

# Once in a Blue Moon

(Number Systems and Number Theory)

## Objective

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Students will use number theory skills to investigate when certain planets are aligned.

## Overview of the Lesson

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In 1988, Earth, Jupiter, Saturn and Uranus were all in alignment. This happens “once in a blue moon.” Students review the order of the planets from the sun and use this data to create a human solar system. They are assigned the name of a planet, and physically demonstrate the orbits and the time it takes for each of the planets to revolve around the sun. These times range from the 88 days it takes Mercury to revolve around the sun to 247 years it takes Pluto. The investigative question is, “When, if ever, will these four planets be in alignment again?” Student groups devise plans for finding answers to this question. The lesson concludes as students share their reasoning and methods for arriving at a solution. Students engage in a self assessment of their performance in solving this problem.

## Materials

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### Each Group

- ① Calculator
- ② Once In a Blue Moon Worksheet

### Per Class

- ③ Graphic of Solar System (Optional)
- ④ Student Self Assessment Criteria (1 per student)

## Procedure

Initiate lesson by having students name/identify the nine planets in order of their distance from the sun. A display or diagram of the solar system may be used to assist students with this task.

Discuss the amount of time it takes for each planet to revolve around the sun. One idea that might be interesting to pursue, is to compare the revolution of the earth around the sun, 1 year, to the revolution of the other planets around the sun. List the information below on the board. They may observe that Neptune and Pluto will never complete a revolution during the lifetime of a human.

Mercury	88 days
Venus	224 days
Earth	1 year
Mars	1.9 years
Jupiter	12 years
Saturn	30 years
Uranus	84 years
Neptune	165 years
Pluto	247 years

Tell students that in 1988, four planets were in alignment. These planets were Earth, Jupiter, Saturn and Uranus. If we were in charge of a space probe, and wanted to do a “fly by” of these four planets, what year would these planets be in a straight line again?

In order to help students visualize the problem, tell them they are going to act it out. You will probably need to use the playground or gymnasium to create the human solar system. Create the human solar system by having nine students represent each of the planets and one student to represent the sun. Have each student position themselves around the sun, each in its own orbit. Each of the nine planets (students) should be labeled. While students are acting as planets, be sure to point out that Pluto appears to barely move when compared to Mercury and Venus. Ask students to explain why. Also point out that the distances and speeds are not scaled.

Stress that during the course of the revolutions it is unlikely that the planets will be in alignment. Have the four students who represent Earth, Jupiter, Saturn and Uranus position themselves so that they are in a straight line. Keep them in their individual orbits. Remind students that they are to find the year when these four planets are aligned again.

Return to the classroom and place students in small groups. Provide a list with the times it takes for the planets to revolve around the sun. In their group, students should discuss the things they need to know in order to solve the problem. This discussion should result in the creation of a plan which is used to find a solution to the problem.

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Reassemble the whole class so that individual groups share their plans, strategies and solutions to the problem. There are many ways for students to find solutions to this problem. Basically, the strategies would involve various methods for finding the least common multiple for the revolution times of the four planets and adding this number to 1988. From 1988, it should take another 420 years for the four planets to be in alignment again. Therefore, in the year 2408 these planets should once again be aligned.

Conclude by having the students complete the Self Assessment Criteria. A copy is included with this guide.

## **Extensions & Connections**

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Have students relate their current age on earth to what it would be if they lived on any other planet, for example: "How old are you in Mars years?"

Have students research mathematical facts about the solar system and display them on the bulletin board. You might want them to present a fact each day for a week to the school on the morning announcements.

## **Resources**

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Six Through Eight Mathematics (STEM). *Once in a Blue Moon*. University of Montana. (1992) Missoula, Montana.

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## Ideas for Online Discussion

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(Some ideas may apply to more than one standard of the **NCTM Professional Standards for Teaching Mathematics**.)

### Standard 1: Worthwhile Mathematical Tasks

- ❶ There is a major thrust to connect the teaching and learning of mathematics with the content from other disciplines. Many teachers find this to be extremely difficult, without affecting the integrity of the other discipline(s). Share an experience that you have had with integrating one or more disciplines with mathematics. Even if it wasn't so successful, share it anyway, maybe together we can use the idea and come up with different strategies that might work better.

### Standard 4: Tools for Enhancing Discourse

- ❷ So much of the data that is presented on a daily basis is in the form of “pictures, diagrams, tables and graphs.” The teacher used a diagram of the solar system and a table to display the data in this lesson. How have a variety of visual presentations of data and other information enhanced your students' interest in and communication of mathematics?
- ❸ “Oral presentations and dramatizations” (p. 52) should be used to enhance discourse. In what kind of fun roles have you engaged your students? How effective were these tools in achieving your goal?

### Standard 5: Learning Environment

- ❹ It is essential to knock down the four walls of the classroom, and utilize all resources available to “wow” the kids. A brief trip to the playground may be just what is needed to raise the interest level. Share your views on this statement.

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# Once in a Blue Moon

*Following is a list of the nine planets of our solar system and the corresponding time it takes for each to revolve around the sun.*

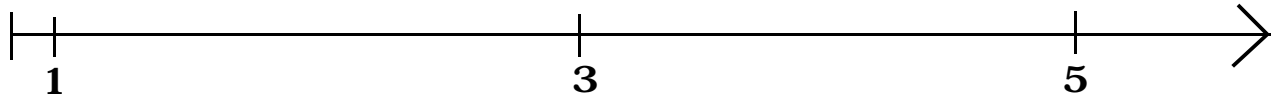
<b>Mercury</b>	<b>88 days</b>
<b>Venus</b>	<b>224 days</b>
<b>Earth</b>	<b>1 year</b>
<b>Mars</b>	<b>1.9 years</b>
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<b>Saturn</b>	<b>30 years</b>
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<b>Neptune</b>	<b>165 years</b>
<b>Pluto</b>	<b>247 years</b>

# Student Self Assessment Criteria

Name \_\_\_\_\_

## Approach

If your score is in this shaded area  
explain why on the back of this sheet and stop.

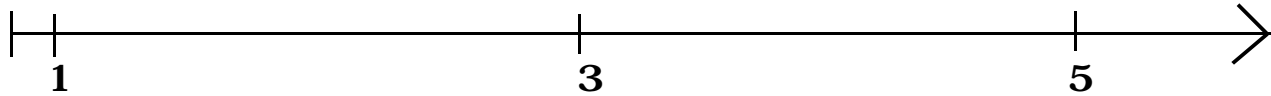


I didn't understand the problem well enough to get started or did not show any work.

I understood the problem well enough to devise an approach to make progress toward a solution

My approach worked well and I correctly solved the problem

## Reasoning

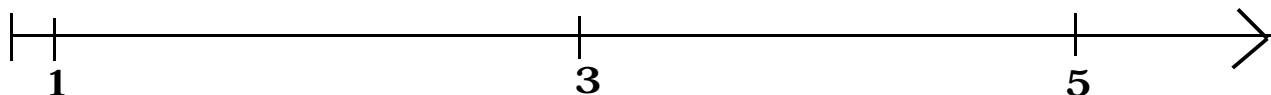


I used reasoning but it may not be evident when you read my work or none of my reasoning was correct.

My work shows that almost all of my reasoning was correct but it could have been made clearer.

I clearly explained my reasoning to show my solution is correct or I verified my solution by using a second approach.

## Language



I didn't use mathematical language or symbols correctly or I didn't use them at all.

Almost all the mathematical language and symbols were used correctly but I could have used more.

I used correct mathematical language and symbols whenever appropriate and used them correctly.