Ranking Tasks for Assessing Conceptual and Quantitative the Understanding of Non-science Majors in Introductory Astronomy

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What Is a Ranking Task?

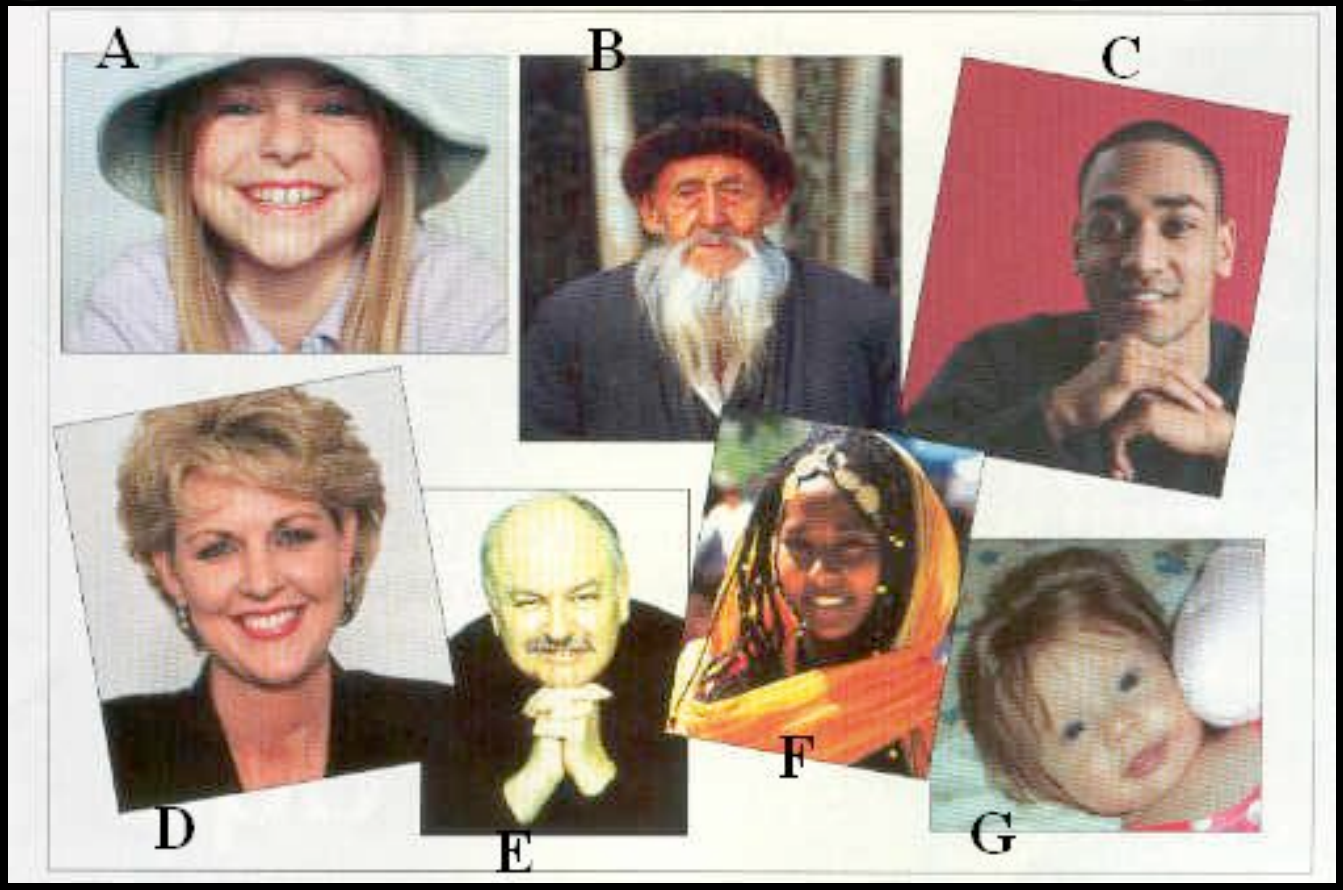
Ranking Task - a conceptual exercise that presents students with several variations of a physical situation ….

(usually presented as pictures or diagrams)

… and asks them to rank order the situations based on a a physical law and/or specific resulting effect.

Example Ranking Task….

The figure below shows the faces of six people (A – G).



Rank these people by AGE from least to greatest.

Least ____, ____, ____, ____, ____, ____ Greatest

“Ranking Tasks in Astronomy”

Research on their effectiveness!!

Core Topics

Seasons **Kepler’s Laws**

Star Magnitude & Distance

Motion of the Sky

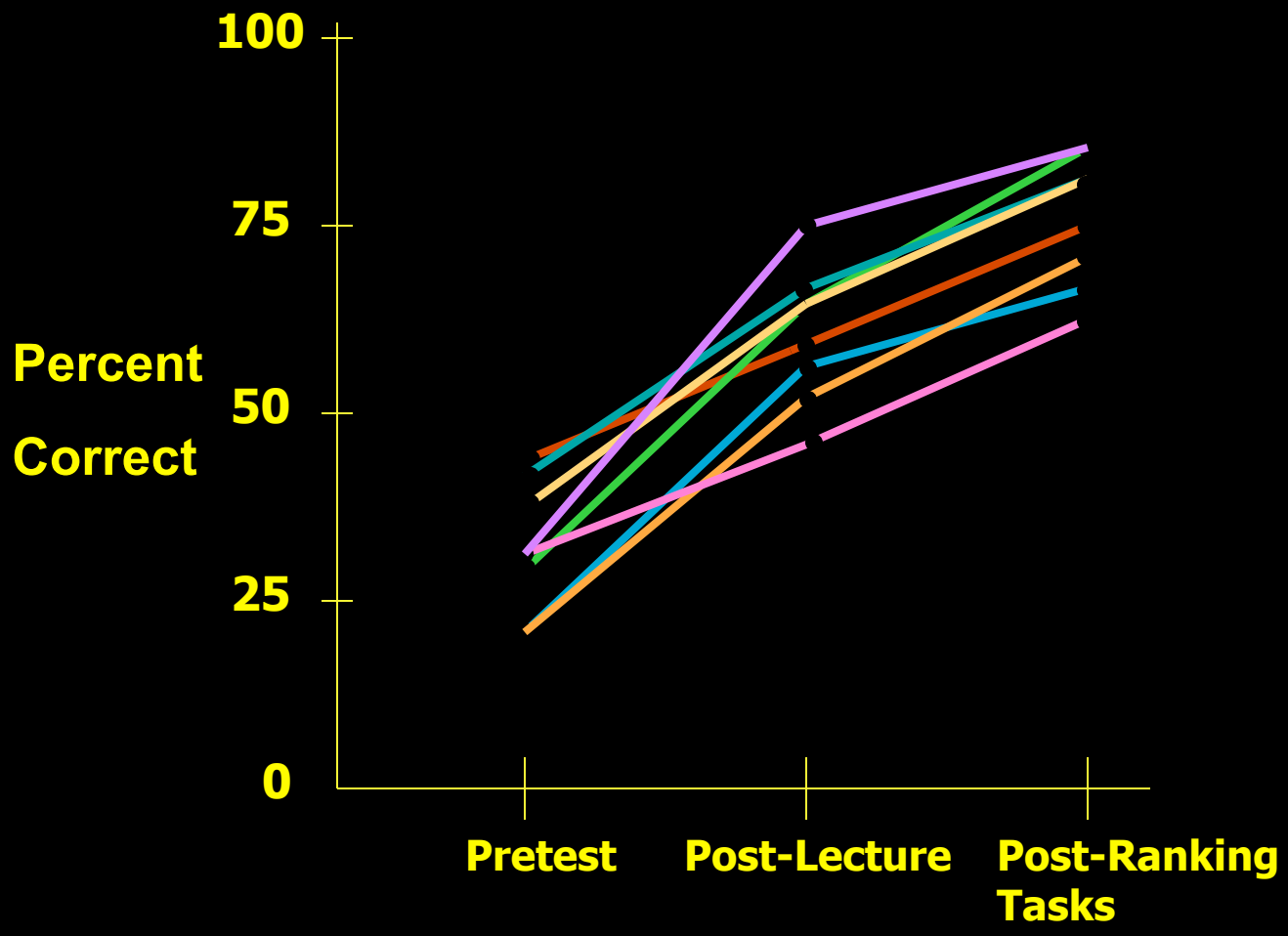
Phases of the Moon

Gravity **Doppler Effect**

Luminosity of Stars

Hudgins, D. W., Prather. E. E.,Grayson, D.J. & Smits, D. P. 2006. "Effectiveness of Collaborative Ranking Tasks on Student Understanding of Key Astronomy Concepts,“ Astronomy Education Review, 5(1)

Results: Over Eight Core Topics

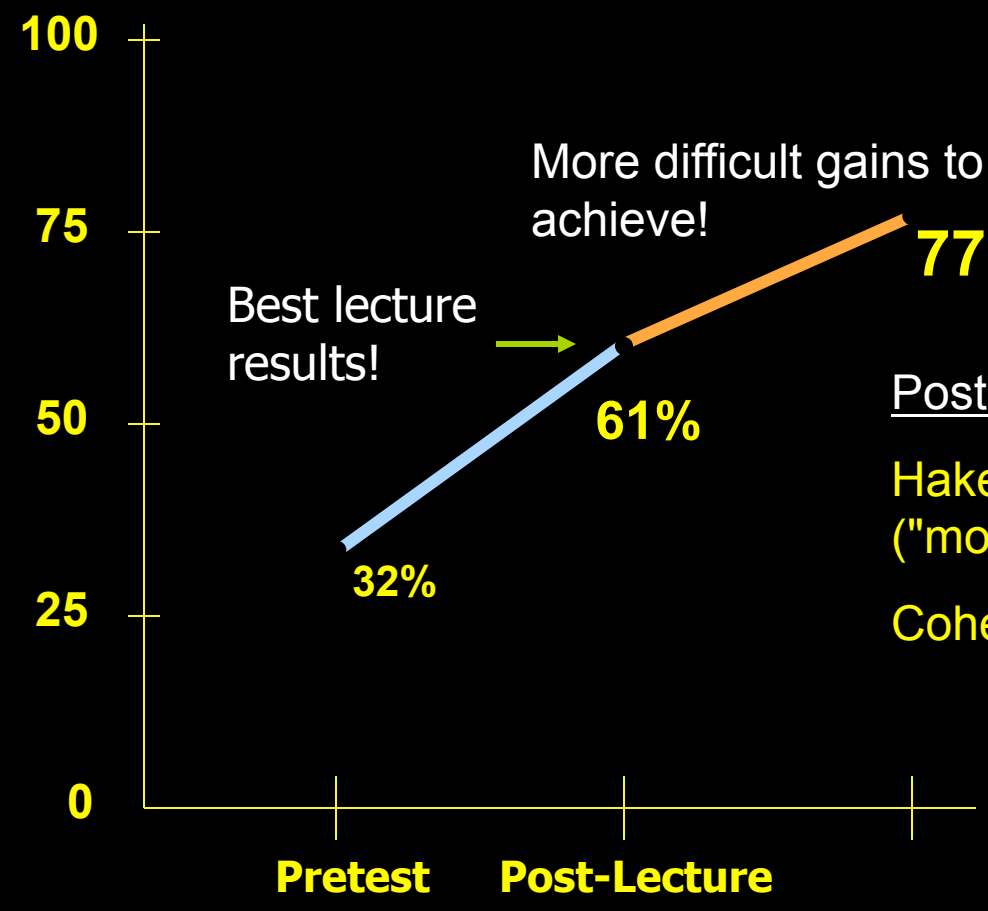


Core Topics

- Seasons
- Kepler's Laws
- Star Magnitude & Distance
- Motion of the Sky
- Phases of the Moon
- Gravity
- Luminosity of Stars
- Doppler Effect

Hudgins, D. W., Prather. E. E.,Grayson, D.J. & Smits, D. P. 2006. "Effectiveness of Collaborative Ranking Tasks on Student Understanding of Key Astronomy Concepts," Astronomy Education Review, 5(1)

Ranking Tasks intellectually engage students at a level that is more effective than traditional lecture at promoting deep conceptual change.



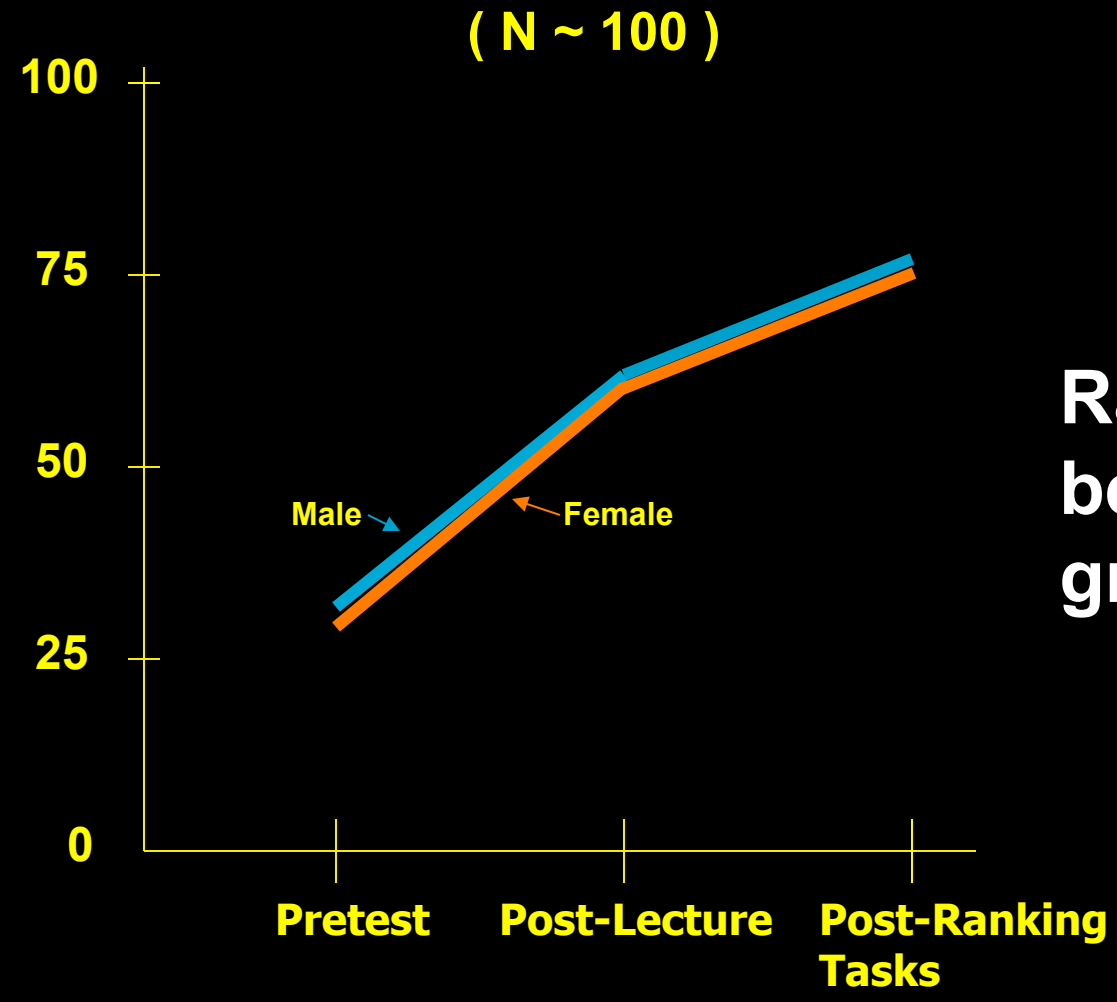
Post-Lecture to Post-Ranking Task:

Hake's Normalized Gain = 0.41 ("moderately large effect")

Cohen's d = 0.62 ("Large effect")

Hudgins, D. W., Prather. E. E.,Grayson, D.J. & Smits, D. P. 2006. "Effectiveness of Collaborative Ranking Tasks on Student Understanding of Key Astronomy Concepts," Astronomy Education Review, 5(1)

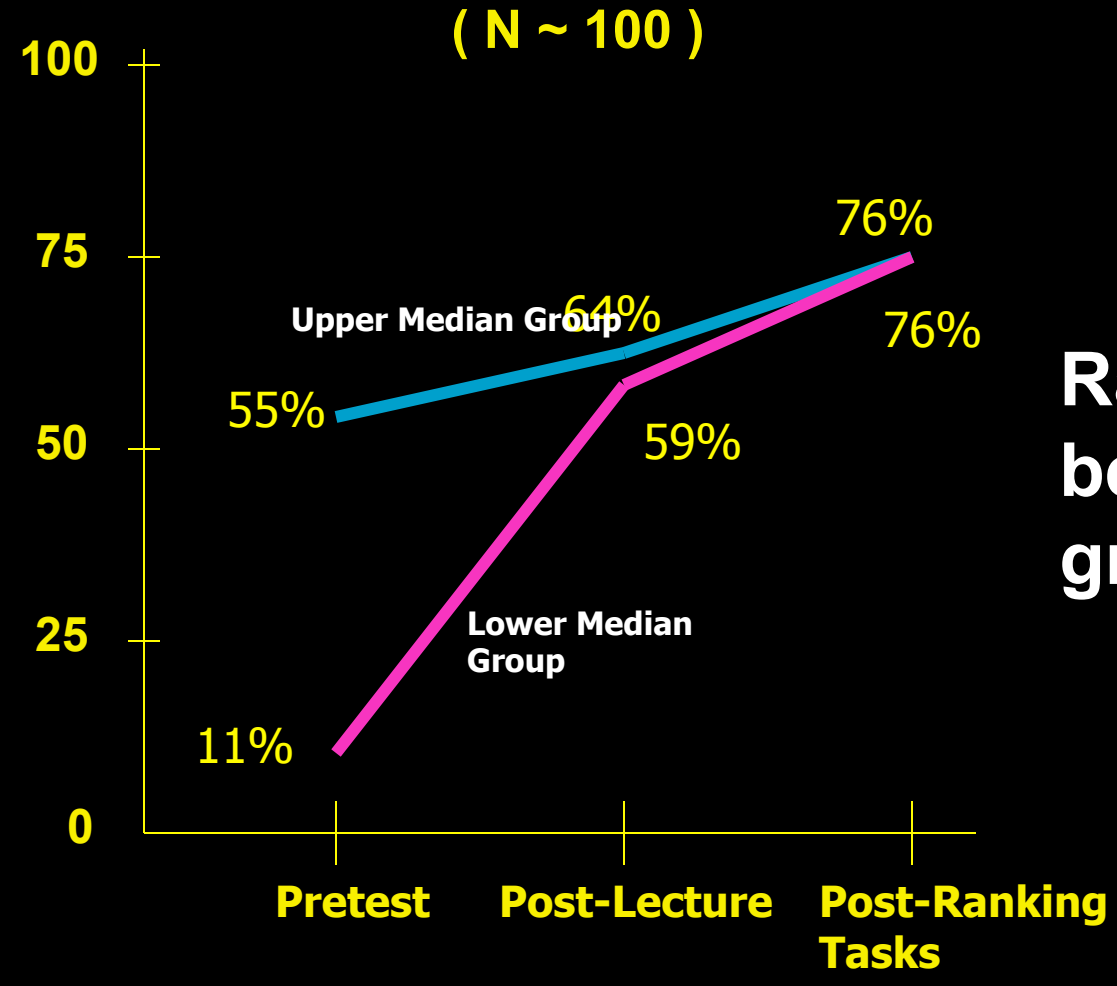
Ranking Tasks: Gender Effect?



Ranking Tasks benefited both groups equally.

Hudgins, D. W., Prather. E. E.,Grayson, D.J. & Smits, D. P. 2006. "Effectiveness of Collaborative Ranking Tasks on Student Understanding of Key Astronomy Concepts," Astronomy Education Review, 5(1)

Ranking Tasks: High vs Low Pretests Groups?



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Ranking Tasks are much more intellectually engaging than just putting things in order!!

Examples:

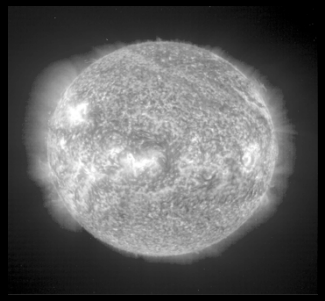
"Ranking Tasks for Introductory Astronomy"

"Mastering Astronomy"

Example: Scale of the Universe

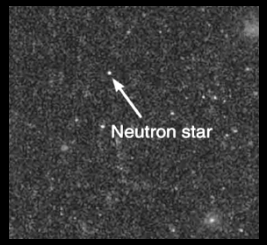
Description: Consider the images of six different astronomical objects (A-F) below.

A. The Moon



B. The Sun

C. Spiral Galaxy



D. Neutron Star

E. Nebula

F. The Solar System

A) Ranking Instructions: Rank the objects in terms of SIZE from smallest to largest. Assume that objects are a "typical" size for that type of object.

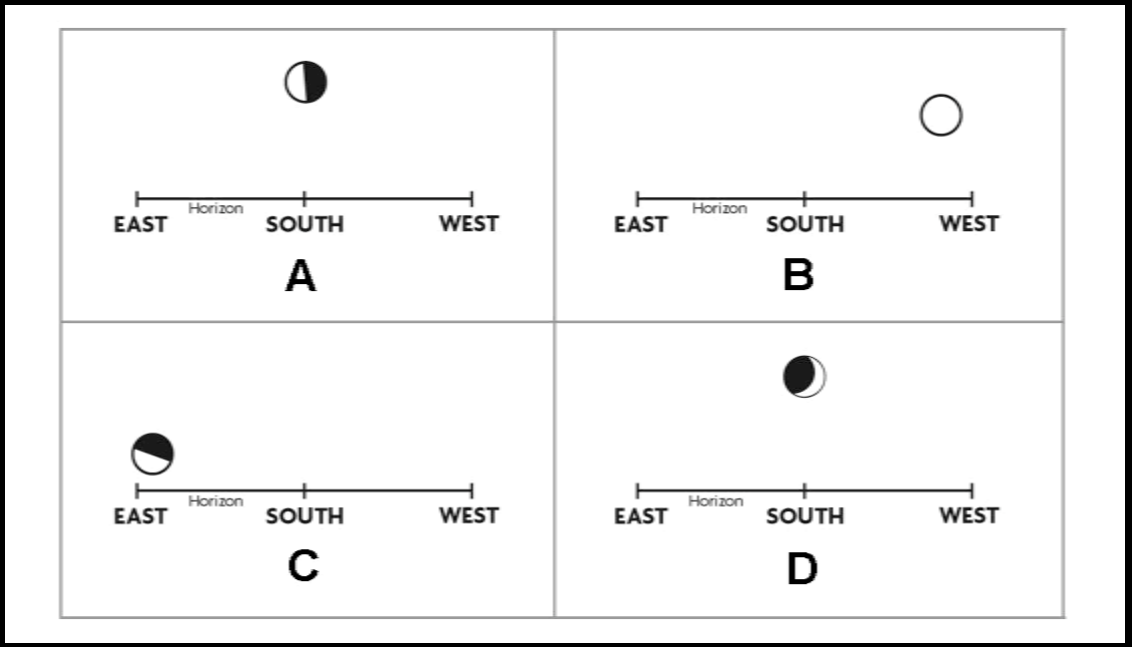
Ranking Order: **Smallest 1 ___, 2 ____, 3 ____, 4 ____ 5, ____, 6____ Largest**

B) Ranking Instructions: Rank the objects in terms of MASS from least to most. Assume that objects are a "typical" mass for that type of object.

Ranking Order: **Least 1 ___, 2 ____, 3 ____, 4 ____ 5, ____, 6____ Most**

Example: Phases of the Moon

Description: In each figure below (A – D) the Moon is shown in a particular phase along with the position in the sky that the Moon would have at one time during the day (or night). The dark areas on each moon figure show the unlit portions of the Moon visible from Earth at that time. Assume that sunset occurs at 6 pm and that sunrise occurs at 6 am.



Ranking Instructions: Use the time each Moon phase (A – D) would appear as shown to rank the figures (from earliest to latest), starting from sunrise (6 am).

Ranking Order: **Earliest (about 6 am) 1 ___ 2 ____ 3 ____ 4 ____ Latest**

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current assignment
current problem
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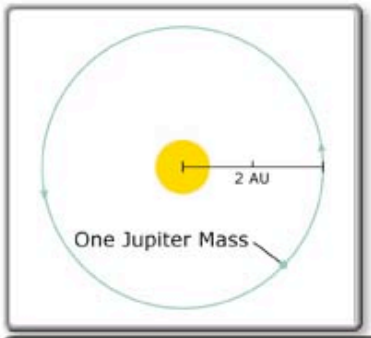
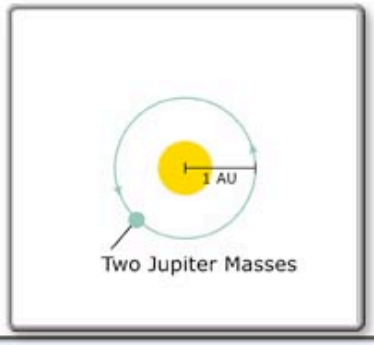
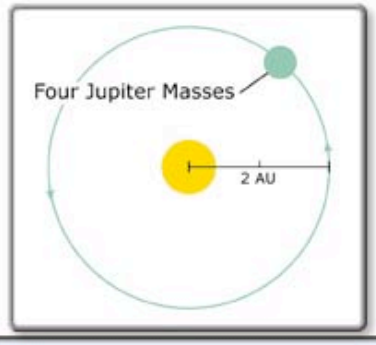
STP Ranking Task: Doppler Shift and the Interaction of Extrasolar Planets and their central Stars Difficulty: **3** Time: **10m** Action: (select action)

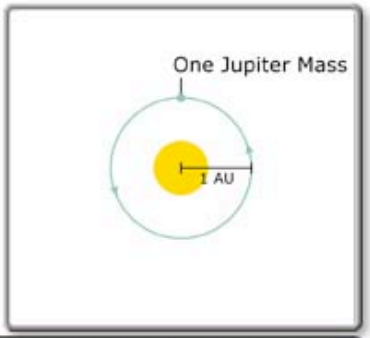
Part A

The images below show four identical Sun-like stars and their companion planets traveling in a circular orbit. In each case, the mass of the planet is given in Jupiter masses and the orbital distance is given in Astronomical Units (AU). Rank each case based on the strength of the gravitational force exerted by the extrasolar planet on its central star, from weakest to strongest. (Not to scale)









Weakest Strongest

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STP Ranking Task: Doppler Shift and the Interaction of Extrasolar Planets and their central Stars Difficulty: **3** Time: **10m** Action: (select action)

The figures below show four identical Sun-like stars and their identical companion planets. Each planet's orbital distance is given in Astronomical Units (AU). Rank the extrasolar planets based on the amount of time it takes each to complete one orbit, from shortest to longest. (Not to scale)

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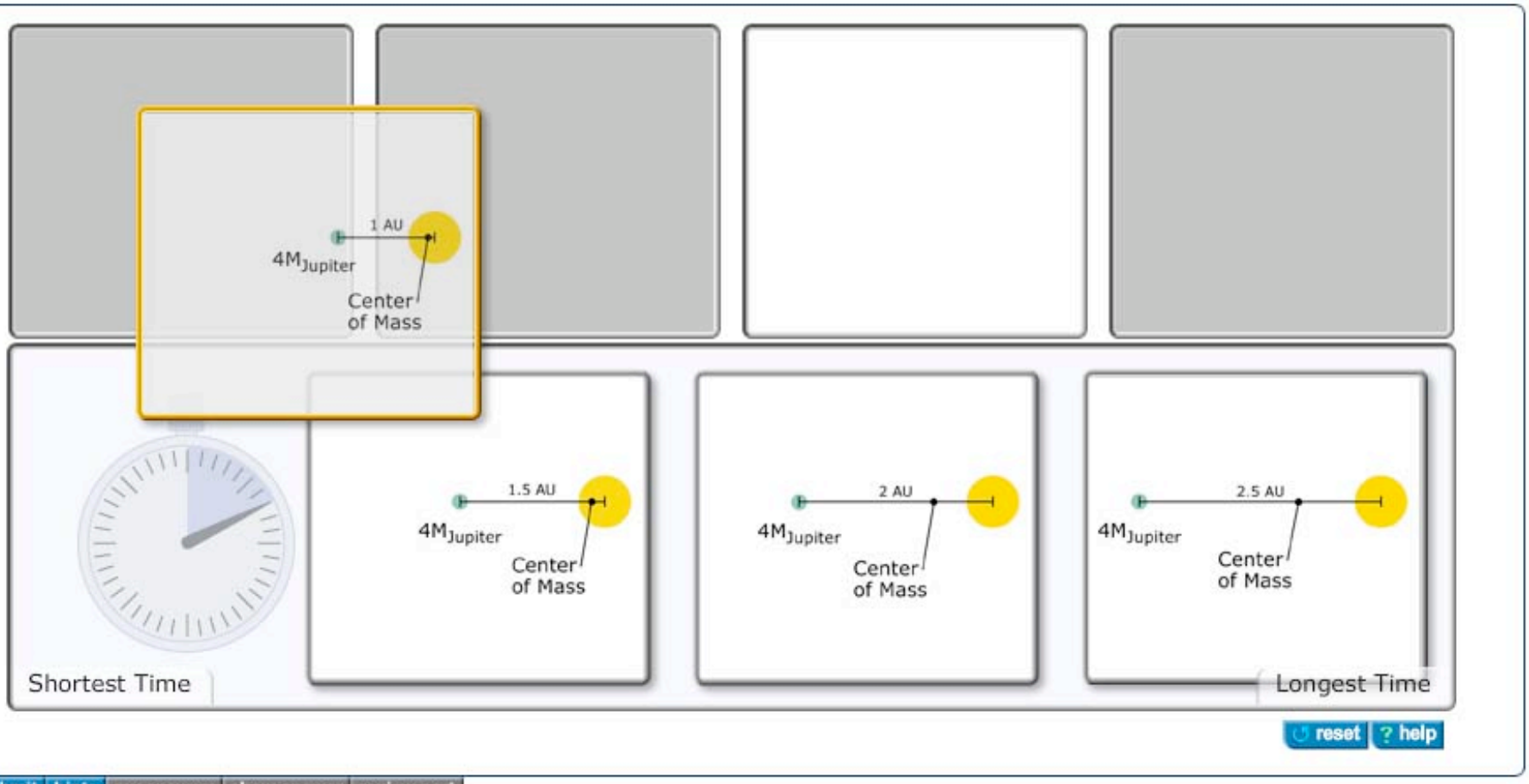
Part B

The figures below show four identical Sun-like stars and their identical companion planets. Each planet's orbital distance is given in Astronomical Units (AU). Rank the extrasolar planets based on the amount of time it takes each to complete one orbit, from shortest to longest. (Not to scale)



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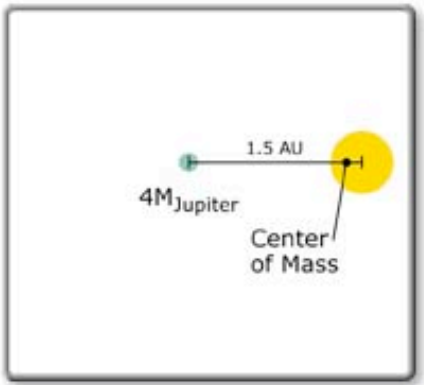
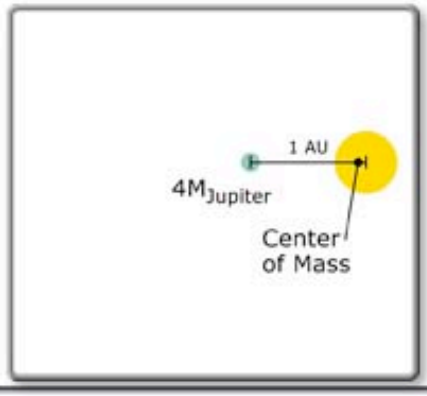
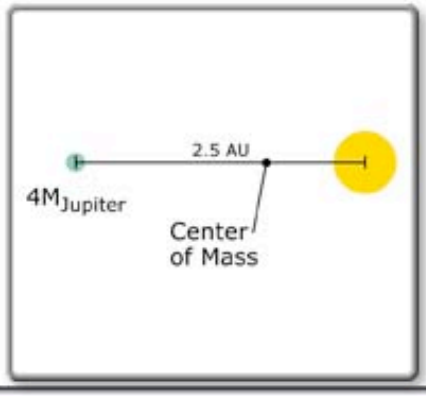
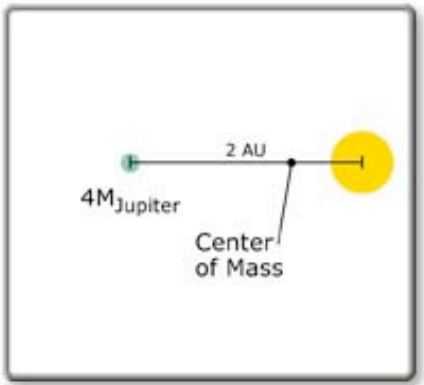
Part C

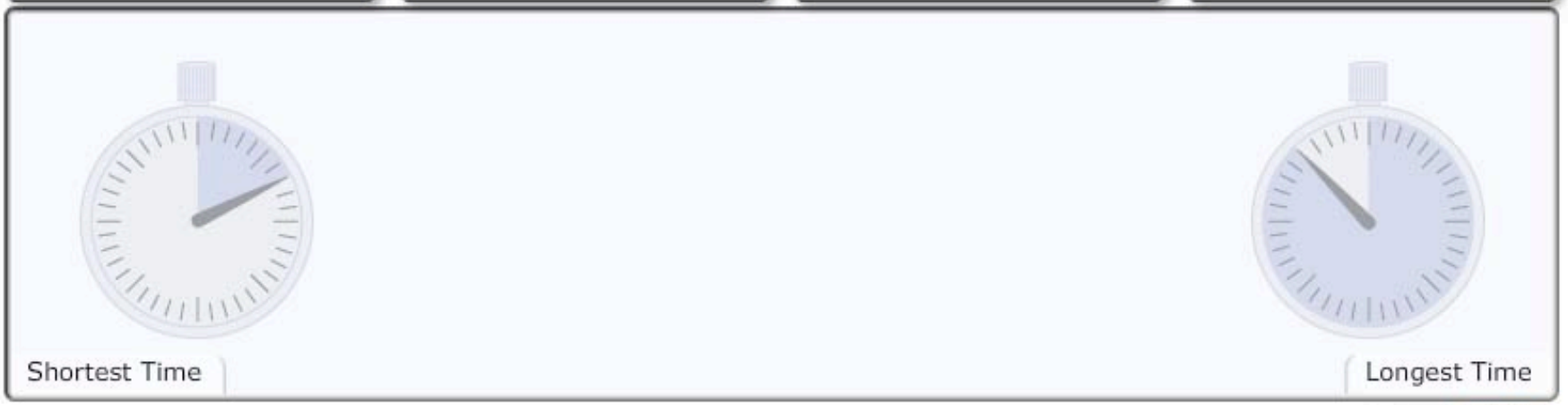
The figures below show four identical Sun-like stars and their identical companion planets. Each planet's orbital distance is given in Astronomical Units (AU). Rank the stars based on their orbital period, from shortest to longest. (Not to scale)











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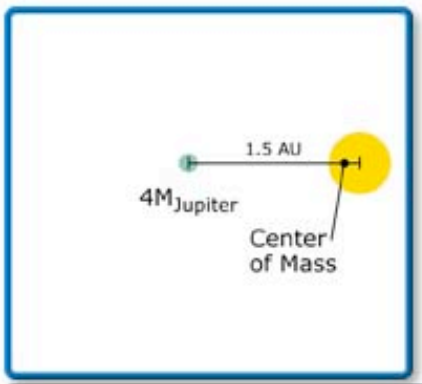
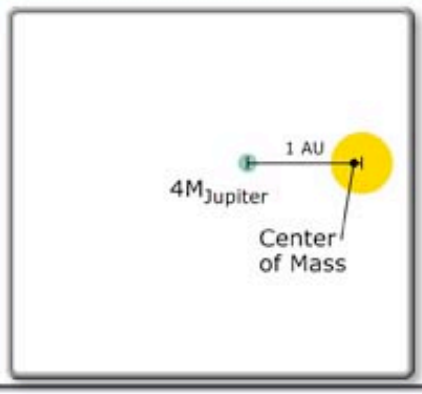
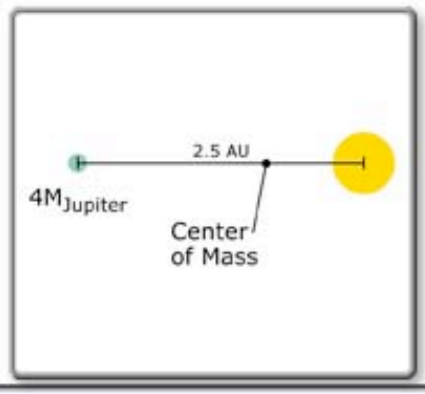
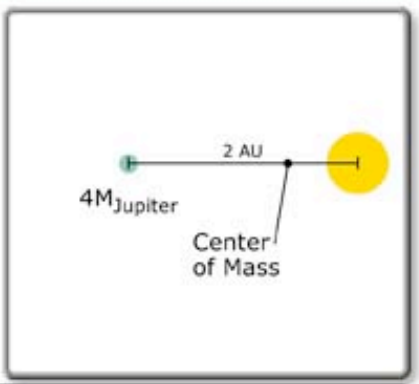
Part D

The figures below show four identical Sun-like stars and their identical companion planets. Each planet's orbital distance is given in Astronomical Units (AU). Rank the stars based on the size of their orbital radii, from smallest to largest. (Not to scale)









Smallest Radius

Largest Radius

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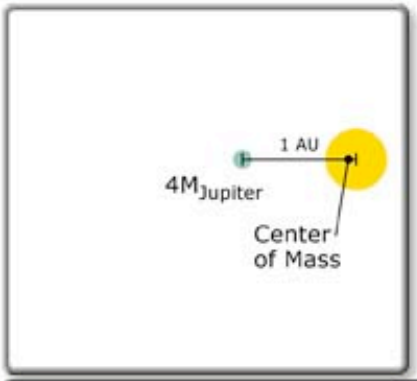
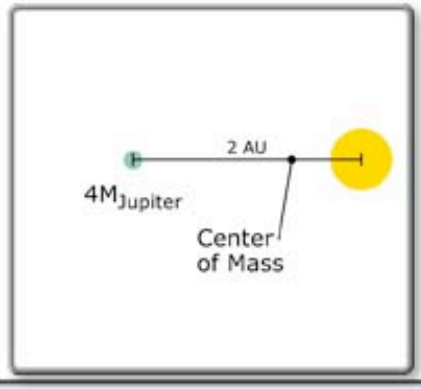
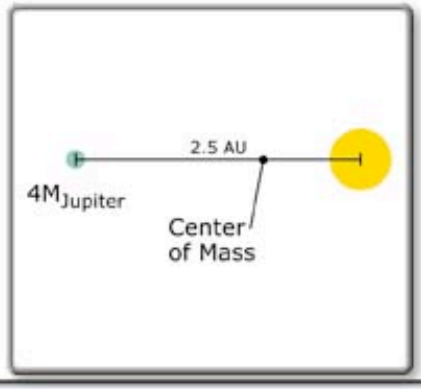
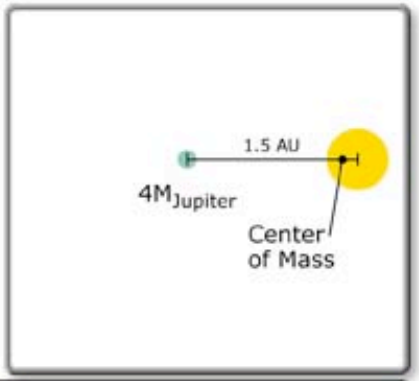
Part E

The images below show four identical Sun-like stars and their identical companion planets. The size of each planet's orbital distance is given in Astronomical Units (AU). Imagine that an Earth-based observer could see the motion of each of the stars edge on. Rank each star based on the amount its light would be Doppler shifted as measured by an Earth-based observer, from smallest to largest. (Not to scale)









Smallest Doppler Shift

Largest Doppler Shift

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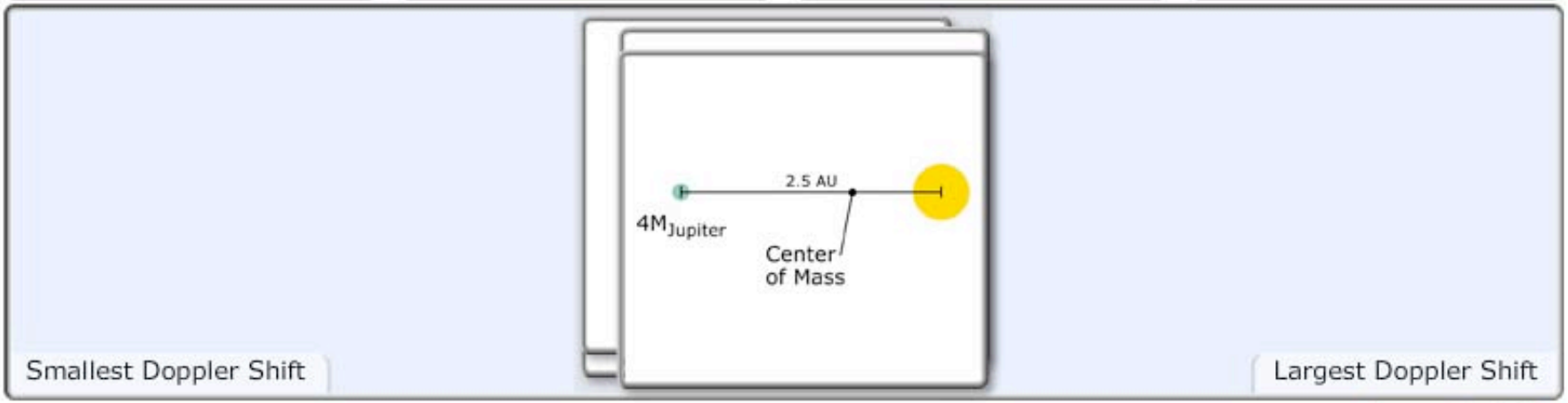

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Try Again; 7 attempts remaining

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Feedback Close

Your answer incorrectly suggests that the speed of the star and correspondingly the size of the Doppler shift only depends on the mass of the extrasolar planet and not on how far the extrasolar planet is from the star.

http://session.masteringastronomy.com - Ranking Task: Doppler Shift and...

Edward Prather

Ranking Task: Doppler Shift and the Interaction of Extrasolar Planets and their central Stars

The images below show four identical Sun-like stars and their identical companion planets. The size of each planet's orbital distance is given in Astronomical Units (AU). Imagine that an Earth-based observer could see the motion of each of the stars edge on. Rank each star based on the amount its light would be Doppler shifted as measured by an Earth-based observer, from smallest to largest. (Not to scale)

Hint 1. How Is a Star's Motion Related to the Size of the Doppler Shift? Open

True or False? The faster a star moves along an observer's line of sight, the more its light will be Doppler shifted.

- True
- False

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Hint 2. How Is a Star's Orbital Speed Related to the Size of Its Orbit? Open

True or False? For two identical stars that have two identical planets, the star with the larger orbit will be moving faster.

- True
- False

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Bennett/Donahue/Schneider/Voit *The Cosmic Perspective, 4/e*

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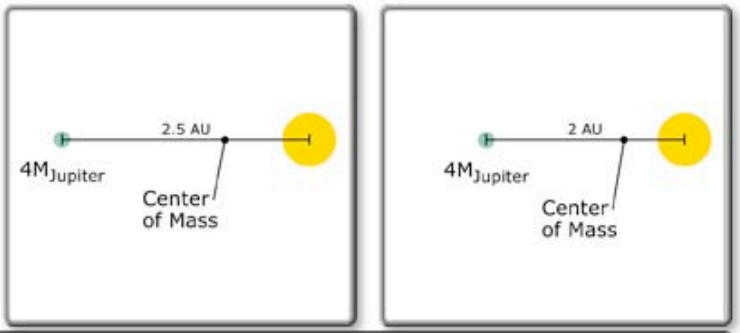
nets and their central Stars | Difficulty: 3 | Time: 10m | Action: (select action)

the stars edge on. Rank each star based on the amount its light would be Doppler shifted as



Largest Doppler Shift

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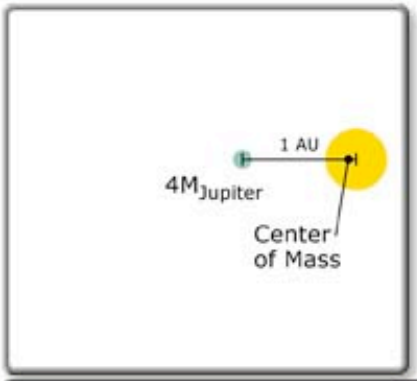
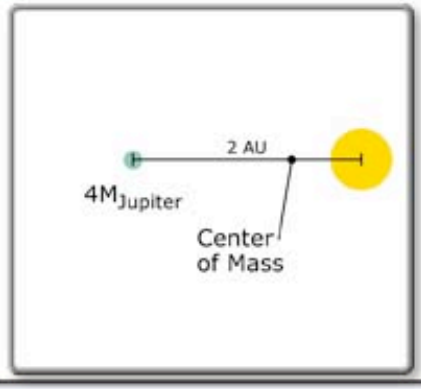
Done | Internet

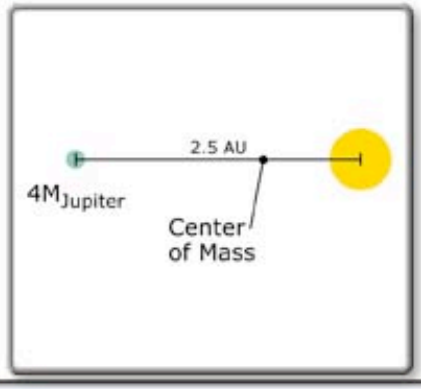
Start | Eudora | Mastro_Ch... | 4 Intern... | Ranking Ta... | Adobe Pho... | Microsoft E... | 1:39 PM

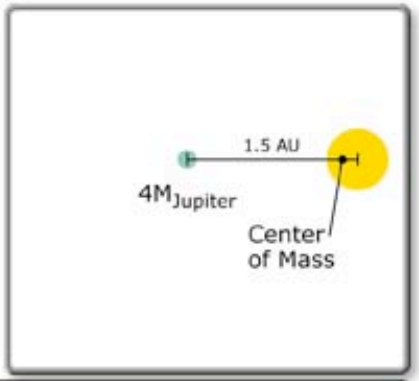
Part E

The images below show four identical Sun-like stars and their identical companion planets. The size of each planet's orbital distance is given in Astronomical Units (AU). Imagine that an Earth-based observer could see the motion of each of the stars edge on. Rank each star based on the amount its light would be Doppler shifted as measured by an Earth-based observer, from smallest to largest. (Not to scale)









Smallest Doppler Shift

Largest Doppler Shift

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