

Student Discussion Worksheet

Directions: Read the *Science News* article "[The Kuiper Belt's dwarf planet Quaoar hosts an impossible ring.](#)" and discuss the questions below. A version of the article, "This dwarf planet has an odd ring," appears in the March 11, 2023 issue of *Science News*.

Ring around the planet

1. What are planetary rings? What planets in our solar system have rings?

2. What are moons, and how do scientists think they formed?

3. Which planets in our solar system have moons?

Defining limits

1. Describe what the Roche limit tells you about gravity and the interactions of objects in space. Draw a simple diagram that supports your description.

2. On your diagram, add force arrows (vectors) to show the relative forces that are present on a moon beyond the Roche limit. Then show the same for forces on the particles on the rings.

3. Check out the "Far-out ring" illustration in the article. What do you notice about the Roche limits indicated for Haumea, Chariklo and Quaoar? How are the Roche limits for Chariklo and Quaoar similar?

4. List all factors that you can think of that might impact the predicted Roche limit of a planet.

Defying limits

1. What does “The dwarf planet Quaoar has a ring that is too big for its metaphorical fingers” mean?

2. Why do you think scientists make generalizations and create limits and rules like the Roche limit? What is the downside of generalizing?

3. How can identifying exceptions to the scientific generalizations or rules help advance scientific knowledge? Explain.

