mystery science

Lesson: “Why does the Moon change shape?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! The Moon, isn't it great? Of all the things in the sky, the Moon has to be the most familiar. It's probably one of the first things you noticed about the world. It's usually a word that little kids learn in their first year of speaking. Since you've known the Moon your whole life, it's really easy to take for granted. It's just kind of there at night, right? It's just a big, bright nightlight in the sky, but it's really not just a nightlight. The Moon is a whole world circling over your head each night. It's full of surprises and mysteries. Like, why can we sometimes see it during the day, and where does the Moon come from, and what's the Moon made out of? Some of these are mysteries scientists have solved, and others, they're still not completely sure yet. Here's the mystery you can notice every night. Sometimes, the Moon looks like this, nice and round. A full Moon, we call it. But sometimes it looks totally different, like this or this or even this. None of these are completely round like the full Moon. All these different shapes are what we call the phases of the Moon. What's going on with all these shapes? Why does this happen? This is the mystery you'll solve today. Why doesn't the Moon always look round? Why does it seem to change shape? Do you have any ideas? Before you just guess, be scientific about this. Ideally, you would spend some time outside actually observing the Moon, making a note of its phase each night, to get as much information as you can. What you'd want to see is how often does the Moon change phases? Every night? Every week? What exactly is going on from night to

night? Now, for convenience, I took a photo of the Moon every night for a month, which you can look through now. You'll see a photo I took with my camera, right here, and in the background is what I saw with just my eyes, standing there looking at the Moon in the sky. Are you ready? Pay attention to both the close-up of what the Moon looked like each night and where it was located in the sky.

EXPLORATION VIDEO 2

Some people have wondered if the reason the Moon has different phases is because the Moon itself might actually be changing shape. But if you look carefully at the real Moon, you can usually see that the rest of the Moon is still there. You see that? So the Moon is always a sphere. It never actually changes shape. So then why does the Moon have phases? When you look at the photos I took of the mMon each evening, hopefully you noticed a couple of clues. The first thing you probably noticed is that the phases go in order. When you observed, you saw a pattern, a very certain order. It's not like one night the Moon was this shape, and then the next night it was this shape, and then back to this shape, and then this shape. No. That didn't happen. Instead, it always went like this, starting with a crescent Moon, and each evening as I came out to look the Moon had gotten a little bit bigger, eventually becoming the half Moon phase, then the phase we call gibbous, and finally, after about two weeks, a full Moon. The second thing you might have noticed is that, even though I went outside at the same time each night, the Moon wasn't always in the same place. As the Moon's phase was growing, it was getting farther and farther away from the Sun in the sky each night. So notice that the phases seem to have something to do with the Sun. When the Moon looks close to the Sun in the sky, it's a thin crescent. And when the Moon looks far away from the Sun in the sky, it's a full Moon. Keep in mind that the Sun is like the light bulb of our solar system. It's what lights up the Earth,

and it's what lights up the Moon, too. Using a light bulb in a dark room, you can actually create the effect of a Moon phase on any ball-shaped object. Like, this is a picture I took of an orange. So here you see, I guess we'd call it full orange. But now here, I made it a crescent orange. Or here's some guy named Dave—hey, Dave. And crescent Dave. So you can see how using an orange, or any round object, it should be possible to figure out how to make the Moon's phases, right there in your classroom. You're going to get the supplies to do this in just a minute. Before you do though, notice one last hint from your observations. Did you notice how over the course of the evenings the Moon seemed to move in an arc across the sky? It's like a section of a circle. Maybe you've heard the idea of an orbit. That the Moon goes in a circle around the Earth once each month. Could this have anything to do with why we see Moon phases? Let's call this clue number three: that the Moon goes in an orbit around the Earth. In the next video, you're going to get a bright light to use as a model of the Sun, and a ball to use as a model of the Moon. So given all the clues you've seen now, see if you can figure out how to make a model that shows the Moon's phases. Spend a few moments now thinking of some ideas you might try out.

ACTIVITY VIDEO 1

In this activity, we're going to create a model of the Moon's orbit to see if this can explain why the phases change. I did this activity with a partner, and I made sure the room was as dark as possible. The darker you can get the room, the better the activity's going to work. Here are the supplies you'll need: a smooth Styrofoam ball, a wooden stick such as a skewer, and a bright flashlight. When you're done with this step, press the arrow on the right.

ACTIVITY VIDEO 2

Are you ready? The Styrofoam ball's gonna be your model of the Moon. Stick the skewer in the Styrofoam ball, so now you have a stick to hold your moon. Now we need a light source. For this, we'll use the flashlight. One of you will hold the flashlight above your head like this, while the other person will hold the moon on the skewer. You're gonna want to hold it the length of one hand away from your head and keep your first at about the level of your chin so that the moon will be pretty high up over your head. You don't want the moon to be at eye level. You want to have to look up at it, so have the moon be above your head. Now here's what you're gonna want to do. I'll do an example first, and then you can try it out for yourself. So watch this. What I'm doing is keeping my eye on the moon and noticing what happens as I go in a circle. So you ready? Go ahead and turn the flashlight on. Turn off the lights. You try it. Turn in a circle, keeping the moon in the light with your eye on the moon so you can see how it appears to change. And when you've done all this, then trade off with your partner.

WRAP-UP VIDEO

So we had this idea that what could explain the changing phases of the Moon was that the Moon is going in an orbit around the Earth. We built a model to see what that would look like. And it works. Did you see the phases of the Moon change? Here's what I saw. OK. Now let's take this play-by-play. When the moon got to here, that's a growing crescent. And look, here's the real Moon phase compared. That's pretty good, huh? And so when the moon got to here, you saw this, a half-moon. And here's the real half-Moon compared. When the moon got to here, now with the light directly behind you, you got a full moon. And for comparison, here's a real full Moon. But all of that is only half an orbit so far. What do we see as we brought the moon

around the rest of the circle? What we saw is that the phases now start to shrink down from full down to half down to crescent and then a smaller crescent. So in the days after a full Moon, the Moon is now going through a series of shrinking phases instead of growing phases. It's moving more and more in the direction of the Sun. And you see, there's the Sun back there. What happens next? Now that the phase of the Moon has shrunk into this tiny crescent and the Moon is almost in the exact direction of the Sun, what happened next? This is what happens. You don't see the Moon at all. Well, OK. Maybe you see the tiniest sliver in this activity. But in real life, the Sun is so bright in our sky, it'd be really hard to see this tiny sliver of Moon given the glare of the sunlight. The Sun is still shining on the Moon. But think about it. The side of the Moon that we're seeing is dark. We have a special name for this phase. It's tempting to think maybe we call it the no Moon or the nothing Moon. Those would actually be really good names. But we call this the new Moon because it's when the whole cycle is about to start over again. How long did this whole cycle take? Well, how long did the first half of the orbit take? If you look at your Moon journal, you can see it takes about 14 days to go from new Moon to full Moon. Those were the growing phases. It's going to take another 14 days for all the shrinking phases to happen to go from full Moon to new Moon. So we can see the Moon is going in an orbit around the Earth. And it's doing this over the course of about 28 days. A cycle that repeats every 28 days. That'd make a really nice unit of timekeeping, a unit that's not as long as a year but not as short as a day. And it's also really easy to keep track of. All you have to do is just watch the Moon phases. You could almost imagine saying to someone, I'll see you at the next full Moon. I'll see you one Moon from now. Is this ringing any bells? We do have a unit of timekeeping based on the Moon cycles. It's the month. The word month is related to the word Moon. In fact, a long time ago, it used to be pronounced "moonth." But the vowel sound has changed over time. And so you might not have suspected any connection between those two

words. How many Moon cycles are there in a year? How many "moonths" in a year? About 12. That's why there are 12 months in the calendar. But the 28 days of a Moon cycle don't divide evenly into the number 365, the number of days in a year. And so we've had to add some days to each of the months in order to make our calendar work. That's why most months have slightly more than 28 days.