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$2^4$

$6x = 24$

**STEM**

$x + 12 > 35$

$2^4$

# *The Remarkable* **RINGED PLANETS**

Problem Solving with Variables

Angela Davids

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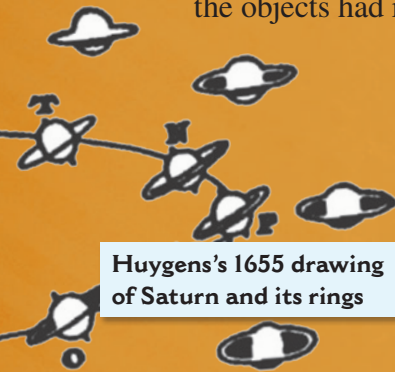
# Saturn: The Most Famous Rings of All



Galileo's drawing

Saturn's rings have been a mystery for more than four hundred years. It began in 1610, when the most famous astronomer in history spotted them. Through his telescope, Galileo saw a large circle with two smaller circles on each side. His best guess was that Saturn had a moon to the left and a moon to the right. He made his next discovery in 1612, when these "moons" seemed to disappear. Two years after that, Galileo discovered that the objects had returned. This time, he described them as handles or arms.

In 1616, Galileo drew Saturn with a thick ring around it.



Huygens's 1655 drawing of Saturn and its rings

The next detective in the great mystery of Saturn's rings is Christiaan Huygens (HOY-gunz). By 1655, telescopes could help people see much farther. With a telescope he designed, Huygens saw Saturn's rings clearly. They were not attached to Saturn as some believed. When Huygens saw the rings, he thought they were solid. For about two hundred years, most scientists agreed.

In the mid-1800s, a few astronomers questioned Huygens's theory. They noted that they could see through Saturn's rings, so the rings could not be solid. Next, physicist James Clerk Maxwell wrote an essay about his opinion. He said two centuries of observations showed that the rings had changed in size. Therefore, they could not be solid. In 1895, astronomers William Campbell and James Keeler confirmed that the rings are actually made up of many small particles.



Galileo Galilei

Christiaan Huygens

1610

1655

## LET'S EXPLORE MATH

Saturn's distance from the sun is farther than Earth's. To determine Saturn's distance from the sun, a scientist writes the equation  $s = 9.5e$ .

1. What do the variables  $s$  and  $e$  mean?
2. What does 9.5 mean?
3. What operation does the scientist indicate?



James Clerk Maxwell

1859



William Campbell

1895

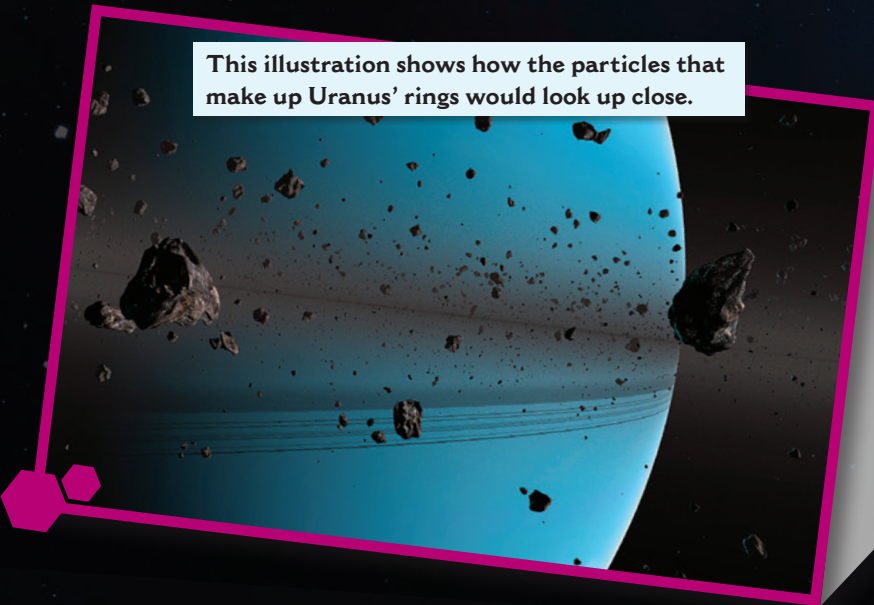


James Keeler

# Uranus: The Tilted Planet

In 1781, William Herschel became the first person to determine that Uranus (YUR-uh-nuhs) was a planet. At first, he thought it was either a comet or a star, like many other people did. By making more detailed observations of its orbit through a telescope, he concluded that it was a planet. Since the planet was nearly invisible to the bare eye, it was the first one to be discovered since ancient times. Herschel quickly became famous for his discovery. Johann Elert Bode confirmed it was a planet in 1783. Uranus was almost named after King George III. It would have been called Georgium Sidus. Instead, the planet was named after the Greek sky god.

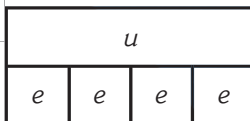
Uranus is 4.5 billion years old. It is easy to identify in photos because of its bluish-green color and pale rings. The planet's 13 rings are made mostly of dust. It takes 84 Earth years for Uranus to orbit around the sun. Winter at its north pole is 21 years of darkness, and summer is 21 years of light. Like Earth, the spring and fall have both daytime and nighttime in a single day. Each day (one rotation) lasts 17 hours and 14 minutes.



This illustration shows how the particles that make up Uranus' rings would look up close.

## LET'S EXPLORE MATH

Uranus' **radius** is about 4 times wider than Earth's. Use the bar model to answer the questions.



1. Write an equation relating Uranus' radius ( $u$ ) to Earth's radius ( $e$ ).
2. Earth's radius is about 6,371 kilometers. How wide is Uranus' radius? Find your solution using the equation and the bar model.

Uranus has 5 major moons, 22 lesser moons, and 13 rings.

# Problem Solving

The sun is actually a giant star. Scientists are studying whether there might be more giant stars in the universe that are similar to our sun. Imagine that Dee, Frank, and Giovanna are scientists who discover a new giant star. Each scientist spots a new planet orbiting this star. They give their research notes to their assistants, using  $g$  to stand for Giovanna's planet,  $f$  to stand for Frank's planet, and  $d$  to stand for Dee's planet.

The scientists request that the assistants draw a map showing their discoveries. Use the research notes to draw a possible map on graph paper, with circles representing the giant star and planets and points representing moons. Let 1 unit on the graph paper stand for 10,000 kilometers. Then, use the equations, inequalities, and numbers of kilometers to write a summary for the scientists, proving that your map is a reasonable possibility.





## Giant Star

- There is a giant star in the middle of the new system.

## Distances

- Frank's planet is twice as far from the giant star as Dee's planet.
- The distance of Giovanna's planet from the giant star is represented by  $g > f + d$ .

## Sizes

- The radius of Dee's planet is represented by  $d = \frac{1}{3}f$ .
- Giovanna's planet's radius is two times the radius of Dee's planet.

## Moons

- The number of moons that Dee and Giovanna's planets have are related by  $d > g$ .
- The number of moons that Frank's planet has is represented by  $f = d + 2$ .