Interactive Engagement in Large Introductory Courses

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http://astronomy101.jpl.nasa.gov

Interactive Engagement Strategies for ALL Classes

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How to Implementation of Active Learning and get your students' to intellectually engage (work) during class!

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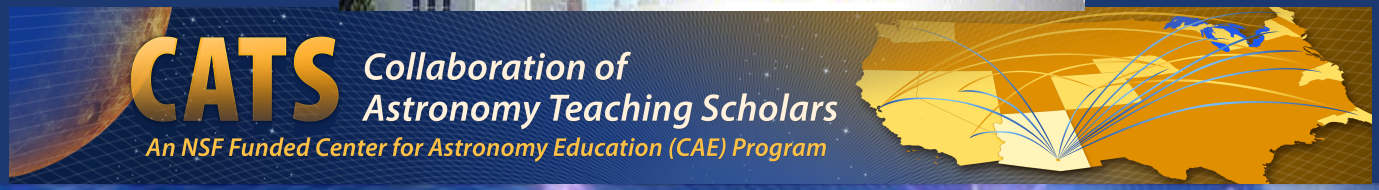

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Center for Astronomy Education

Dedicated to the professional development of introductory astronomy instructors

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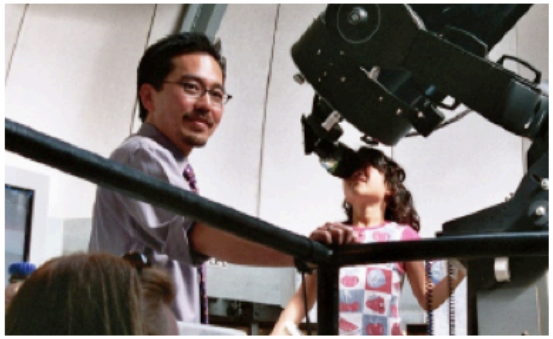
Moderation Continues to Grow by Leaps & Bounds

Tips from Our New Guest Moderator on Moderation

Hello, fellow astronomy educators! I'm Patrick M. Len ("P-dog" to my students), and I am your new Guest Moderator for AstroIrner@CAE. I currently teach physics and astronomy at Cuesta College, a small community college in San Luis Obispo, CA, and have taught physics and astronomy at Cosumnes River College (Sacramento, CA), Sonoma State University (Rohnert Park, CA), and University of California (Davis, CA).

I have been closely following AstroIrner@CAE for a number of years. Moving ... More >>



More Teaching Strategies

CAE Methods & Materials:
A "Newbie" Instructor's Perspective
This Month's Teaching Strategy comes to us from Joe Kabbes (Harper Community College). We met Joe at our CAE Teaching Excellence Workshop in St. Louis last summer.... More >>

Revisiting Think-Pair-Share:
An Expanded "How-To" Guide
After attending the Austin CAE Teaching Excellence Workshop in January, Amy Forestell, UT Austin graduate student, decided to take a look at the Think-Pair-Share... More >>

Classroom Assessment Techniques:
A Brief Overview
In our CAE Teaching Excellence Workshops, we discuss quite a few *classroom assessment techniques* that could be used to improve learning in an introductory... More >>

Additional Teaching Strategies >>

Seeing the Universe through NASA's Eyes

NASA's Image of the Day Gallery

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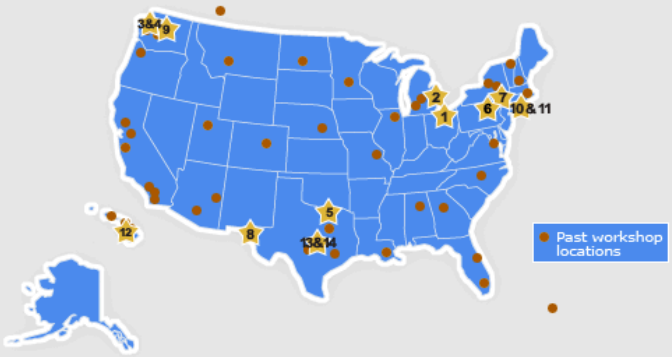


Fall/Winter 2010/11

0. Boulder, CO
   Cosmos in the Classroom
   July 31 - August 4, 2010
1. Oberlin, OH
   Tier I
   September 18-19, 2010
2. Dearborn, MI
   Regional Teaching Exchange
   October 01 - 02, 2010
3. Seattle, WA
   Tier I,CATS
   January 8-9, 2011
4. Seattle, WA
   Tier II,CATS,Special Topics
   January 9, 2011
5. Plano, TX
   Regional Teaching Exchange
   February 12, 2011

Spring/Summer 2011

7. New Paltz, NY
   CATS,Regional Teaching Exchange
   March 26, 2011
8. El Paso, Texas
   Tier I
   April 15 - 16, 2011
9. Seattle, WA
   CATS,Regional Teaching Exchange
   April 16, 2011
10. Boston, MA
    Tier I,CATS
    May 21 & 22, 2011
11. Boston, MA
    Tier II,CATS,Special Topics
    May 22, 2011
12. Hilo, HI

Fall/Winter 2011/12

13. Austin, TX
    Tier I,CATS
    January 7-8, 2012
14. Austin, TX
    Tier II,CATS,Special Topics
    January 8, 2012

Take Home Messages

- Research-validated interactive learning strategies can benefit ALL students in ALL classroom environment - BUT
- The quality of our implementation is likely the most deterministic factor toward student achievement

adapted from "How People Learn"

- Students enter the classroom with preconceptions about how the world works. *If their initial understanding is not fully engaged, they may fail to grasp new concepts in meaningful ways that last beyond the purposes of an exam.*
- To fully develop competence, students must: *(1) have a deep foundation of factual knowledge, (2) understand the interrelationships among facts and ideas in the context of a conceptual framework, and (3) organize knowledge in ways that facilitate retrieval, application, and critical thinking*
- A "metacognitive" approach to instruction can help students learn to take control of their own learning and monitor progress.

How People Learn: Brain, Mind, Experience, and School (Expanded Edition),
National Research Council, National Academy Press, 2000.

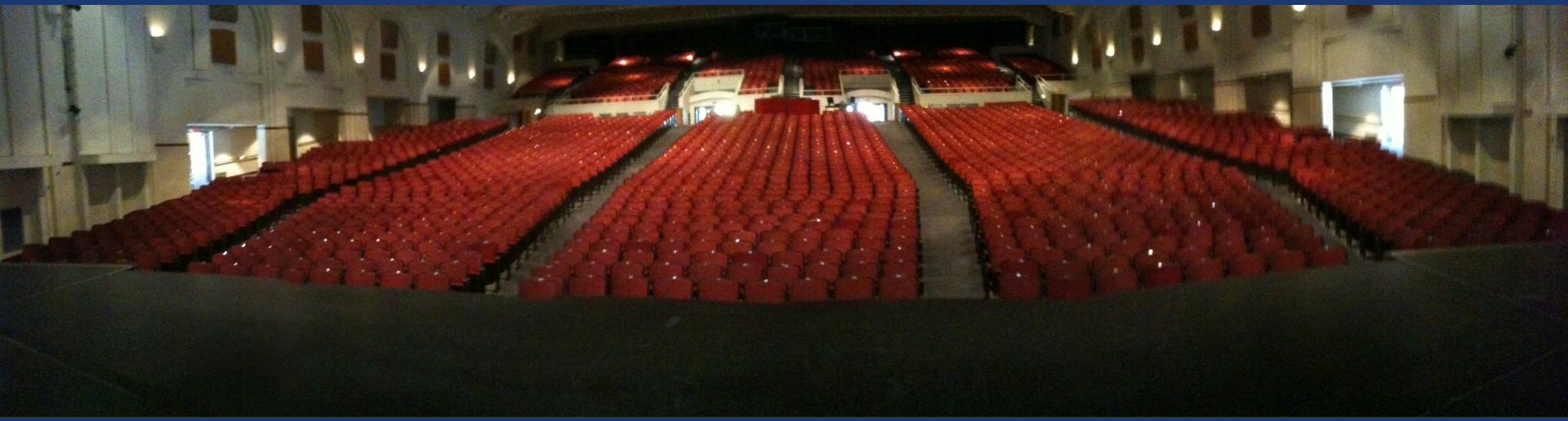
"Most ideas about teaching are not new, but not everyone knows the old ideas." Euclid (300 B.C.)

A Commonly Held Inaccurate Model of Teaching and Learning

Your discipline content

Bill Watterson,
Calvin and Hobbs

Centennial Hall Performing Arts Theater at University of Arizona



The best learners often make the worst teachers. They are, in a very real sense, perceptually challenged. They cannot imagine what it must be like to struggle to learn something that comes so naturally to them.

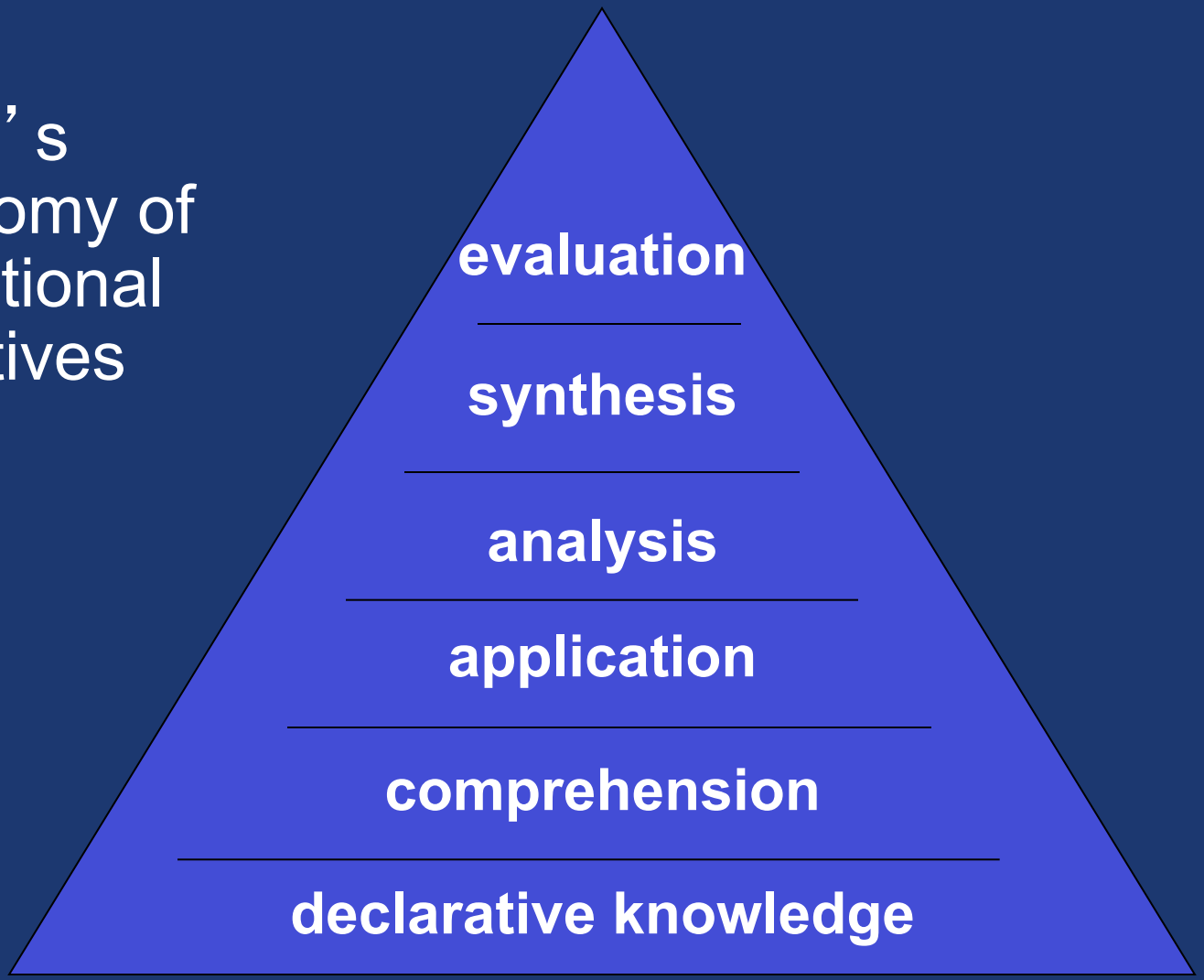
Stephen Brookfield (2006), *The Skillful Teacher*, Jossey-Bass Publishers

What Can I do Besides Lecture to Engage Students in their Learning?

- Ask students questions (not all questions are equal)
- Use interactive videos, demonstrations, animations, and simulations
- In-class writing (with or without discussion)
  - Muddiest Point
  - Summary of Today's Main Points
  - Writing Reflections
- Think-Pair-Share or PeerInstruction
- Small Group Interactions
  - Concept Maps
  - Case Studies
  - Sorting Tasks
  - Ranking Tasks
  - Lecture-Tutorials
  - Collaborative Problem Solving
- Student Debates (individual/group)
- Whole Class Discussions

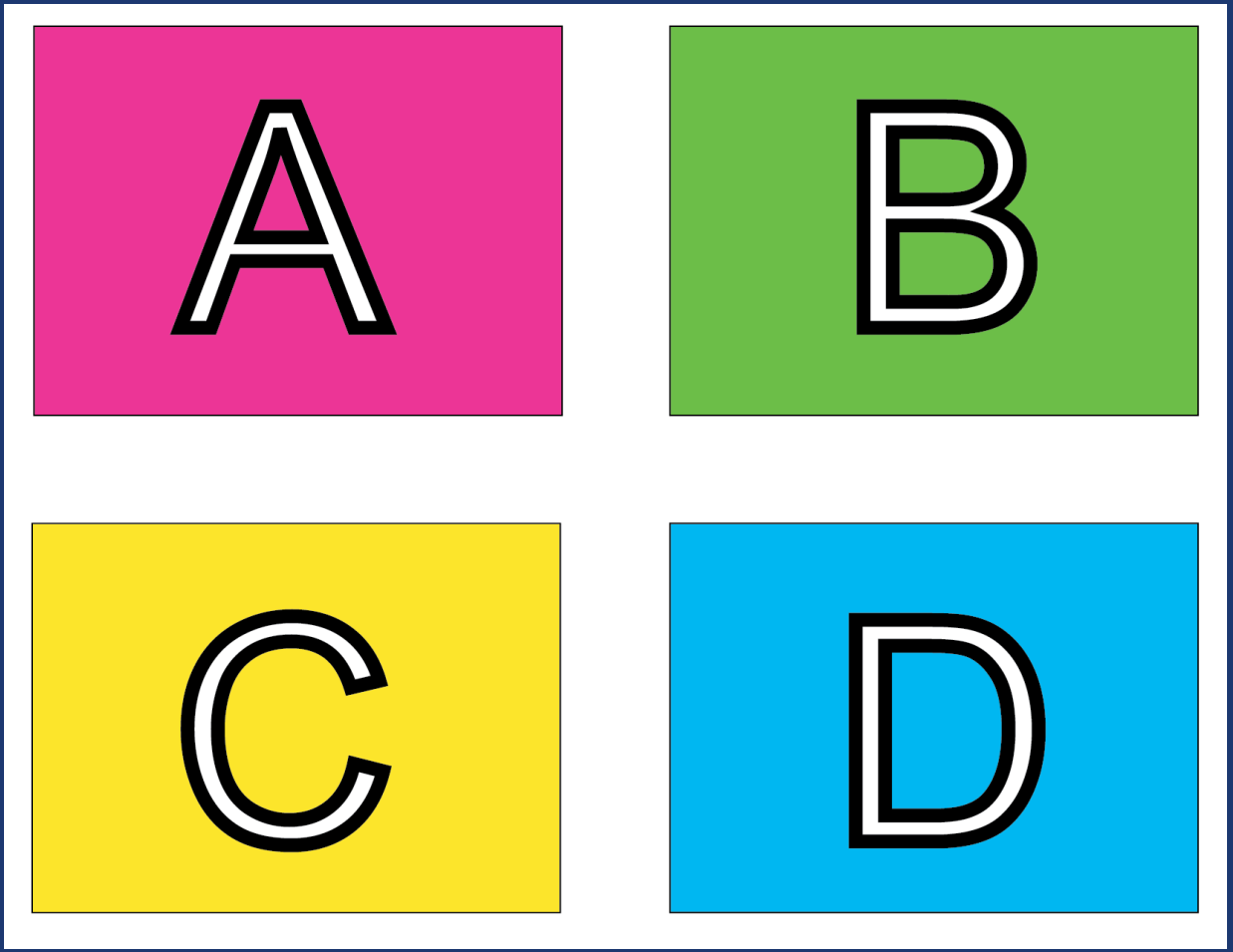
Does your class intellectually engage your students and deepen their conceptual understanding and critical thinking ability or does it re-enforce the memorization of facts and declarative knowledge?

Bloom's Taxonomy of Educational Objectives



The Role of Assessment in the Development of the College Introductory Astronomy Course A "How-to" Guide for Instructors. Astronomy Education Review, 1(1), 1-24, 2002. G. Brissenden, T.F. Slater, and R. Mathieu.

Class Response System—Medium Tech



Which of the following is the best ranking (from greatest to least), for the gravitational force exerted on asteroids 1, 2 and 3 by their partner asteroids?

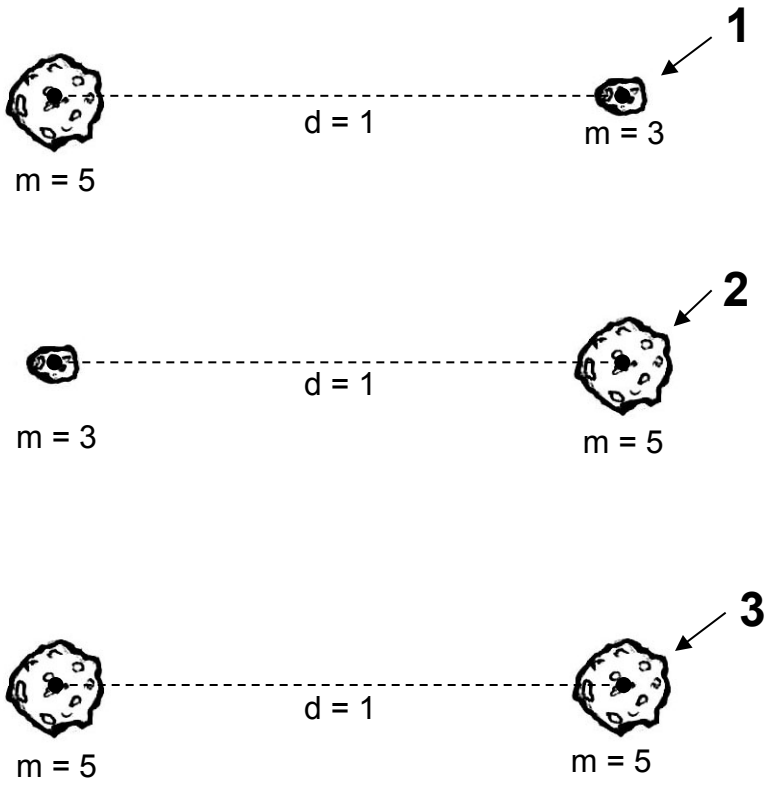
A. 3>2>1

B. 3=2>1

C. 3>2=1

D. 1=2>3

E. 3=1>2



Rank the acceleration of asteroids 1, 2 and 3 from greatest to least.

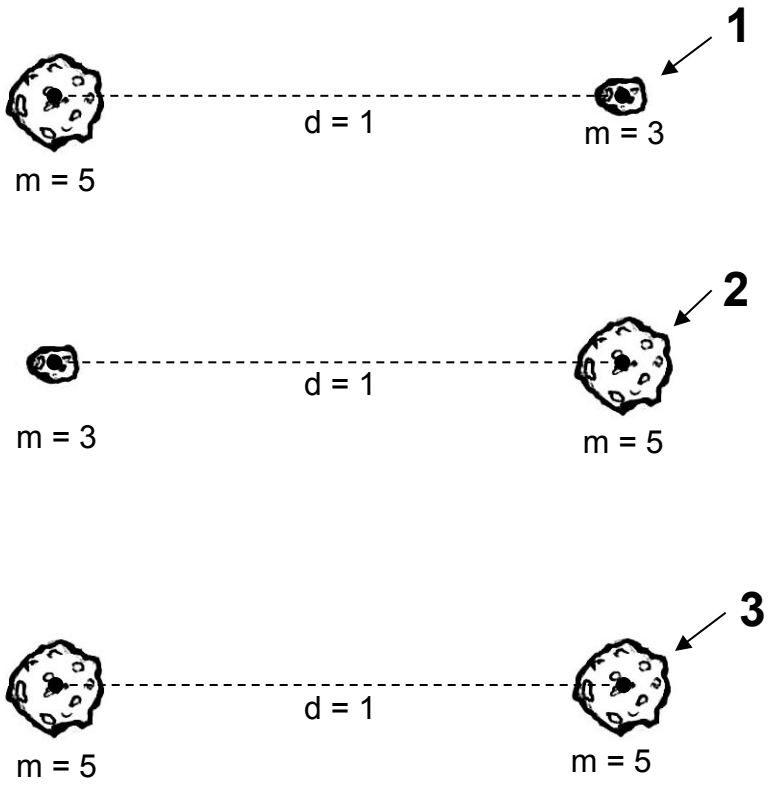
A. 1>2>3

B. 1>3>2

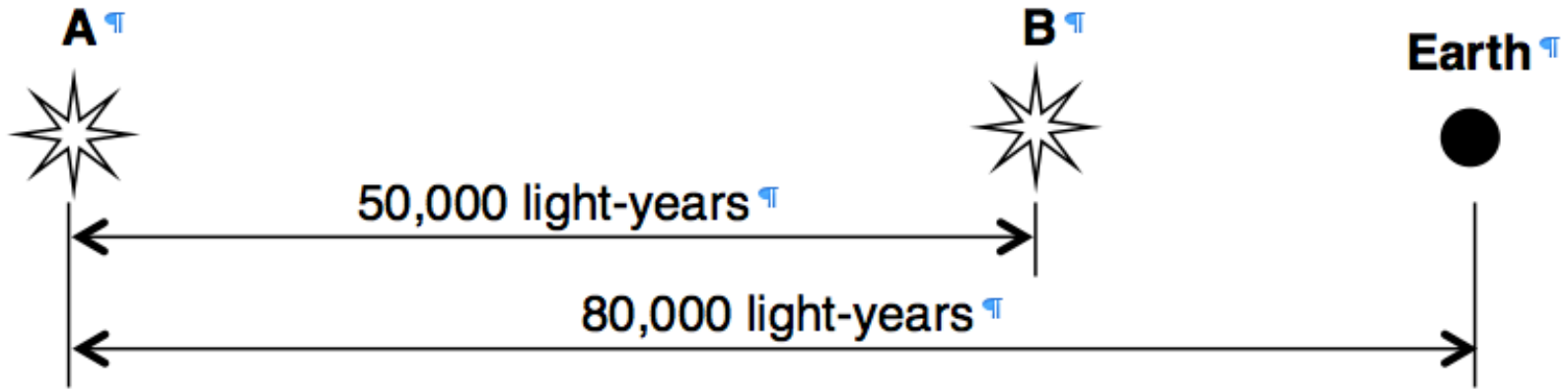
C. 3=1>2

D. 1>2=3

E. 2=3>1



The drawing below (not to scale) shows Star A, Star B, and Earth all in a line. Star B is 50,000 light-years from Star A, while Earth is 80,000 light-years from Star A.



When an observer on Earth can first see Star A, how old would Star A appear to an observer orbiting Star B?

a. 30,000 years old
b. 50,000 years old
c. 80,000 years old
d. 130,000 years old

What would the phase of the moon be?

A. Waxing crescent

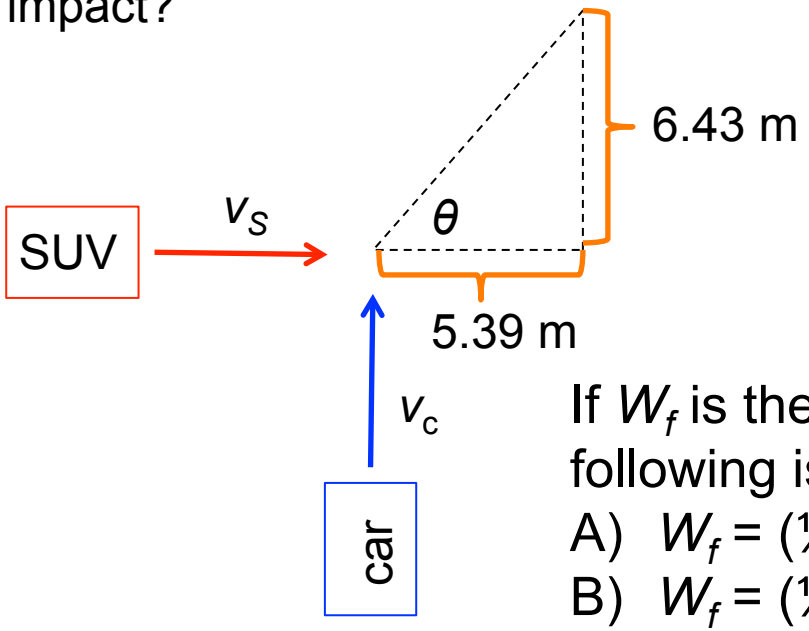
B. Third Quarter

C. Waxing Gibbous

D. Waning Crescent

E. Waning Gibbous

A 1500 kg car is traveling north through an intersection when it is hit by a 2200 kg SUV traveling east. The two vehicles become locked together during the impact and slide together as one after the collision. The cars slide to a halt at a point 5.39 m east and 6.43 m north of the impact point. The coefficient of kinetic friction between the tires and the road is $\mu_k = 0.75$. How fast was each car traveling just before the impact?



If W_f is the work done by friction, then which of the following is true?

A) $W_f = (\frac{1}{2}\, m_s v_s^2 + \frac{1}{2}\, m_C v_C^2) - \frac{1}{2}(m_S + m_C)(v_{S+C})^2$

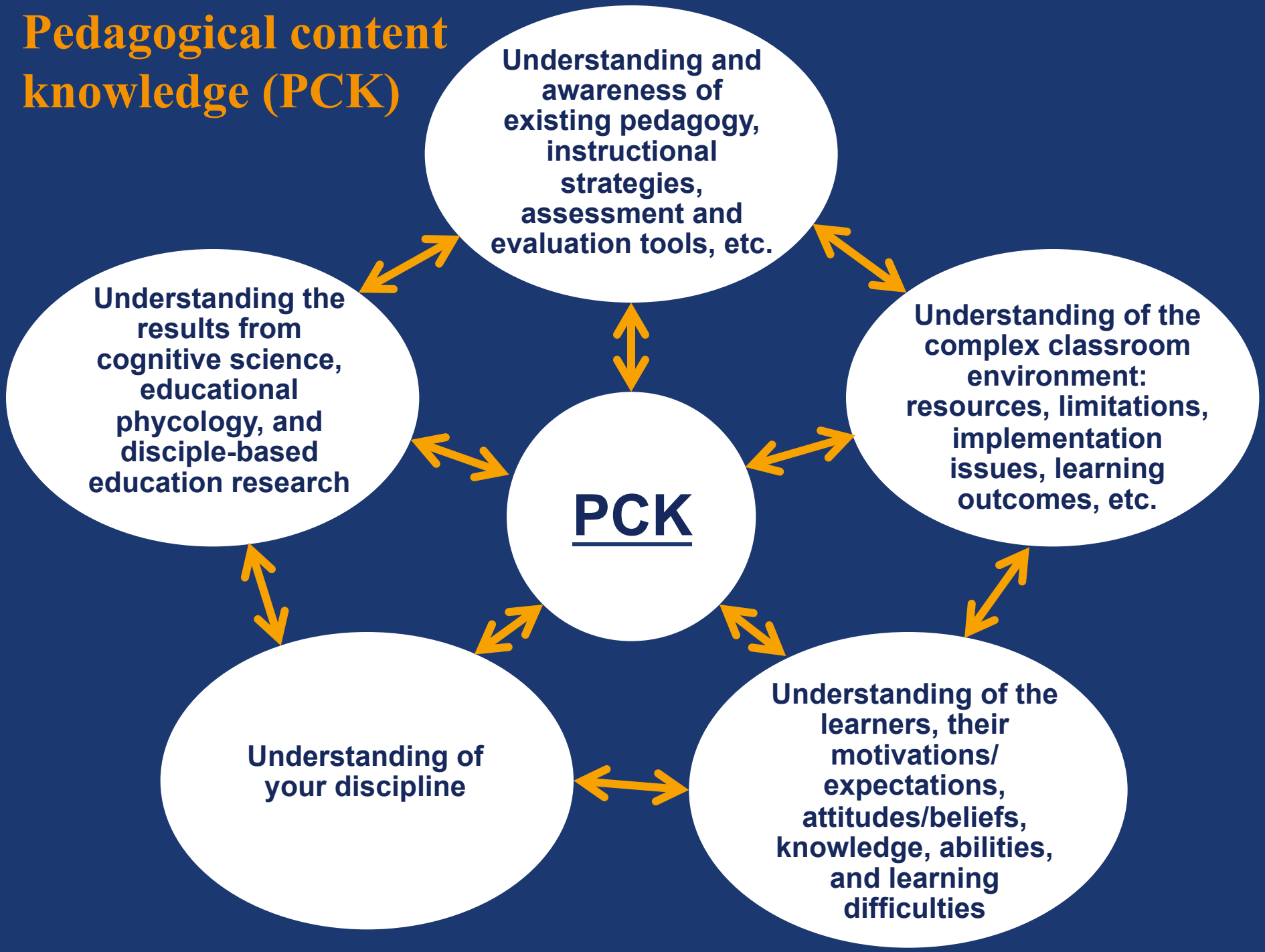
B) $W_f = (\frac{1}{2}\, m_s v_s^2 + \frac{1}{2}\, m_C v_C^2) - 0$

C) $W_f = 0 - \frac{1}{2}(m_S + m_C)(v_{S+C})^2$

D) $W_f = (\frac{1}{2}\, m_s v_s^2 + \frac{1}{2}\, m_C v_C^2) + \frac{1}{2}(m_S + m_C)(v_{S+C})^2 - 0$

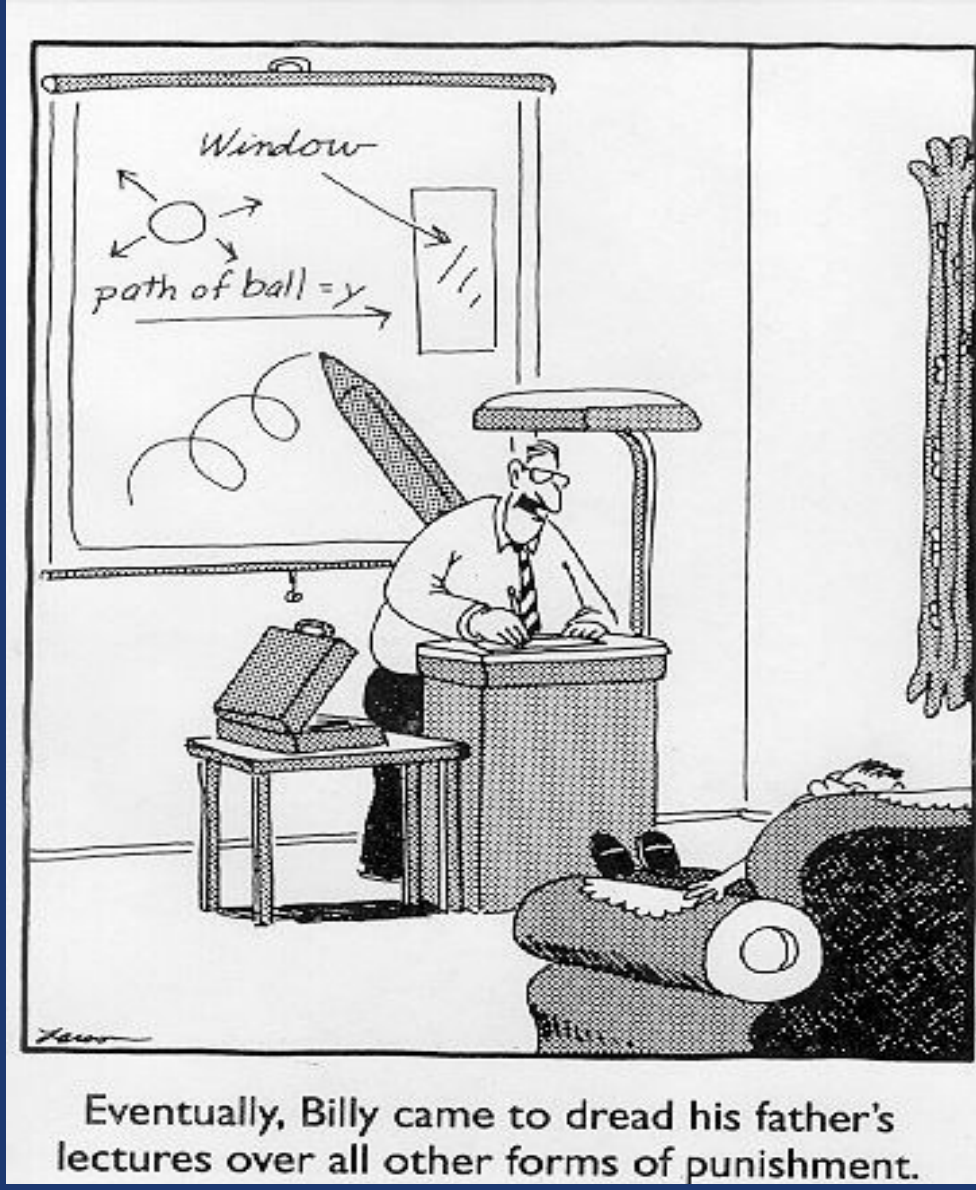
E) $W_f = (\frac{1}{2}\, m_s v_s^2 + \frac{1}{2}\, m_C v_C^2) - \frac{1}{2}(m_S + m_C)(v_{S+C})^2 - 0$

Pedagogical content knowledge (PCK)



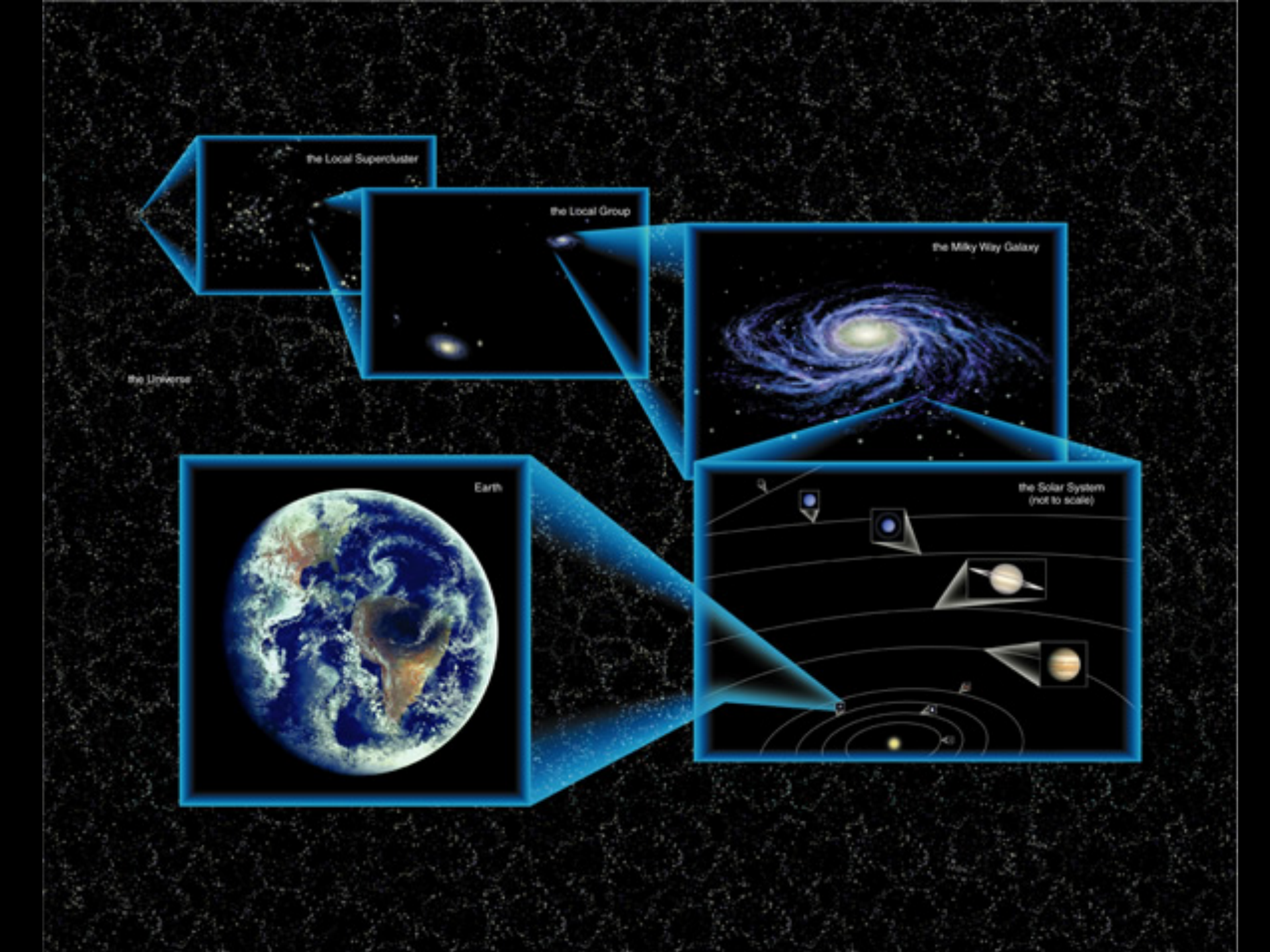
If a Picture is worth a thousand words, then what is a real-world, first-hand, experience worth?

- Audience participation is strongly encouraged
- Demos are sometimes life-threatening



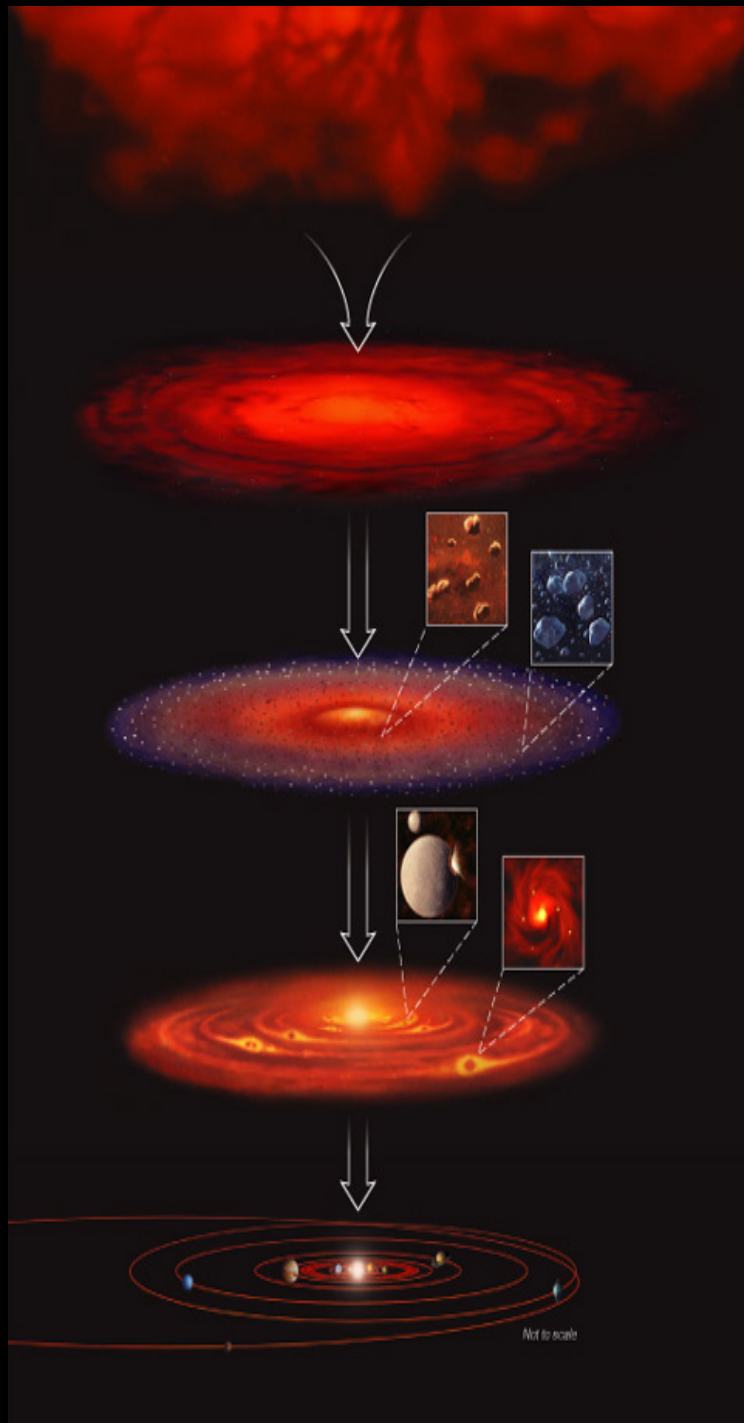
Eventually, Billy came to dread his father's lectures over all other forms of punishment.

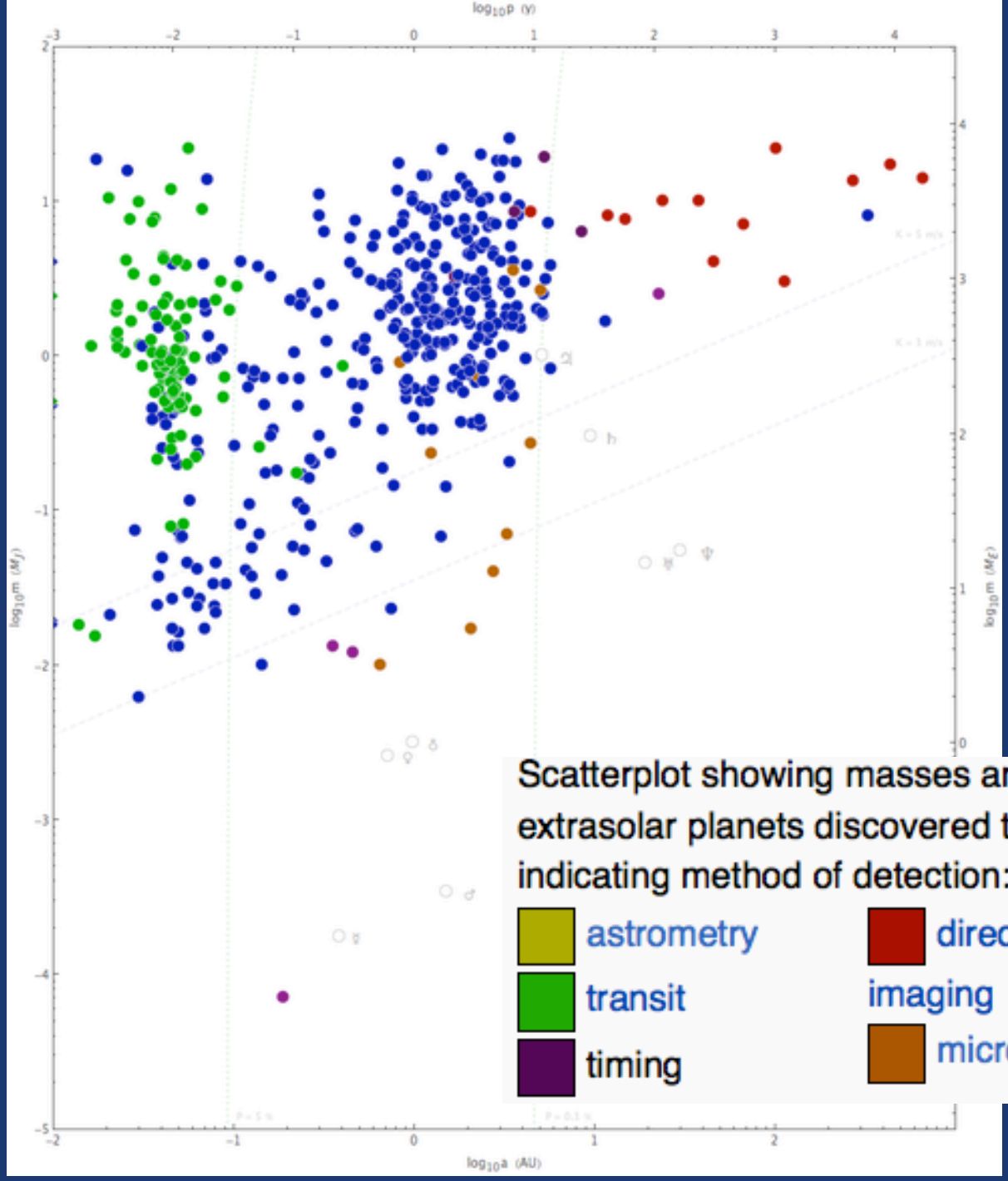
"Eventually, Billy came to dread his father's lectures over all other forms of punishment"


the Local Supercluster
the Local Group
the Universe
the Milky Way Galaxy
Earth
the Solar System
(not to scale)

… one of these?

How many of these are in ..

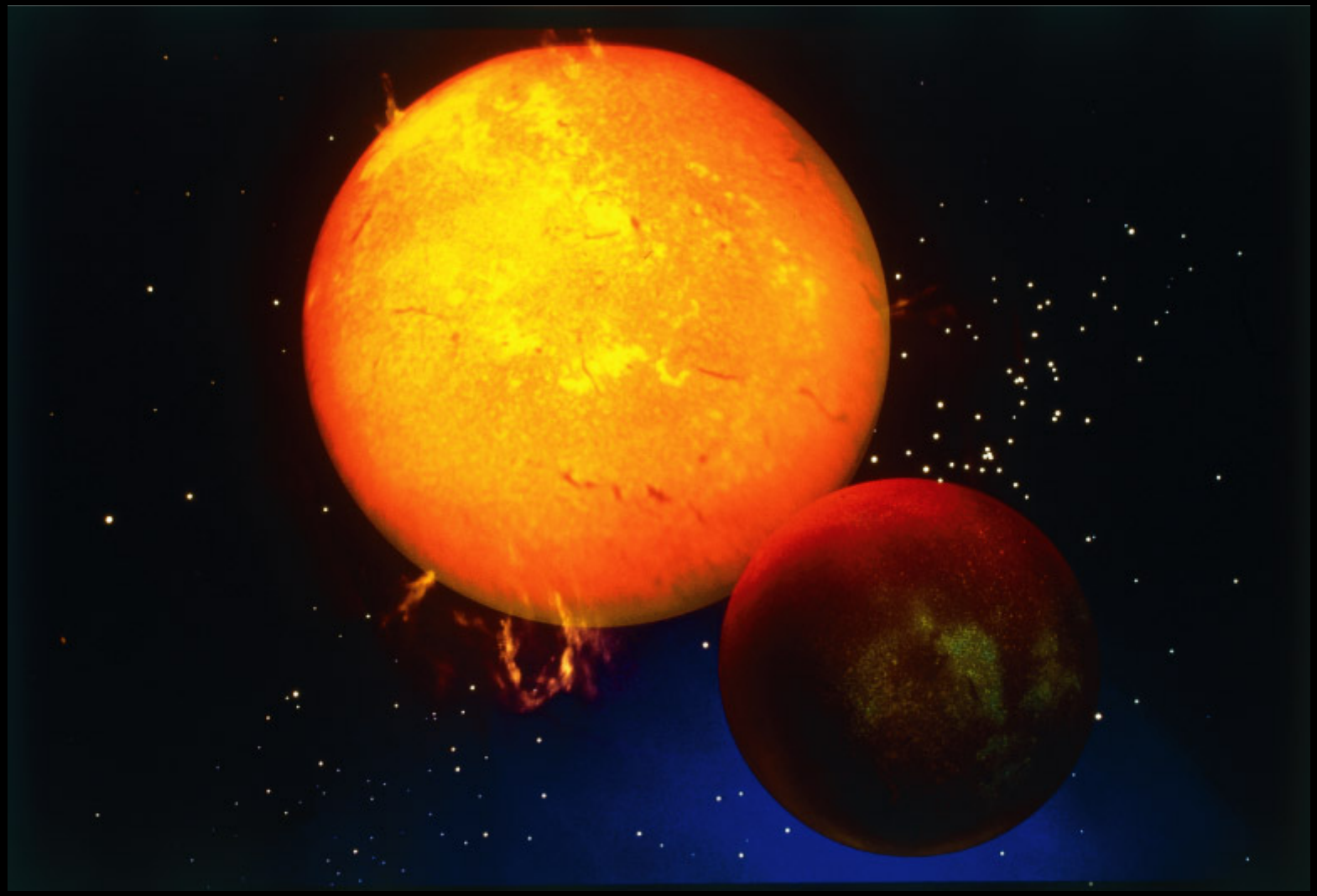


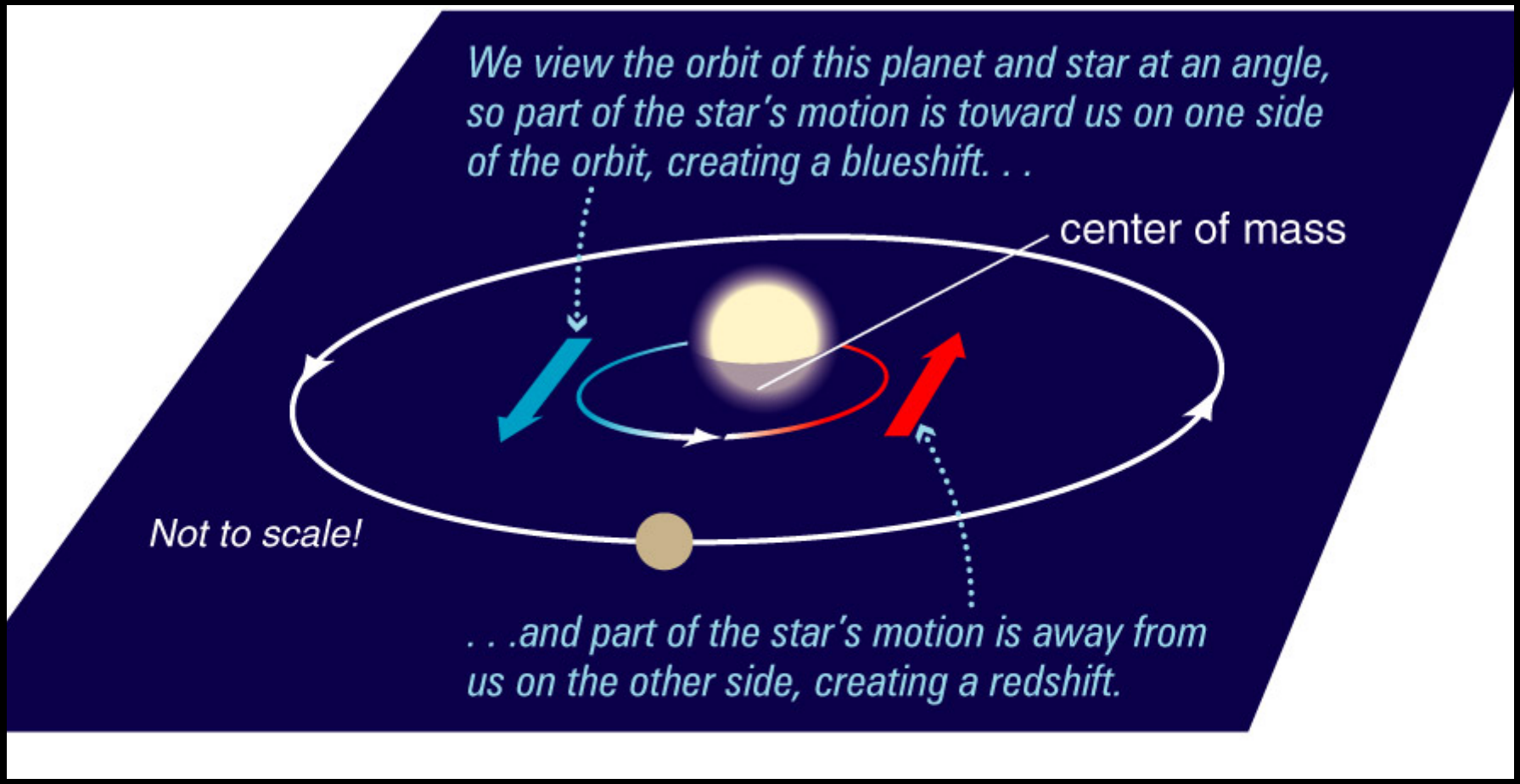


Rank the different methods for finding extrasolar planets from most successful to least.

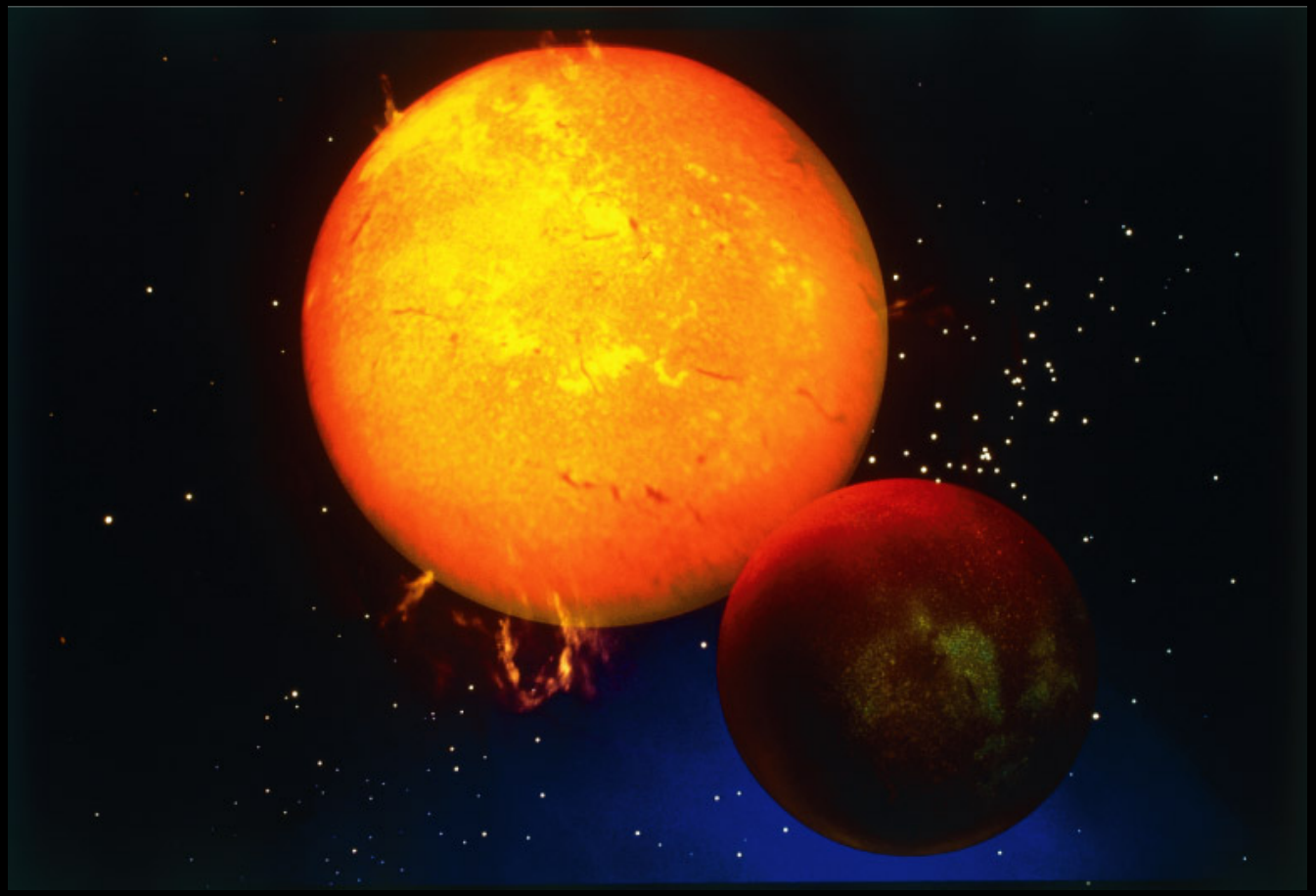
Scatterplot showing masses and orbital periods of all extrasolar planets discovered through 2010-10-03, with colors indicating method of detection:

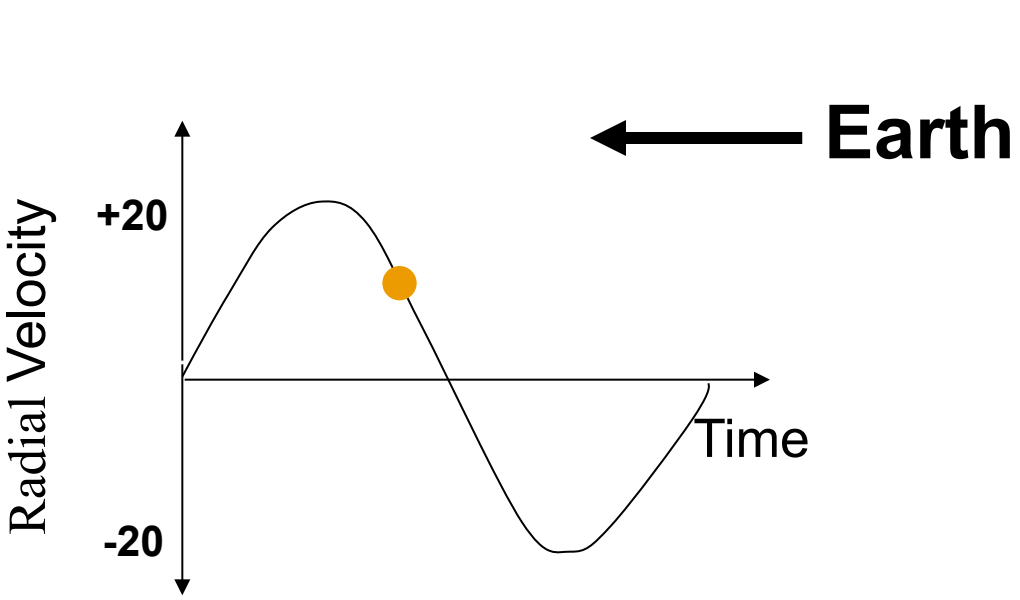
- astrometry
- direct imaging
- radial velocity
- transit
- microlensing
- pulsar timing
- timing

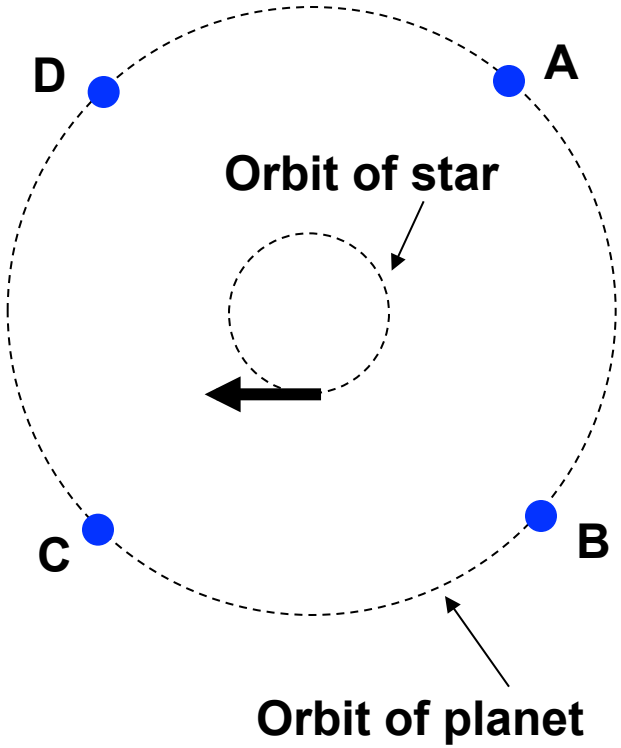



We view the orbit of this planet and star at an angle, so part of the star's motion is toward us on one side of the orbit, creating a blueshift. . .
center of mass
Not to scale!
. . .and part of the star's motion is away from us on the other side, creating a redshift.

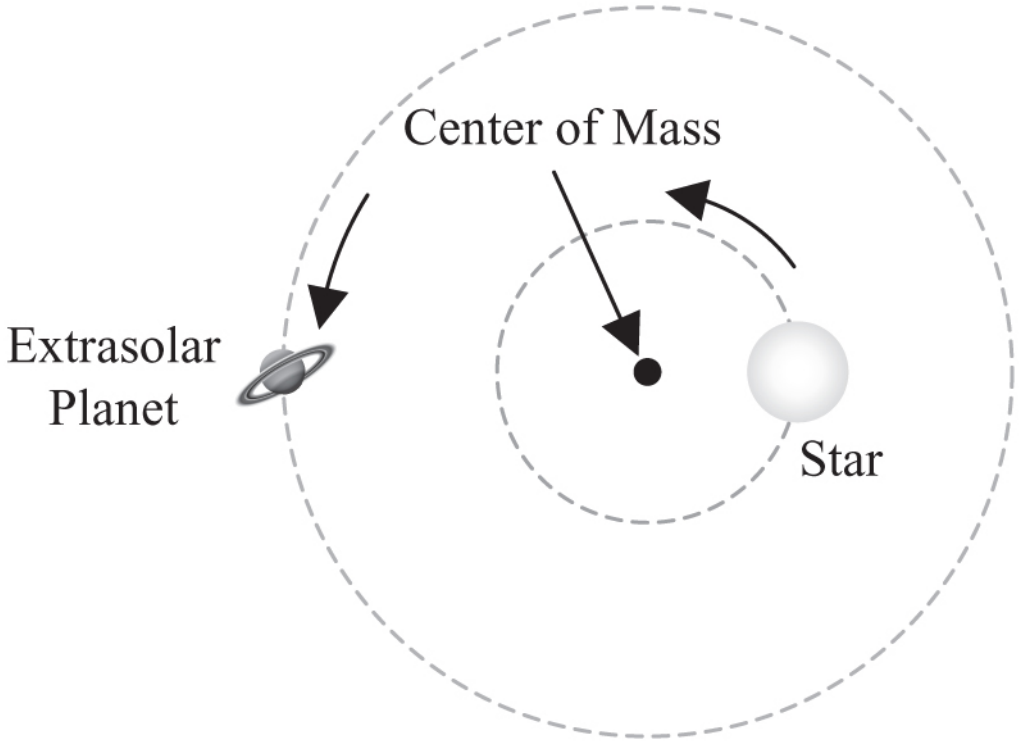
Amount of Doppler shift in Star's light $\approx \frac{M_p}{\sqrt{(M_s \times d)}}$





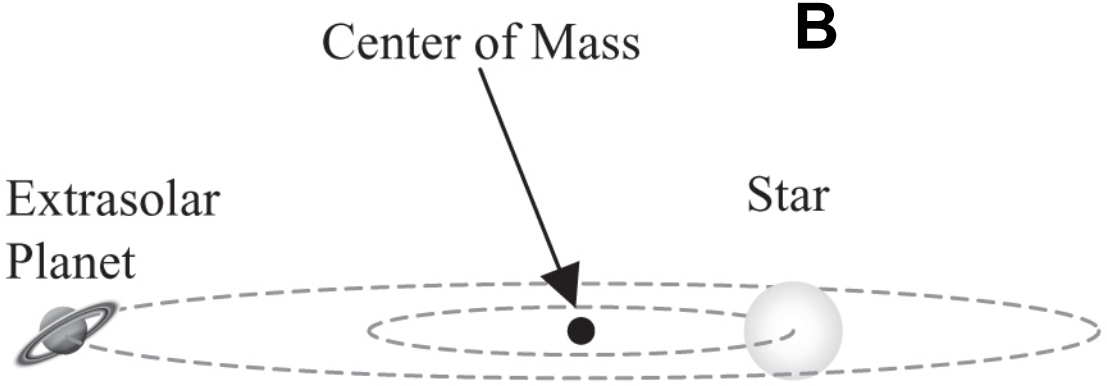


Given the location marked on the star's radial velocity curve, at which location in the planet's orbit would you expect the planet to be?

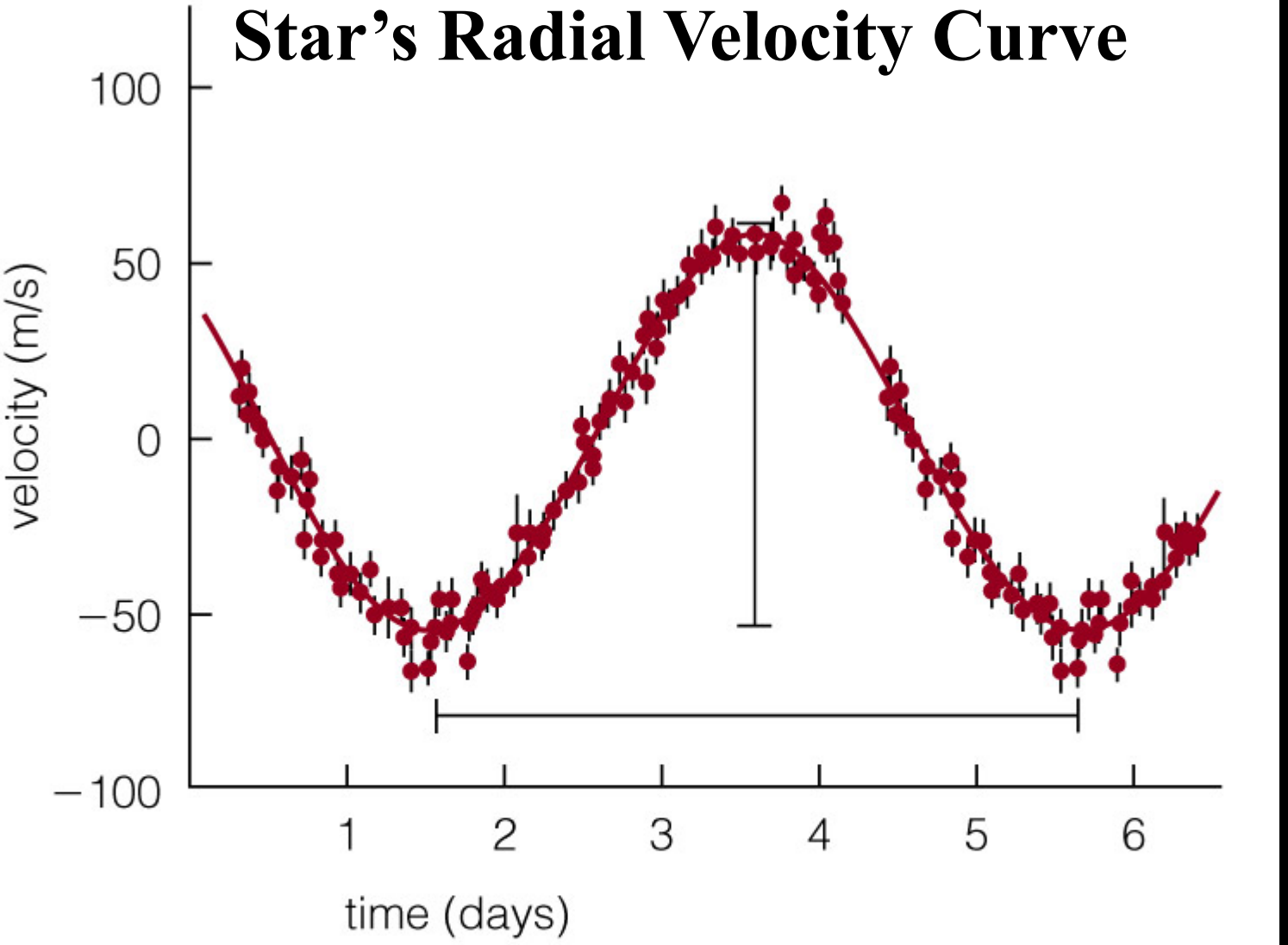


A

B



Star's Radial Velocity Curve



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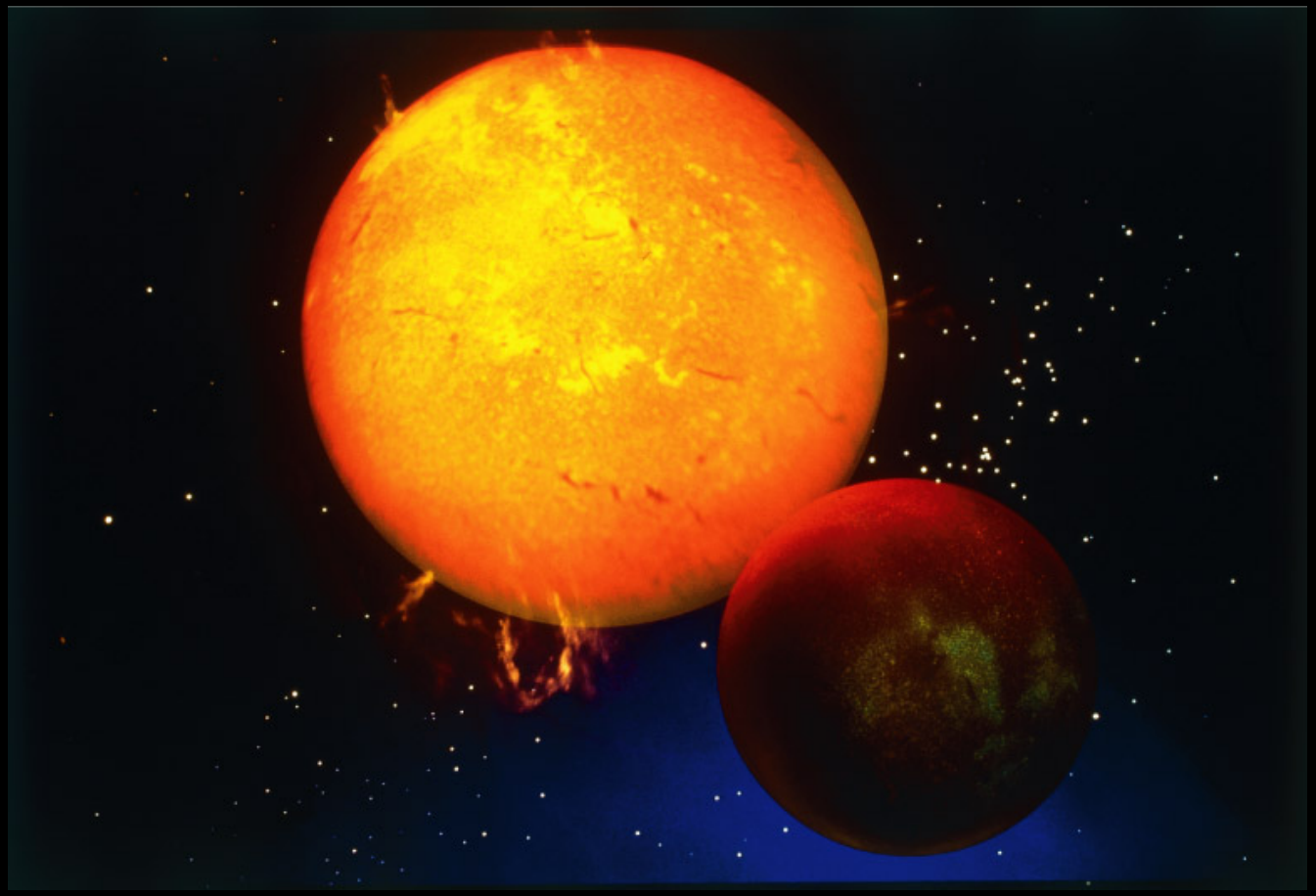

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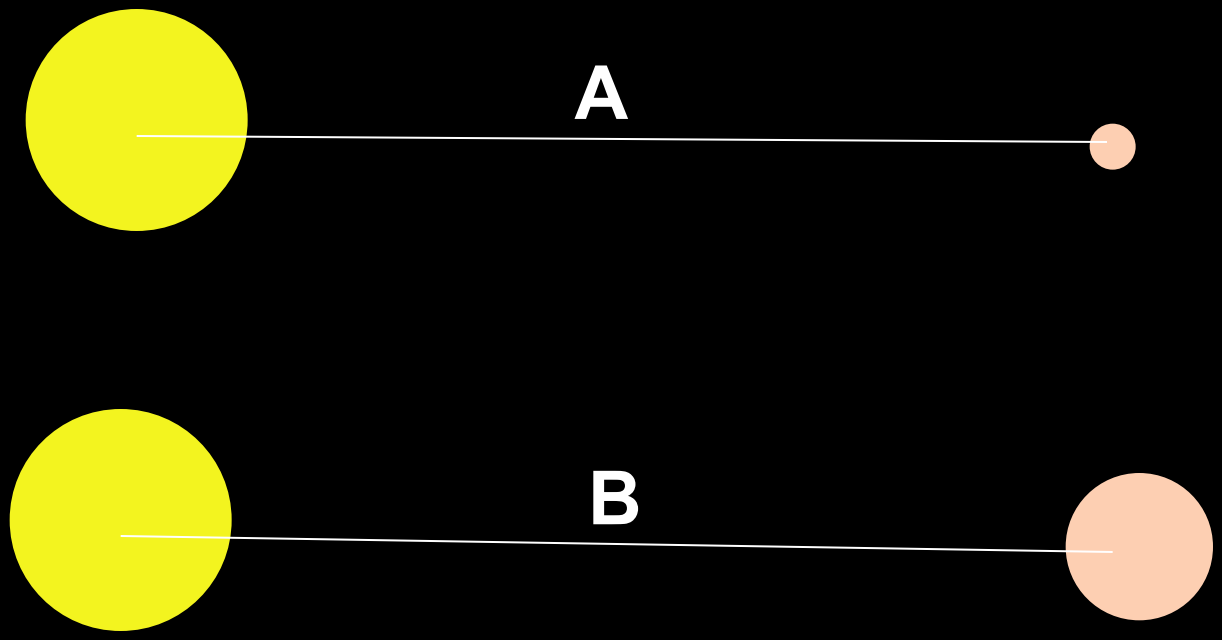

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