

Physical Properties Hypothetical Construct Map



KeriAnn Rubin, Julia Plummer, Christopher Palma, Alice Flarend, Yann Shiou Ong, Scott McDonald, and Tanya Furman
 Earth and Space Science Partnership (ESSP) – www.essp.psu.edu

Upper Anchor: Observable patterns in the locations, motion, and physical properties of the objects in the Solar System at the current time reveal that the Sun, planets, moons, and smaller bodies formed roughly 4.6 billion years ago from the same initial pool of material, which was a slowly rotating cloud of gas.

Research Question: How does instruction informed by our hypothetical learning progression alter student understanding of the physical properties of the objects in the Solar System?

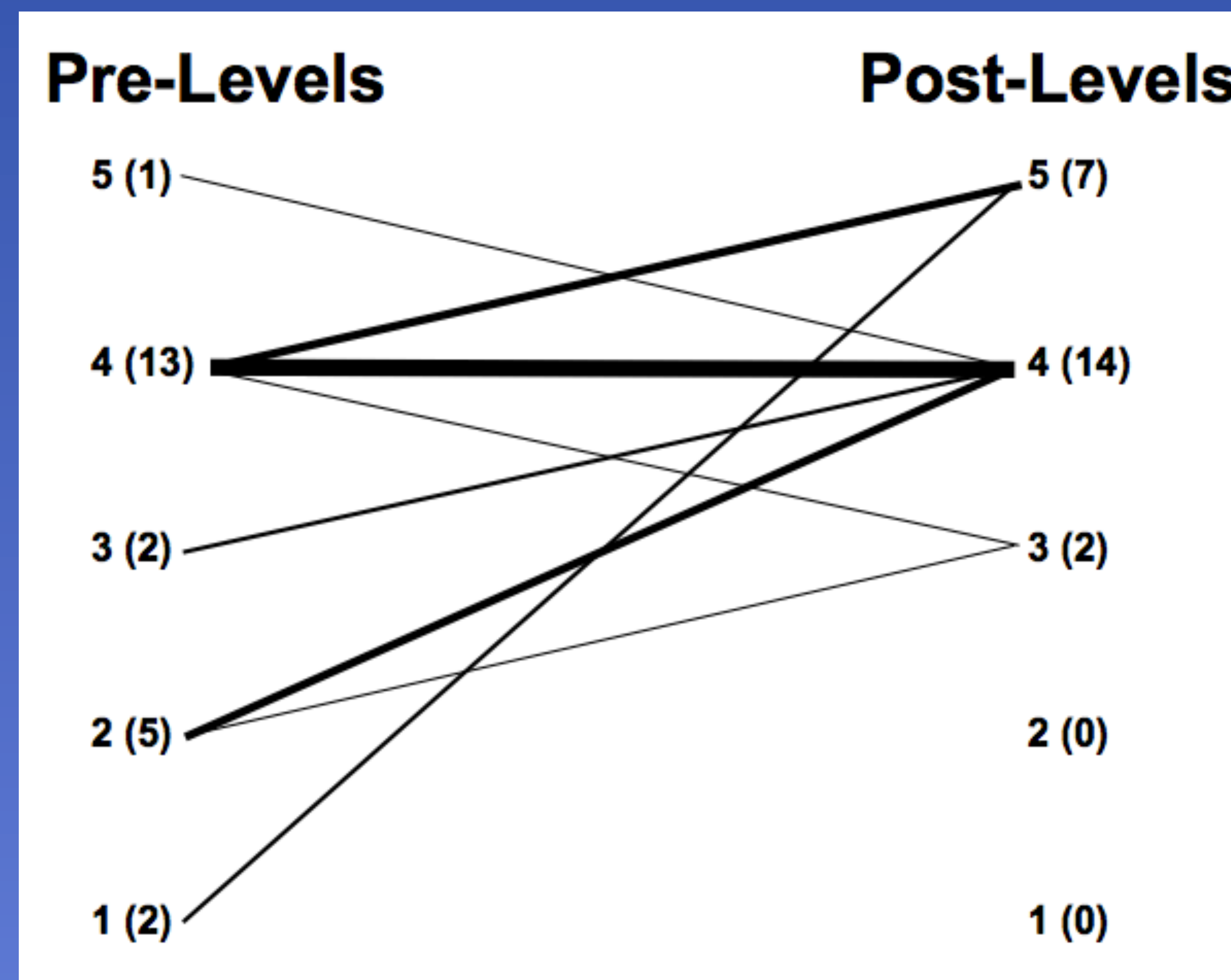
Participants: Sixth grade students (n = 24)

Data: Pre/Post interviews and classroom recordings

Physical Properties Hypothetical Construct Map

Level	Level Descriptions
5	Students articulate an accurate picture of what the Solar System contains, what the planets are composed of (primarily rock, gas, and ice), and how they are all grouped based on their composition. Students also know that the Sun is composed of gas or plasma.
4	Students understand that planets are all or mostly rock, gas, or ice, but <i>usually</i> refer to two of the three at this level. Students use their understanding of planetary composition in their grouping of the planets. They may still include non-normative objects in the Solar System.
3	Students understand that planets are all or mostly rock, gas, or ice, but <i>usually</i> only refer to two of the three at this level. Students do not use their understanding of planetary composition in their grouping of the planets. They may still include non-normative objects in the Solar System.
2	Students know some of the objects found in the Solar System and what at least one of them is composed of, but do not have an understanding of the range of compositions and how they are grouped. They may still include non-normative objects in the Solar System.
1	Students have a non-normative understanding of what objects are found in the Solar System, what they are made of, and how they are grouped.

Change in Students' Understanding of Physical Properties



Change in Student Understanding

- All of the students identified at least two of the three planetary compositions.
- The number of students who grouped the planets by their compositions increased.



Classroom Instruction Contributing to Change

Kinesthetic Accretion: Instructional Days: 1

- Students used their bodies to represent rocky, gaseous, and icy particles.

Planetary Grouping: Instructional Days: 5

- Students collected planetary properties (mass, density, size, etc.) data from a variety of sources.
- Students analyzed this data to determine how the planets could be grouped by their properties.

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15
Size / scale of Earth Sun system	Reasons for the seasons	Phases, eclipses, & tides	Tides	Meteors, comets, & asteroids	Planet and asteroid orbits	Relative mass of Solar System objects Planet properties	Spring Break	Grouping planets by their properties	Planetary orbits Exoplanets	Gravity, mass, & density	Astronomical Technology	Solar system formation – accretion theory	Solar System formation – Solar nebula theory	
Modeling phenomena with Earth's rotation	Earth's motion in the Solar System	Sun Earth Moon system				Size / scale of the Solar System								

