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# **Full Moons, Blue Moons, and Lunar Calendar: How are they related?**

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# Special Interest in Astronomy



# Introduction

A full moon is the phase of the moon when we see a complete disk that is illuminated. A Blue Moon is a second full moon that happens in a month, but is more than a full moon. When there is a clear night sky, a full moon/Blue Moon can be seen without any special equipment, such as binoculars or a telescope.

# Research Questions and Expected outcomes

## Research Questions

1. What are the scientific definitions of full moons and Blue Moons?
2. How does the phases of the the lunar cycle affect the Blue Moon?
3. How do I predict the timing of Lunar New Year based on a double blue moon?
4. How does the solar calendar compare to the lunar calendar?

## Expected outcomes

1. A comprehensive guideline for Blue Moon
2. Understanding of differences between solar calendar and lunar calendars in terms of Blue Moon

## Theory

The average distance between the earth and moon is 238,900 miles (384,400 kilometers). The lunar periods could have different values in days.

NASA has been researching the moon since about the 1950s. It turns out that the “blue” moon is a myth and false belief.

# Definitions

Blue moon: the second full moon in a month

Double blue moon: there are two blue moon in a year

Length of a year in solar calendar: 365 days or 366 days (leap year)

Moon rotation: 29.5 days to circle the earth

Length of year in lunar calendar: 354 days ( $=29.5 * 12$ ) or 384 days ( $=29.5 * 13$ )

# Myth and False Belief

## Why It Is Called “Blue” Moon?

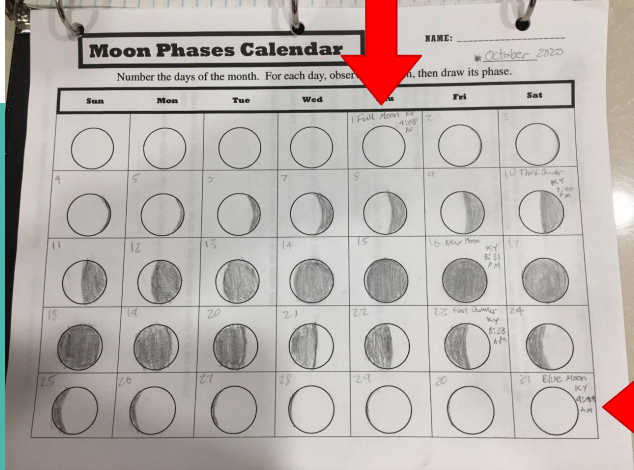
Oxford English Dictionary in 1528, If they say the moon is **blue**, We must believe that it is true.

19th century phrase, “Once in a blue moon” mean **rarely**.

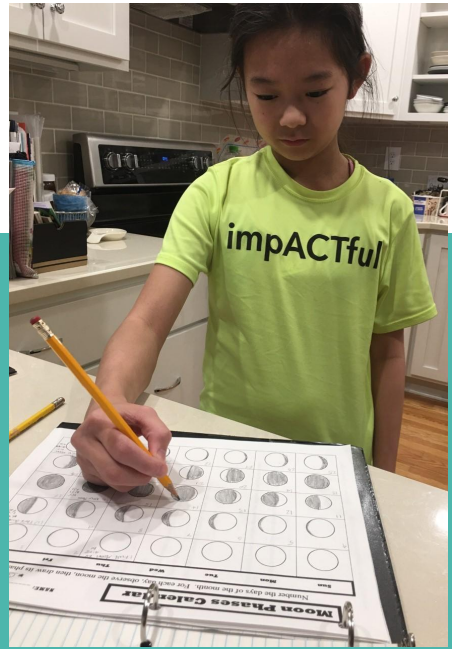


# Moon Phases Calendar for October 2020, Blue Moon

Full Moon

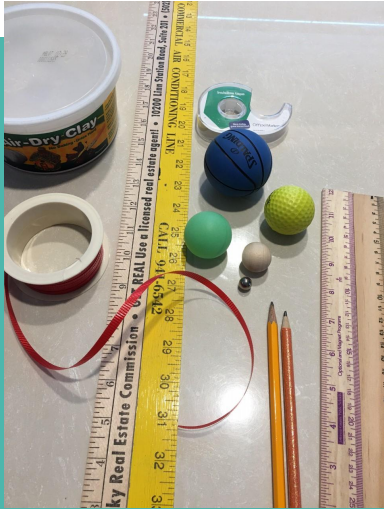


Blue Moon





# Earth-Moon Scale Model 1/318,550,000



# Blue Moon Data From 1960 to 2040

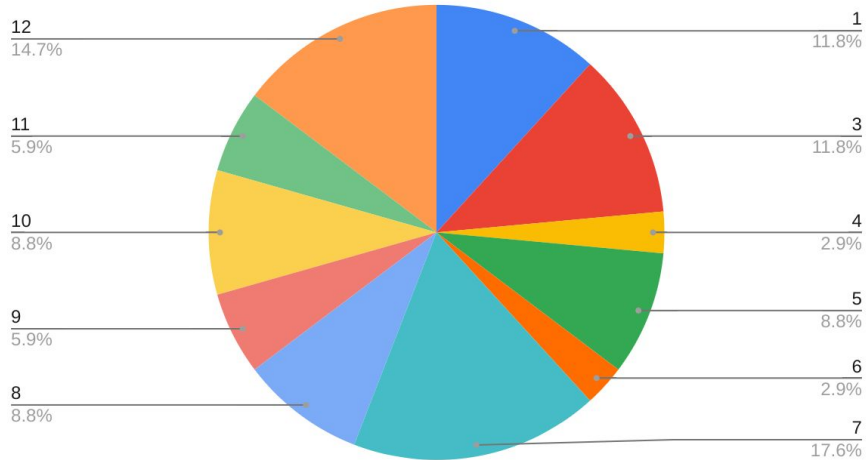
(Lunar Calendar)

(Solar Calendar)

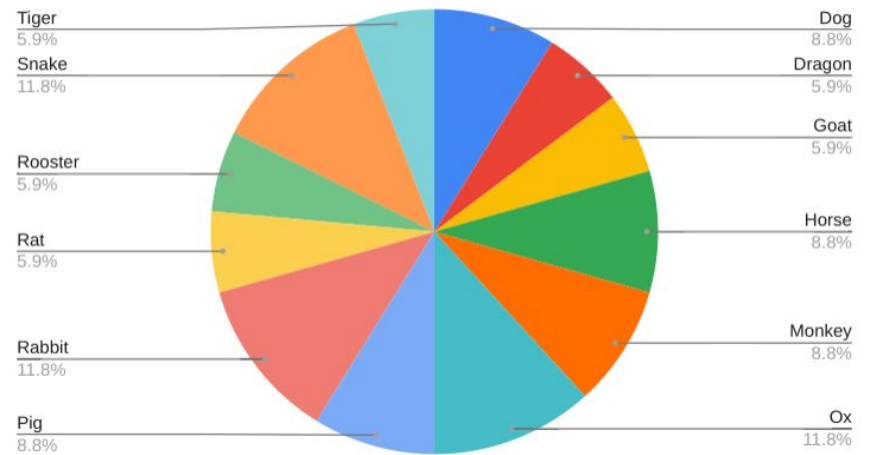
Year	Month	Day	Leap Year?	Holiday	Lunar Calendar Month	Lunar Calendar Day	Lunar Year	Lunar New Year Month	Lunar New Year Day
1961	1	31	N		12	15	Ox	2	15
1961	4	30	N		3	16	Ox	2	15
1963	11	30	N		10	15	Rabbit	1	25
1966	8	31	N		7	16	Horse	1	21
1969	5	31	N		4	16	Rooster	2	17
1971	12	31	N	New Year's Eve	11	14	Pig	1	27
1974	10	31	N	Halloween	9	17	Tiger	1	23
1977	7	30	N		6	15	Snake	2	18
1980	3	31	Y		2	15	Monkey	2	1
1982	12	30	N		11	17	Dog	1	25
1985	7	31	N		6	14	Ox	2	20
1988	5	31	Y		4	16	Dragon	2	17
1990	12	31	N	New Year's Eve	11	15	Horse	1	27
1993	9	30	N	Moon Festival	8	15	Rooster	1	23
1996	7	30	Y		6	17	Rat	2	19
1999	1	31	N		12	15	Rabbit	2	16
1999	3	31	N		2	14	Rabbit	2	16
2001	11	30	N		10	16	Snake	1	24
2004	7	31	Y		6	15	Monkey	1	22
2007	6	30	N		5	16	Pig	2	18
2009	12	31	N	New Year's Eve	11	16	Ox	1	26
2012	8	31	Y		7	15	Dragon	1	23
2015	7	31	N		6	16	Goat	2	19
2018	1	31	N		12	15	Dog	2	16
2018	3	31	N		2	15	Dog	2	16
2020	10	31	Y	Halloween	9	16	Rat	1	25
2023	8	31	N		7	16	Rabbit	1	22
2026	5	31	N		4	15	Horse	2	17
2028	12	31	Y	New Year's Eve	11	16	Monkey	1	26
2031	9	30	N		8	14	Pig	1	23
2034	7	31	N		6	16	Tiger	2	19
2037	1	31	N		12	16	Snake	2	15
2037	3	31	N		2	15	Snake	2	15
2039	10	31	N	Halloween	9	14	Goat	1	24

# Some Interesting Data Results

Count of Blue Moon Month & Frequency



Count of Blue Moon in Lunar Years



## Discussion

### **1. No blue moon in February.**

This is because the moon takes 29.5 days to circle the earth. Even a leap year does not have enough number of days to have a second full moon in February.

### **2. Blue moon always occurs on the 30th or 31st day of a month.**

To have a second full moon in a month, the earliest date would be the 30th of the month because the moon takes 29.5 days to circle the earth.

## Discussion

**3. During the 81-year period, blue moon occurs in a 30-day month 6 times and occurs in a 31-day month 28 times.**

In a 30-day month, the only date that a blue moon may occur is the 30th of a month. In a 31-day month, a blue moon may occur on the 30th or 31st day of the month. Therefore, the chance of having a blue moon in a 31-day month is greater.

**4. During the 81-year period, the only holidays that have a blue moon are New Year's Eve and Halloween.**

Those are the only holidays that are on the 31st of a month.

## Discussion

**5. When a double blue moon occurs, the first blue moon always occurs on January 31. This results in lunar new year occurring on February 15 or 16.**

To have a double blue moon, the first full moon must be on January 1. Therefore, the first blue moon in a double blue moon year must be on January 31.

Because lunar new year is a new moon day, which occurs 14 or 15 days after a full moon day, lunar new year in a double blue moon year occurs on February 15 or 16.

# Discussion

**6. When double blue moon occurs in a year, there is no blue moon in the next year. The next lunar new year occurs around February 5.**

In a double blue moon year, the last full moon happens around December 21. (=January 1 + 12 \* 29.5 days). The next full moon happens around January 20. Since lunar new year is a new moon day. So it happens around February 5.

## Conclusion

The key contribution of this project is that I show how the timing of lunar new year can be predicted based on the double blue moon.



# Acknowledgement

I want to express my sincere appreciation to those who have helped me along this research journey. Specifically, I want to thank STEMY Meyzeek Science Fair Support group for offering important research advice. Also, I want to thank my science teachers at Meyzeek, including Mr. Fowler, Mr. Hirth, Dr. Cooper, and the 6th grade assistant principal Mr. Guest.

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# Blue Moon Q and A

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