

Cycles in the Sky

RMSC Strasenburgh Planetarium school show

Transcript of recorded version

Rev. 5/27/09

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Hello, boys and girls, ladies and gentlemen, and welcome to the Star Theater at your Strasenburgh Planetarium, part of the Rochester Museum & Science Center. For the next forty minutes you will use your eyes, your ears, and especially your brain to learn about the sky. To be sure you don't miss anything you will need to pay quiet attention through the whole program. Your teachers and adult leaders will be watching and listening throughout the program to make sure everyone is paying quiet attention so everyone can learn today.

Your seat is made to give you a comfortable view of the ceiling here in the Star Theater. But the Star Theater ceiling is not like a regular ceiling. The Star Theater ceiling is shaped like a giant upside-down bowl. You might know the word for a ceiling with that shape – a dome. The dome here in the Star Theater is 40 feet high and 65 feet across. It is very smooth and light gray in color, so when we slowly turn down the lights the dome seems to go on forever like the sky.

To make the dome look like the sky at night, we use that amazing blue machine in the center of the room. It may look like a space station from the 60's, or a camera, or a robot, but it is ...a star projector. If it's a star projector, you can guess that its job is to project ...stars! The star projector contains many light bulbs, large and small, that project beams of light onto the dome. Each beam of light makes a point of light that matches a real star in the sky outside. We'll see the Planetarium sky, with stars on the dome, in a few minutes. The star projector also has lights that show us the sun and the moon, just where they belong for any time we want.

Our star projector was made in 1968 at a factory in West Germany called the Carl Zeiss factory. Since it was made at the Carl Zeiss factory, we like to call the machine Carl. We like to come into the theater every day, wave, and say “Hi, Carl!” Go ahead, try it. “Hi, Carl!” Today Carl will help us see things in the Planetarium sky that you can watch for in the real sky later.

“cycle”

Our program is called Cycles in the Sky. Now, you might have heard about cycles in school before. Maybe you’ve heard of the life cycle of a frog, or a butterfly, or the water cycle. But even if you have not had cycles in school yet, you probably already know the word cycle, because you know a word that has cycle in it. Think of a kind of transportation vehicle that is powered by someone’s legs and feet on pedals. The name of this vehicle has cycle in it. It is – a bicycle.

“Bicycle”

In the word bicycle, the prefix “bi” means two. What’s the main thing a bicycle has two of? Wheels! Now a bicycle also has two pedals and two handlebars, but the biggest two things are the wheels. If the vehicle has three wheels it’s what? – a tricycle. If it has one wheel, it’s – a unicycle. If it’s driven by a motor – a motorcycle.

Anyway, the word cycle means anything that happens over and over again, like a wheel going around and around. Today we are going to see things that happen over and over again in the sky – cycles in the sky. Today we will see three cycles in the sky.

“Day”

Our first cycle: the day. One day takes 24 hours. The day is caused by the rotation of the Earth. We’ll see how the sun takes a trip through our sky every day on the calendar, then it starts all those trips over again one year later.

“Year”

Our second cycle: the year. One year takes 365 days, or 366 days if it’s a leap year. The year is caused by the revolution of the Earth around the sun.

Our final cycle is fun to watch.

“Lunar month”

Maybe you have noticed that the moon seems to have different shapes on different days or nights. Those shapes are called phases of the moon. They are not random. They change in a cycle we call the lunar month. Lunar means having to do with the moon, and you can remember that month sounds a little like “moonth.”

The day, the year and the lunar month. Those are the cycles in the sky we will see today.

To get started, let’s change the lights and bring Carl up on his elevator, to make the Star Theater dome look like the daytime sky.

Blue sky

Daytime sky scene

This is the Planetarium’s way of showing daytime. It’s not as bright as real daytime outside, because the Planetarium sun is not as bright as the real sun outside.

If we want to find things in the sky, it always helps to know which way is north, which way is south, which way is east, and which way is west. Here in the planetarium we have green letters to give us a clue. Take a moment to look around, quietly, and find green letters for north, south, east and west. Also, look for the rising sun.

Now, to help everyone look at the same thing in the Planetarium sky, here’s something else you’ll see only in the Planetarium: a special flashlight that makes a green arrow.

Compass directions

Let’s follow the green arrow to the green letter S. You can guess that stands for – south. Now, where should we look for an N for north? Behind you? Follow the green arrow. Now, which way is west? Which way is east?

And there’s the Planetarium sun, rising on the first day of spring. You might think that’s supposed to be the moon, but it’s Carl’s way of showing the sun.

On the first day of spring, the sun rises exactly in the east, right behind the green E.

Now Carl will do one of the things he does best: put time in fast forward, like holding down “forward scan” on a DVD player. We’ll go through all of the morning of the first day of spring in just a few seconds.

Sun rising

Now we see the sun going up, or rising, as it does every morning. But, when we see the sun rise the real sky outside, is the sun really going up, or is something else moving? In the real world outside, we see the sun rise because our Earth is moving. We all live on the outside of a big round ball we call planet Earth. Earth is always turning slowly – we call that rotation. But Earth’s rotation gives us such a smooth ride that we feel as if we’re standing still. So, to us, the sun *appears* to go up in the sky.

Sun stops at highest point

When the sun is above the S for south, it is at its highest place in the sky for the entire day. Would you all please quietly point to the sun so your arm will remember how high the sun gets in the middle of the day on the first day of spring?

Okay, you can rest your arm now. Next, think quietly about where the sun will go down on the afternoon of the first day of spring. Watch that place. Carl will show us how the sun goes down and sets on the first day of spring.

Sunset and night

On the first day of spring, the sun sets exactly in the west.

Now, if we let the Earth rotate some more, our side of Earth will turn away from the sun. The sun will set. Students and teachers, please watch quietly what happens next. The sky darkens, and other suns appear. We call them stars.

Sky darkens

Boys and girls, ladies and gentlemen, in a few minutes we will find the Big Dipper, the North Star and Leo the Lion. But not yet. Right now, please look east, and see stars rising. Then look south, and see stars moving across the sky. Then look west, and see stars

setting. But, in the real sky outside, do you think stars are going up, across and down just for our entertainment, or is something else really moving? Outside, in the real world, WE are moving, because we all live on the outside of a big round ball we call planet Earth. Earth is always turning slowly – we call that rotation. But Earth’s rotation gives us such a smooth ride that we feel as if we’re standing still. So to us the stars look like they moving around us.

Well it’s been nighttime for a while. Sooner or later the sun will rise to begin a new day. Would you please quietly watch the place where you think the sun will rise on the morning after the first day of spring. Carl will show us sunrise on that day.

Sunrise, next day

And there’s the sun, rising again. But wait – we already saw this. We just finished a cycle, and we’re starting it over again. Outside, in the real world, how many hours does it take to go from one sunrise to the next? Twenty-four hours. Another name for that length of time is one...day. In astronomy, when we say a day, we mean the daytime part plus the nighttime part together. They always add up to 24 hours.

So we just finished our first cycle, the day.

Now this sunrise, on the day after the first day of spring, may look about the same as the last sunrise, ON the first day of spring. But if we measured it carefully we would see the sun is in a slightly different place.

To help us understand that better, let’s see another feature of Carl, the star projector.

Orange dotted line marked with sun’s positions at various dates of the year

Look for an orange dotted line with dates on it. If we want to see what the sun does on some particular date, we turn on knob on the star projector control panel, and the sun moves to whatever date we want. Then Carl can show us how the sun rises on that day.

Let's look at what the sun will do on some other interesting days of the year – for example, the first day of summer. That's usually June 21, so we will move the Sun to June 21 on the orange dotted line.

June 21

All right, the Sun is on June 21. Carl, please show us how the sun rises on the first day of summer.

Look at the difference! On the first day of spring, the sun rose right behind the green E for east. Every day after that the sunrise was a little farther toward the north – March, April, May, June... and now, on the first day of summer, the sun is as far north as it will ever get. Teachers, this is the day of the summer solstice.

Now let's see what the sun does in the sky on the first day of summer.

Sun's path on first day of summer

First it rises – or that's how it looks. Actually, we all live on the outside of a big round ball we call planet Earth. Earth is always turning slowly – we call that rotation. But Earth's rotation gives us such a smooth ride that we feel as if we're standing still and the sun is going up. Get ready to point to the sun when it's above the green S for south.

Sun's highest position on first day of summer

This is the sun at its highest place on the first day of summer. Would you all please quietly point to the sun so your arm will remember how high it gets?

Teachers, even on the summer solstice the sun never gets directly overhead in the Rochester-area sky. At its highest it's about 71 degrees above the horizon.

In the middle of the day, on the first day of summer, the sun is higher than it will ever be at any other moment of the entire year. Teachers, this does not happen at noon, but a few minutes after 1 o'clock in the afternoon, because we're on daylight saving time and we're not exactly in the middle of the eastern time zone.

Okay, you can rest your arm if you want. In the middle of the day on the first day of summer, the sun is shining down almost on top of your head. Now think about your shadow on the ground at that moment. You won't have a shadow in here on the floor of the Planetarium, but outside, where the real sun is much brighter, you will, if it's not cloudy. Will you have a *long* shadow, or a *short* shadow right underneath you? Actually, in the middle of the day on the first day of summer, you will have the *shortest* shadow you will ever have. Now if you can't go outside a few minutes after 1 o'clock on the first day of summer, the sun is in practically the same place at that time for about a week before and after that date. If you can, go outside at that time and check out your short shadow.

Also, since the sun's rays are coming almost straight down on our part of the world in the middle of the day on the first day of summer, each square foot or acre or square meter or hectare of land gets more solar energy than any other time of year. That's one reason summer is warm.

Now let's finish the first day of summer. Predict in your mind where the sun will go down and set. Watch that place quietly, and Carl will show us the setting sun on the first day of summer.

Sunset on first day of summer

On the first day of summer, the sun sets as far north as it will ever get. And look at the long trip the sun takes in our sky on the first day of summer.

Summer laser line

On the first day of summer the sun is in the Rochester sky for more than 15 hours. Sometimes we call this the longest day of the year. The entire day still lasts 24 hours from one sunrise to the next, but more of it is daytime than any other day of the year.

Okay, we're done with summer. What is the next season after summer? It's fall, or autumn. The first day of fall, or autumn, is about September 22. Let's move the sun on the orange dotted line to September 22.

Sun moves to Sept. 22

Now the sun is at September 22. Carl, please show us how the sun rises on the first day of fall.

Sunrise on first day of fall

If we were all sitting in the best seat in the theater, right on top of Carl the star projector, we would see that the sun is rising exactly behind the green E for east. On the first day of fall, the sun rises exactly in the east. But wait – we saw the sun rise exactly in the east before – it happened on the first day of spring. So, on the first day of fall and the first day of spring the sun rises exactly in the east.

Now, let's see what the sun does during the rest of the day on the first day of fall.

The sun is rising. Get ready to point to the sun when it passes above the S for south. We won't stop this time. Is the sun higher than it was in summer, or lower? In the fall, the sun is lower than in summer.

Now, where will the sun set on the first day of fall?

Exactly in the west. But wait – we saw the sun set exactly in the west before – it happened on the first day of spring. So, on the first day of fall and the first day of spring the sun sets exactly in the west.

On the first day of fall, the sun takes about 12 hours to go from rising to setting. Day and night are nearly equal. Teachers, our word equinox means equal night.

Okay, we're done with fall, or autumn. What is the next season after fall? It's winter. The first day of winter is about December 21. Let's move the sun on the orange dotted line to December 21.

Sun to Dec. 21

Now the sun is at December 21. Carl, please show us how the sun rises on the first day of winter.

Look at the difference! Remember, on the first day of spring, the sun rose exactly in the east. Every day after that the direction of sunrise moved farther and farther north until the first day of summer. Then the direction of sunrise stopped and started to move south. Teachers, the word solstice means sun stop. On September 23 the sun rose exactly in the east again. After that, the direction of sunrise moves south until the first day of winter. Then, the sun is as far south as it can get. Let's see what the sun does during the rest of the day on the first day of winter.

Get ready to point to the sun when it's above the green S for south. This time we'll stop in the middle of the day.

In the middle of the day on the first day of winter, the sun is low. The sun's light hits you almost sideways. Everything has long shadows. The sun's rays shine on our part of the world at a slant, so each square mile or acre or square meter or hectare of land gets less solar energy than any other time of year. That's one reason winter is cold.

Here's the other reason winter is cold. Watch where the sun sets.

On the first day of winter, sunset is as far south as it can get. And the sun is in the sky for only about 9 hours. Sometimes we call this the shortest day of the year. The entire day still lasts 24 hours from one sunrise to the next, but less of it is daytime than any other day of the year.

Okay, we're done with winter. What is the next season after winter? Spring – again! Let's move the sun to March 20.

Sun to March 20

You know what's going to happen. The sun will rise exactly in the east, go medium-high, and set exactly in the west. We already saw that, so let's move the sun a little later in the year, to sometime in the middle of spring.

Sun to a typical springtime date

Later on in spring, the sun takes a higher trip through the sky than it does on the first day of spring, but not as high as it will on the first day of summer.

Here's another way to remember what the sun does.

PAN: solstice/equinox azimuth arrows

Look around for big arrows of three different colors: light yellow, orange, and light blue. You can figure out what the colors mean. The light yellow arrows ...show us sunrise and sunset on the first day of summer. The light blue arrows ...show us sunrise and sunset on the first day of winter. And the orange arrows ...show us sunrise and sunset on the first day of spring OR fall.

Now, boys and girls, ladies and gentlemen, sit back in your seats and try to look at the whole sky at once. You can imagine that the sky is a big playing field, and the green laser lines are the boundaries. The sun always stays within the boundaries. On the first day of summer, the sun is at the northern boundary. On the first day of winter the sun is at the southern boundary. The days we call the first day of spring and the first day of fall are the days when the sun is exactly halfway between the two boundaries.

Now let's take away the laser lines and the arrows so the Planetarium sky looks more like the real sky. Teachers and students, let's watch quietly for a moment while the sun sets and the stars come out again.

Sunset, more contemplative this time

Ladies and gentlemen, boys and girls, let's now look quietly at the stars. It is springtime, but you can still see some famous stars of winter, up until sometime around Memorial Day. Maybe you've heard of Orion, or Orion's Belt. To see Orion's Belt in springtime, look west right after dark. Go partway up in the sky until you see three stars close together in a row. That's Orion's belt. Orion, O-R-I-O-N, is the name of a big man in stories that people used to tell thousands of years ago. If you connect the stars, like connecting the dots in a coloring book, you can see the shape of a man. The three stars in a row are supposed to be sparkling jewels in Orion's belt. There are stars for Orion's shoulders...and his feet or knees. Put them all together, and Orion is a big stick man in the sky.

Now we will use Orion's Belt to find a very interesting star. Pretend the belt is a ruler. Draw a line to the left and keep going till you come near a very bright star. That is the brightest star in the entire night sky. No, it's not the North Star – we'll see that later. This star is called Sirius, spelled S-I-R-I-U-S. Sirius seems to be winking on and off. That's twinkling. You may have heard of the children's song "Twinkle, Twinkle, Little Star." Now you see what that song is about. Twinkling is also called scintillation. But Sirius is not really winking on and off. Instead, moving air in Earth's atmosphere, just above our heads, bends the light of Sirius back and forth just before it reaches our eyes. Sometimes we get more light from Sirius, sometimes less. Check the real sky outside, and you'll see other stars scintillate or twinkle, especially when they are low in the sky.

Now we will let the Earth rotate until it's later in the evening. Sirius and Orion will set. Now, look high in the sky, right in front of you, for a group of stars that skywatchers always look for in the spring: Leo, the lion.

Sky changes due to Earth's rotation until Leo is high in the sky

Of course, there's not really a lion in the sky. But you might be able to imagine a lion if you look for two shapes: first, a shape like the curved hook on the top of a coat hanger. The curve goes around the back of the lion's head. Teachers, the traditional name for this star group is the sickle, a tool that farmers once used to cut grass by hand. There's a curved blade...and a handle. Next, look for a triangle pointing to the lion's tail. Put the curved hook, or Sickle, together with the right triangle, and you might be able to imagine a lion.

In spring 2009, Leo seems to have an extra star under his right rear foot. If we look at it through an instant telescope...we can see that it's not a star, it's a planet...the planet with the most famous rings...it's Saturn. In 2009, Saturn is visiting Leo. Next year, Saturn will be behind Leo's back foot...in 2010, still farther back, in 2011, still farther back. Planets move compared to the stars. You

can track the progress of your life over the next few years by watching Saturn depart from Leo.

In spring 2010, Leo seems to have an extra star behind his right rear foot. If we look at it through an instant telescope...we can see that it's not a star, it's a planet...the planet with the most famous rings...it's Saturn. In 2010, Saturn is just behind Leo's back foot. Next year, Saturn will be farther back, in 2011 still farther back, in 2012, still farther back. Planets move compared to the stars. You can track the progress of your life over the next few years by watching Saturn depart from Leo.

Big Dipper outline as mentioned

Always near Leo in the sky, there is a star shape almost everyone has heard of. It's the Big...Dipper. Connect the stars and you see three stars for the handle, where you hold the Dipper...and four stars for the cup, where you put the water.

Here's the most important thing to know about the Big Dipper. The last two stars in the cup are called the Pointer Stars. Use the Pointer Stars in the Dipper's cup as a ruler, and draw a straight line going out the open side of the cup. Keep going till you come near a medium-bright star. That star is so famous, I'm sure you've heard of it. Here's a hint: it's always above the green N for north. It's the North Star.

Little Dipper

In case you're wondering about the Little Dipper – you are looking right at it. We do not have a picture of the Little Dipper, but you can imagine it if we point out the stars. The Little Dipper has seven stars, and some are very faint, so watch carefully. First the handle, then the cup: One, two, three...four, five, six, seven. Here it is again: the curved handle...and the small square cup...of the Little Dipper.

Polaris, the North Star

The North Star is the end of the handle of the Little Dipper. Sometimes people say they've heard that the North Star is the

brightest star in the night sky. Look around – do you think it is? No, it's not. Actually, we already saw the brightest star in the night sky, Sirius. The North Star is NOT special because of how bright it is. With the help of Carl the star projector we can see why the North Star IS special.

Sky motion caused by Earth's rotation

This is how the sky changes during the night as our Earth rotates. What's the North Star NOT doing? It's not moving. That's what is special about it. As Earth rotates, we don't feel as if we're moving, so the stars appear to go around in circles every 24 hours. But the North Star stays in the same place. The North Star is special because it does not move. So, anytime you look, no matter what time of night, no matter what season of the year, the North Star is in the same place. Face the North Star and you can be sure you're facing north.

Can you still find the Big Dipper?

Because the Earth was rotating, the Big Dipper moved to a different part of the sky. But the pointer stars always work, no matter where the Big Dipper is.

Now, ladies and gentlemen, let's relax and look to our left, to the east. It's very dark now, so you might be able to see a hazy band of light stretching over us. Someone, long ago, thought it looked like milk spilled in a river and called it...the Milky Way. It is really millions of stars, so far away and so faint that they seem to blend together like a glowing mist. Most of us do not see the Milky Way at night because most of us live in a city or a suburb where bright lights make the sky glow all night.

So far we have seen how the stars move in the night sky, and how the North Star doesn't move. We saw how the Sun rises and sets every 24 hours in a cycle we call the day. We saw how the Sun takes a different trip through our sky every day on the calendar, then starts all those trips over again in a cycle we call the year. We have one more cycle to look at: the cycle of phases of the moon. We will change the sky and have Carl show us the sun and the moon in the sky at the same time.

Sky brightens

Sky changes so we see both Sun and moon

Here are some important things to know about the moon:

The moon and the sun look about the same size in our sky, but they are really completely different things. The sun is a giant ball of fiery gases 93 million miles away. The moon is a lump of rock, smaller than the continental United States, about one quarter of one million miles away.

The moon goes all the way around the Earth in less than a month. So if we move the sun just a little on the orange dotted line, the moon moves a lot.

The moon can be seen in the daytime almost as often as at night. Most people just don't bother to look for the moon in the daytime, so they don't see it.

At different times the moon seems to have different shapes. Those shapes are called phases, and they are not random. The phases of the moon change in a cycle that takes about 29 1/2 days. The cycle of phases of the moon is sometimes called the lunar month. Lunar means having to do with the moon.

New moon

Sometimes, the moon is so close to the sun's place in the sky that we cannot see it – for two reasons. First, the real sun is so incredibly bright that we cannot see anything else near it in the sky. Second, at these times the side of the moon facing us has no sunshine on it, so it's dark. The time when there seems to be NO moon in the sky is called NEW moon. NEW moon means NO moon can be seen in the sky.

But if we wait two or three days, the moon moves away from the sun's direction.

Waxing (young) crescent moon

Sunset glow

Then, if we look just after sunset, low in the west, we see a thin curve we call a crescent moon. People around the world watch for

this because the first sighting of the crescent moon in each lunar cycle marks the beginning of a new month in both the Jewish and Muslim religious calendars.

Let's say you see a thin crescent moon one evening, and you say to yourself, "I want to see that again tomorrow." Well, the next evening it won't be the same.

Moon advances through phases

The moon will be higher, and the crescent will look bigger. That "getting bigger" is called waxing. These are the waxing crescent phases of the moon. Every evening for about a week, the waxing crescent moon appears higher and looks bigger.

Then comes an evening when you look south, around the time the sun is setting, and you see what looks like a half moon. Astronomers call that a first quarter moon, because the moon has completed the first quarter of its cycle of phases.

After that, for about a week, you will look high in the sky in the afternoon, while the sun is still up, and you'll see the moon with a shape that looks as if there's a rounded hill on one side. That's a gibbous moon. Gibbous, g-i-b-b-o-u-s, comes from a Latin word that means shaped like a hill. Every afternoon it looks bigger, so these are waxing gibbous phases.

Then, one evening, about the time the sun is setting, or maybe an hour earlier or later than that, you'll look in the opposite direction from the sun and see the moon rising, with the shape of a FULL circle, FULLY lit by the sun. This phase we call...FULL moon.

The full moon, and only the full moon, is in the sky all night. Let's follow the moon across the sky on the night when it is full.

Sunset glow fades off

Full moon crosses the sky,
apparent motion caused by
Earth's rotation

If the full moon rises when the sun sets, then the full moon should set at the time the sun rises. So, as the full moon sets, look in the opposite direction for the sun rising.

Now, let's say that you get up some morning and you see the full moon setting at sunrise, and you say to yourself, "I want to see that again tomorrow!" Well, tomorrow, it won't be the same. The moon does not wait.

Waning (old) gibbous moon

The next morning the moon will appear higher. The morning after that, higher still. Once again the moon has a shape that seems to have a rounded hill on one side...a gibbous moon. But this time the "hill" is on the other side, and the moon seems to be getting smaller every morning. That getting-smaller is called waning, so these are the waning gibbous phases.

Last (third) quarter moon

Then comes time when you might look south in the morning as you're going to school, and you see what looks like a half moon. Astronomers call this last quarter moon, because the moon has only the last quarter of its cycle of phases left to go.

Sunrise glow

After that, early in the morning, as a reward for those who get up early, in the glow before sunrise, the waning crescent phases of the moon appear lower and lower each morning. Finally, once again, we have a time when the moon is so close to the sun in the sky that we can't see it. There seems to be no moon in the sky. The phase is NEW moon.

But, if we wait two or three days, the moon moves past the sun's place in the sky. It appears as a thin waxing crescent in the west just after sunset, and the cycle begins again. The complete cycle of phases of the moon takes about 29 1/2 days.

Let's look at the phases of the moon another way.

Large pictures of moon phases

Everyone loves this picture, but what phase is it? It's a crescent moon. And if it seems to be getting bigger every evening, is that waxing or waning? It's a waxing crescent.

Then comes first quarter moon.

Then the shape that seems to have a hill on one side – the name starts with G – gibbous.

Then comes the phase of the moon everyone's heard of, full moon.

Next, the phases almost no one has heard of because you have to stay up late or get up early to see it, the waning gibbous phases.

Then comes the phase you might see on your way to school in the morning, last quarter.

Then, as a reward for those who get up early, the waning crescent phases appear just before sunrise. Finally new moon marks the end of one cycle and the beginning of the next.

VIDEO: moon phase animation with labels

What would the phases of the moon look like from outer space? Here's a movie we made on a computer. You can see the Earth, rotating every 24 hours to make day and night for the people on Earth, and you can see the moon going around the Earth. There is not really a white line in space. The computer put that in to show where the moon goes. The sun is way outside the picture, shining on the Earth and the moon.

Remember that we humans are little tiny people living on that rotating Earth. The names for phases of the moon are just names for how the moon looks to us. Sometimes the side of the moon facing us has no sunshine on it, so we call that new moon. After that, the side of the moon facing us has just a little sunshine on it, so we call that a waxing crescent moon. Then, about half of the side of the moon facing us has sunshine on it, so we call that first quarter. Then we have the waxing gibbous moon. What phase comes next? It's full moon, but this full moon is special – watch carefully. It went through the shadow of the Earth, so we had a lunar eclipse.

Now let's change our point of view and see how this look to us on Earth. Of course, there is not really a white line in space. That's just to show us where the moon goes. In a moment you'll see the planets Venus and Mercury and the Sun. Sometimes the moon gets between us and the sun, and we see...a solar eclipse. The next solar eclipse that will be noticeable in Rochester will be in the year 2017.

So you can see that the phases of the moon are NOT caused by clouds; they are NOT caused by shadows; they are NOT caused by the Earth hiding anything. The phases of the moon are simply changed in how much of our side of the moon has sunshine on it. Every day and every evening it's a little different. The phases of the moon change in a cycle that takes 29 1/2 days.

Ladies and gentlemen, we have finished our final cycle in the sky for today. A cycle is something that happens over and over again, like a wheel going around and around.

We saw three cycles in the sky:

"Day"

first, the day, which takes 24 hours from one sunrise to the next, caused by the rotation of the Earth. We saw how the sun takes a different trip through our sky every day for a year, then starts all those trips over again one year later.

"Year"

That was our second cycle, the year. A year takes 365 days (or 366 days in a leap year) and is caused by the revolution of the Earth around the sun. Finally, as our third cycle, we saw how the phases of the moon change in a cycle we call the lunar month.

"Lunar month"

The cycle of the lunar month is caused by the revolution of the moon around the Earth, and it takes about 29 1/2 days.

Now that you have seen these cycles in the Planetarium sky, we hope you will watch for them in the real sky. And if you want to find out what else is happening up in the sky and out in space, we hope you will visit the Planetarium again!

End of program