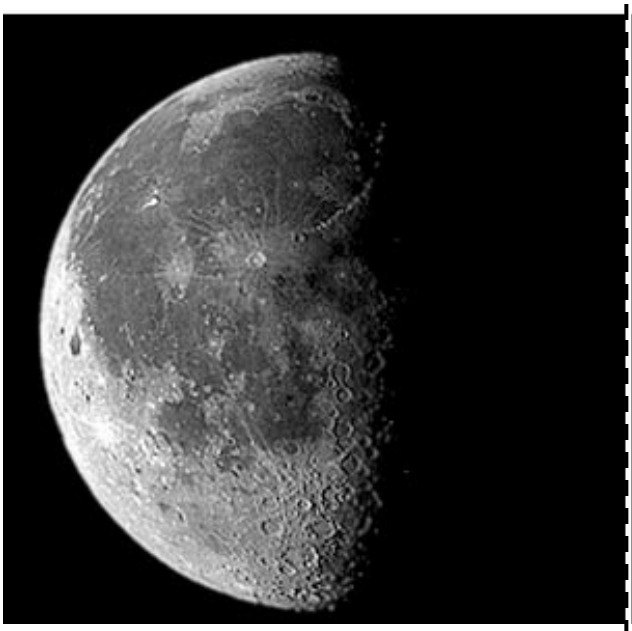
Waning Gibbous

Waning Gibbous

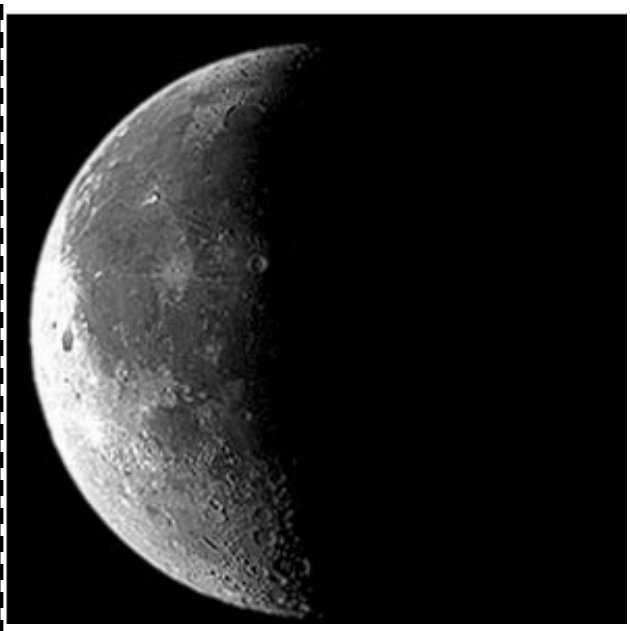
Waning Gibbous

Waning Gibbous

Waning Gibbous



Third Quarter



Waning Crescent

Waning Crescent

Waning Crescent

Waning Crescent

Moon Phases Flip Book

New Moon

Oreo Moon Phases

During a month, the part of the Moon that we see in the sky changes shape. It passes through different phases, growing from New Moon to Crescent to First Quarter to Gibbous to Full, and then decreasing in the amount *that we see from Earth* that is illuminated until it is back at New Moon again. Each of these stages is a "phase." Invite your child to create the 8 phases of the Moon using Oreo cookies.

In this activity, you and your child will learn about the Moon's phases using Oreo cookies!

What You Need:

- 4 Oreo cookies
- Paper towel
- Plastic knife, spoon or popsicle stick
- Phrases with Phases song sheet

What to Do:

- Twist open the Oreo cookies and remove the cream with the knife, spoon or popsicle stick so that it looks like the pictures below.
- Place the cookies in order in a line to represent the order of our Moon's phases.
- Point to and name the different phases with your child while singing the Moon phase song – Phrases with Phases.

Lunar Phases:

New Moon | Waxing Crescent | First Quarter | Waxing Gibbous | Full Moon | Waning Gibbous | Third Quarter | Waning Crescent

Parent Prompts:

What are the different phase names – can you place them in order?

What phase is the Moon in tonight?

How does the Moon's appearance change?

Which phase will the Moon change to next?

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Phrases with Phases

Lyrics by Becky Nelson, The Lunar and Planetary Institute
Sung to the tune The Ants Go Marching . . Moon phases and important terms are in capital letters.

Each Moon phase marches COUNTERCLOCKWISE —
Now, let's start . . .
The FIRST PHASE is the NEW MOON that we see as DARK.
Then next the WAXING CRESCENT shines
A LITTLE LIGHT upon the RIGHT,
And after that's the
QUARTER MOON, where the
RIGHT HALF'S LIGHT.

Following is WAXING GIBBOUS on the RIGHT,
Where the LIGHT continues SPREADING and becoming bright.
We'll be HALFWAY through the phases soon,
With the FULLest, brightest, biggest MOON,
Just before the DARK creeps
On the RIGHT
Of a WANING MOON.

The WANING GIBBOUS phase is when the LIGHT will SHRINK,
Then what will be the next phase after that, you think?
It's once AGAIN a QUARTER MOON,
But the DARK HALF's now upon the RIGHT,
And the LEFT side is the
One's that's BRIGHT!!
Did you get that right?

The next phase is the LAST phase where there's just a spark
Of light, so WANING CRESCENT appears ALMOST DARK!
The Moon is really magical,
When it's WAXING, WANING, NEW OR FULL.
And it COULDN'T SHINE at all
WITHOUT…….
THE SUN'S……..bright light!!

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Lunar Eclipse Demo

In this activity, children will create a Lunar Eclipse.

What You Need:

- Earth Globe
- Masking Tape
- Flashlight
- Tennis ball to represent the Moon
- 1 poster
- Print-outs of the below text

What to Do:

- Create a poster using the below text. Hide the answer under a piece of cardstock.
- Create a circle – the Moon's orbit around Earth – on the floor with masking tape. The circle should be around 4' to 8' in diameter.
- In the center of the circle, place the Earth globe on a table so that the globe is about chest-high for the children in your program.
- Outside of the circle, place the flashlight – the Sun - so that it shines on the Earth globe.
- Mark 4 places along the orbit with one being on the farthest side of the orbit (so that the light is blocked by the Earth globe and doesn't shine on the Moon.)
- Have children walk the orbit holding the "Moon" in front of them. As they walk the orbit, have them identify where the Earth's shadow eclipses the Moon.

What causes a lunar eclipse?

The Earth's shadow covers the Moon.

The light represents the Sun's light.

Follow the orbit on the floor to move a "Moon" ball around the Earth globe.

At which point in the orbit does the Moon become eclipsed—A, B, C, or D?

Answer: B

Recipe for a Moon

The Moon is proposed to have formed when an object - about half the size of Earth - struck the Earth early in its formation and broke off chunks of the Earth. Over time those chunks clumped together to form the Moon. The Moon has a core, mantle and crust just like Earth. The Moon's core is much smaller than Earth's, though. Also, the Moon's crust is thicker.

In this activity, you and your child will create an edible model of the Moon.

What You Need:

- 1 Rice Krispie Treat (mantle)
- ½ small marshmallow (core)
- Zip-loc baggie with chocolate Teddy Grahams and powdered sugar (crust)
- Rubber mallet
- Icing (crust)
- 1 spoon
- 1 cardboard plate
- Wet wipes or damp paper towels

What to Do:

- Eat one half of the small marshmallow, leaving half for the Moon.
- Open up the Rice Krispie Treat and place half of the small marshmallow (tell your child that this will be the Moon's core) in the middle of the treat. Gently wrap the treat (the Moon's mantle) around it. Form it into a ball, rolling it around to make it firm. Ask your child to compare the size of the mantle and core.
- With the mallet, crush the Teddy Grahams until they are crumbs, and work the crumbs and powdered sugar together until the color turns gray.
- Cover the Rice Krispie's Treat with a thick coat of icing and then roll it in the cracker and powdered sugar mix. Together, the icing, sugar, and crumbs will make the Moon's crust.
- Create craters in the crust using your fingers.
- Examine the model and then invite your child to eat their "Moon!"

Parent Prompts:

Which part of the Moon is in the center? [The core.]

What is on the outside of the Moon? [Your child may answer crater or crust.]

What is between the crust of the Moon and its core? [The Moon's rocky mantle.]

Build a Lunar Base

The Moon is very different from Earth. It has no atmosphere to breathe and temperatures that range from a *very hot* 130°C (265°F) during the day to a *very cold* 110°C below zero (–170°F) at night. The Moon spins slowly on its axis, so a day is about 14 Earth days long – and the night is about 14 Earth days long. The lack of atmosphere and magnetic field means that radiation dangerous to humans can reach the surface. There is no water, although there may be water ice trapped in the deep craters at the Moon's poles.

So, if humans are to live on the Moon they are going to need a place to work, rest, live, and have fun that protects them from the extreme heat and cold - and dangerous radiation - of the environment. They will need air to breathe. They will need power, light, food, and water. They will need medical facilities and ways to exercise to keep their muscles and bones strong. They will need transportation and equipment able to operate in these conditions. They will need to be able to communicate with Earth, other colonies, and transport shuttles. And they will need all of the equipment to maintain the station and conduct experiments.

In this activity, you and your child will build a habitable lunar base using craft items.

What You Need:

- 11x17" poster board
- Ruler
- Color pencils or crayons
- Craft items, including:
  - Aluminum foil
  - Styrofoam blocks
  - Meat trays
  - Plastic, Styrofoam, and paper cups of different sizes
  - Pom-poms
  - Small milk cartons
  - Foil cupcake holders
  - Buttons
  - Rivets
  - Color saran wrap
  - Old CDs
  - Screen, mesh fabric
  - Felt
  - Pipe cleaners
  - Toothpicks
  - Glue
  - Tape
  - Scissors
  - Wire
  - Egg cartons
  - LEGO's with wheels

What to Do:

- Ask your child what a future Moon base might look like?
- Ask them what types of things would be necessary to make the Moon habitable – what do they need and use in their lives? (air, water, food,

restrooms, electricity. Discuss these needs and invite them to create a habitable base that has everything to meet the needs of future astronauts.

- Other factors to consider might be rocket launch and landing pads, transportation on the surface, lab equipment, ways to call home, places to relax and ways to exercise….
- Based on your discussion about the needs of future lunar explorers, invite your child to build a base using the items available. Have them identify the different components as they are building the base.

Parent Prompts:

What would a lunar base require to be habitable?

What are some of the challenges that people may encounter while living on a lunar base?

If you were living in a space colony, what would you miss most about Earth?

Coloring Sheets

The following are links to possible coloring sheets and games.

Enchanted Learning - Moon
http://www.enchantedlearning.com/subjects/astronomy/activities/coloring/Moon.shtml

Enchanted Learning – Earth and Moon
http://www.enchantedlearning.com/subjects/astronomy/activities/coloring/earthMoon.shtml

Enchanted Learning – Moon Quiz
http://www.enchantedlearning.com/subjects/astronomy/activities/findit/qMoon.shtml

Moon Phases Word Find
http://its.guilford.k12.nc.us/webquests/Moon/puzzle.htm

Enchanted Learning – Label the Moon Phases
http://www.enchantedlearning.com/subjects/astronomy/activities/label/labelMoonphases.shtml

Explore the Moon!

Websites

http://www.enchantedlearning.com/subjects/astronomy/ Enchanted Learning offers tons of information, resources and activities about all astronomy topics for kids ages 5 and up.

http://www.windows.ucar.edu/ Windows to the Universe is great for anyone who is interested in space science. The website has 3 learning levels that range from beginner to advanced. There are games, links and lots of great information.

http://stardate.org/nightsky/Moon/ Stardate's website allows you to print out a calendar with the Moon's phases. Some guidance or assistance may be needed to print the calendar.

http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level2/Moonlight.html Learn all about the Moon's phases and play a game to test what you've learned at NASA's Starchild website. Appropriate for ages 5 and up.

http://www.dustbunny.com/afk/constellations/ The Dustbunny website provides astronomy information for kids. Learn all about the constellations here! This site is great for ages 8 and up.

http://www.lpi.usra.edu/education/skytellers/ The Lunar and Planetary Institute's SkyTellers program offers lots of information and activities for children ages 8 and up. Check out *Constellations*, *Polaris*, and *Moon Phases*!

Explore the Moon!

Books

The Moon Seems to Change, Franklyn M. Branley, HarperTrophy; Revised edition 1987, ISBN-10: 0064450651, ISBN-13: 978-0064450652.
The Moon's shape seems to change. Learn why that is in this great book by doing an activity. Appropriate for ages 4-8.

So That's How the Moon Changes Shape, Allan Fowler, Childrens Press Chicago, 1991, ISBN-10: 0516449176, ISBN-13: 978-0516449173.
Learn why the Moon changes shapes in this great book for 4-8 year olds.

Moon Observer's Guide, Peter Grego, 2004, Firefly Books Ltd., ISBN 1552978885.
Grego provides practical night-by-night guide to observing the Moon.

Full Moon, Michael Light, 1999, Knopf, ISBN 0375406344.
This book offers artful lunar photography featuring enhanced images from Apollo missions.

The Big Splat, Or How Our Moon Came to Be, Dana Mackenzie, 2003, Wiley, ISBN 0471150576. This is an account of the giant impact theory of the Moon's origin and a history of humanity's relationship with the Moon. This is a great book for parents to share with their children.

The Best Book of the Moon, Ian Graham, Kingfisher/Houghton Mifflin, 1999, ISBN 0753451743. In Graham's book, large colorful spreads with action-oriented text reveal the answers to questions children ages 7 to 11 want to know, including a section on eclipses and why the Moon seems to change shape.

The Moon, Carmen Bredeson, Franklin Watts Publishing, 1998, ISBN 0531203085.
Bredeson presents comprehensive coverage of a variety of Moon-related facts and topics, from Moon superstitions and myths to exploration. A myriad of interesting photos enhance the clear and concise text for children ages 8 to 12.

The Moon Seems to Change, Franklyn M. Branley, 1987, Harper & Row, ISBN 0064450651.
In this brief, easy-to-read text Branley presents a complete explanation of how our Moon changes shape. Colorful illustrations and diagrams and a simple experiment augment the text. Intended for ages 4–8.

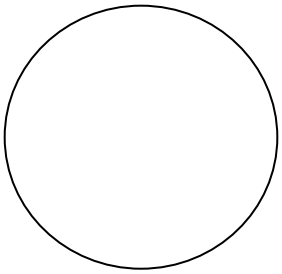
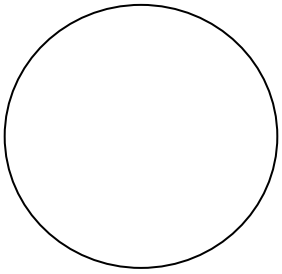
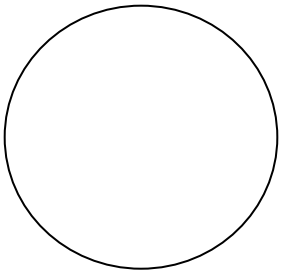
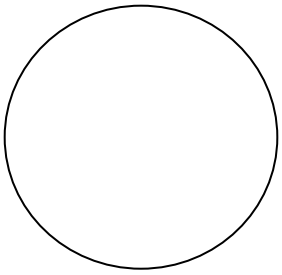
Reaching for the Moon, Buzz Aldrin, HarperCollins, 2005, ISBN 0060554452.
Buzz Aldrin, famed Apollo 11 Moonwalker, shares with children ages 7-12 his extraordinary adventures on the Moon, and all the events that led up to that remarkable journey. Colorful illustrations and personal insights from a man who lived the dream, make this an interesting and inspiring read.

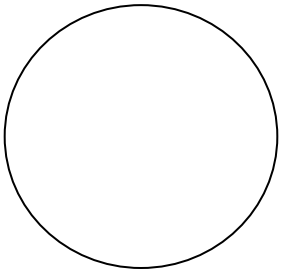
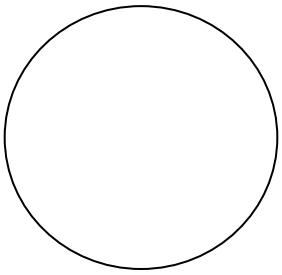
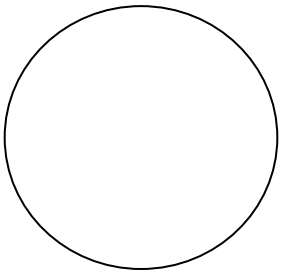
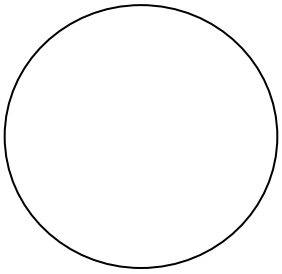
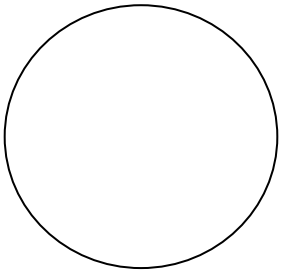
All About the Moon

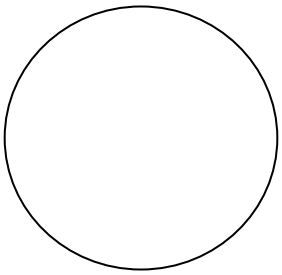
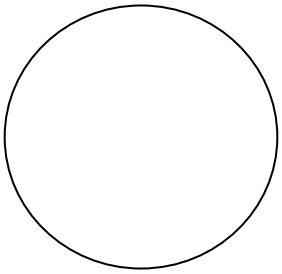
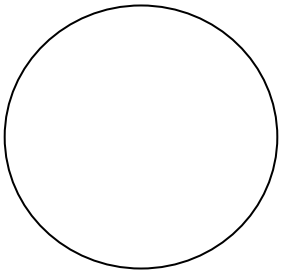
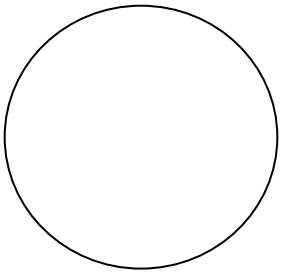
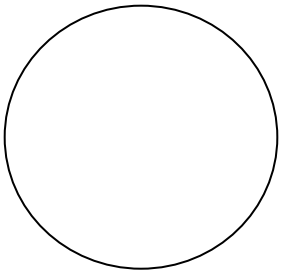
- The Moon is about 1/4th the diameter of Earth - it would take about 64 Moon's to fill up the Earth's inside.
- The Moon is ~250,000 miles from Earth - A trip takes humans 2 - 3 days.
- If the Earth were the size of a basketball, the Moon would be the size of a tennis ball and it would be about 23.5 feet away.
- The Moon's gravity is about 1/6th of Earth's - if you weighed 80 pounds on Earth you would weigh about 13 pounds on the Moon.
- The Moon does not make its own light. The Moon glows because it reflects the Sun's light. Planets (like Earth) and moons do not make their own light; only stars like our Sun make their own light.
- Lunar eclipses occur when the Sun, Earth, and Moon are all in a line, with the Earth between the Sun and Moon; the Moon is in the Earth's shadow.
- The mean temperature at the surface is 224° F on the side exposed to the Sun and 243° F *below zero* on the side facing away from the Sun.
- The Moon rotates about as fast as it orbits Earth (about 27 days) – so we always see the same side of the Moon from Earth.
- There is no atmosphere (or magnetosphere) on the Moon to project the surface from dangerous radiation or incoming meteoroids.
- You can see the dark circular lunar basins and light colored highlands on the Moon's surface.
- The light colored, very cratered highlands are the old lunar crust – the crust that formed from a magma ocean soon after the Moon formed 4.5 billion years ago!
- The basins were formed by BIG impacts early in the Moon's history.
- Later, lava filled the basins. The dark-colored plains we see are made of a fine-grained, dark, volcanic rock called basalt – the same rock that is found on Earth's ocean floors and that makes up the Hawaiian islands.
- While BIG impacts stopped occurring after about 4 billion years ago, smaller, more occasional, impacts continued, giving the Moon its cratered surface. All this pummeling has created layer of ground-up rocky "soil" - regolith - that blankets nearly the entire surface of the Moon.
- Since 1959 there have been 46 successful missions to the Moon, including orbiters, landers, and the Apollo missions. 12 Astronauts have walked on its surface between 1969 and 1972.

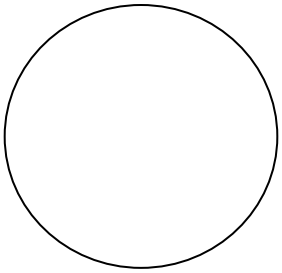
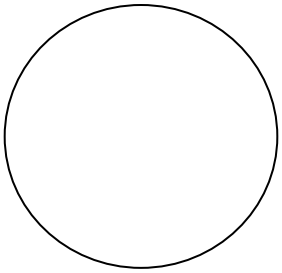
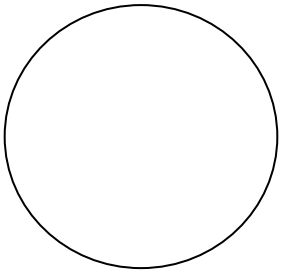
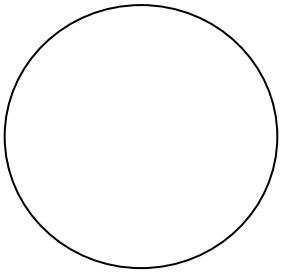
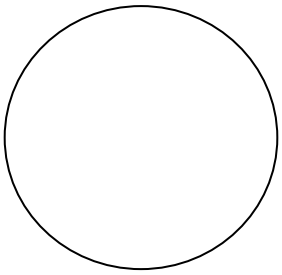
Chain of Phases

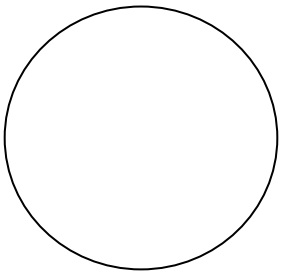
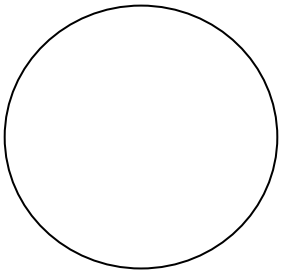
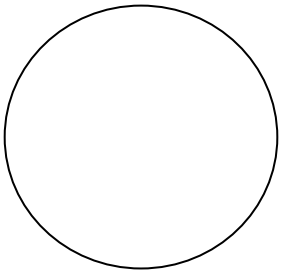
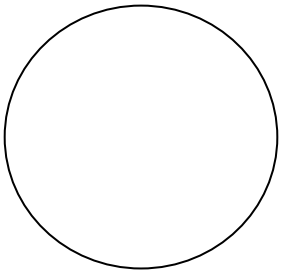
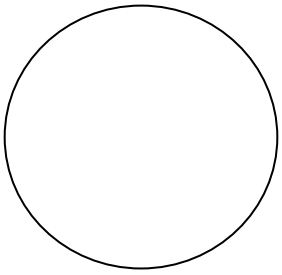
In this take home activity, you and your child will view the Moon over a period of one month. After viewing the Moon each evening, have your child draw the shape of the Moon onto one of the strips. The strips can be cut out and linked together like a chain.

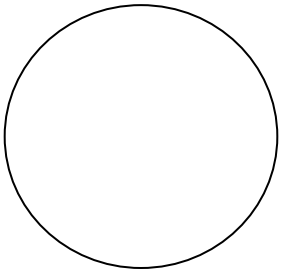
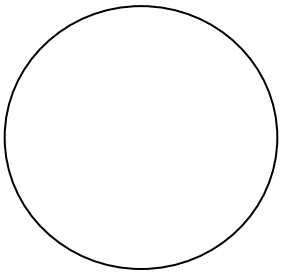
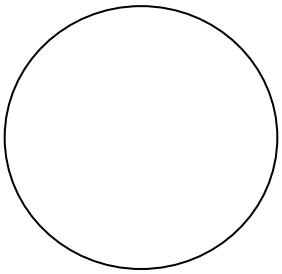
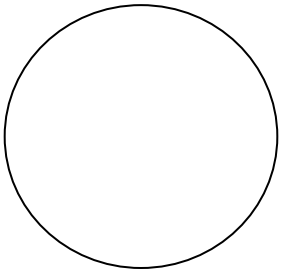
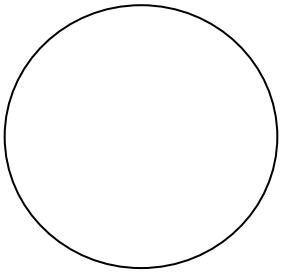
Day 1 Date:	
Day 2 Date:	
Day 3 Date:	
Day 4 Date:	

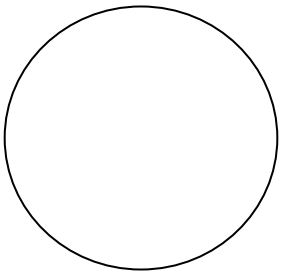
Day 5 Date:	
Day 6 Date:	
Day 7 Date:	
Day 8 Date:	
Day 9 Date:	

Day 10 Date:	
Day 11 Date:	
Day 12 Date:	
Day 13 Date:	
Day 14 Date:	

Day 15 Date:	
Day 16 Date:	
Day 17 Date:	
Day 18 Date:	
Day 19 Date:	

Day 20 Date:	
Day 21 Date:	
Day 22 Date:	
Day 23 Date:	
Day 24 Date:	

Day 25 Date:	
Day 26 Date:	
Day 27 Date:	
Day 28 Date:	
Day 29 Date:	

Day 30 Date:	
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