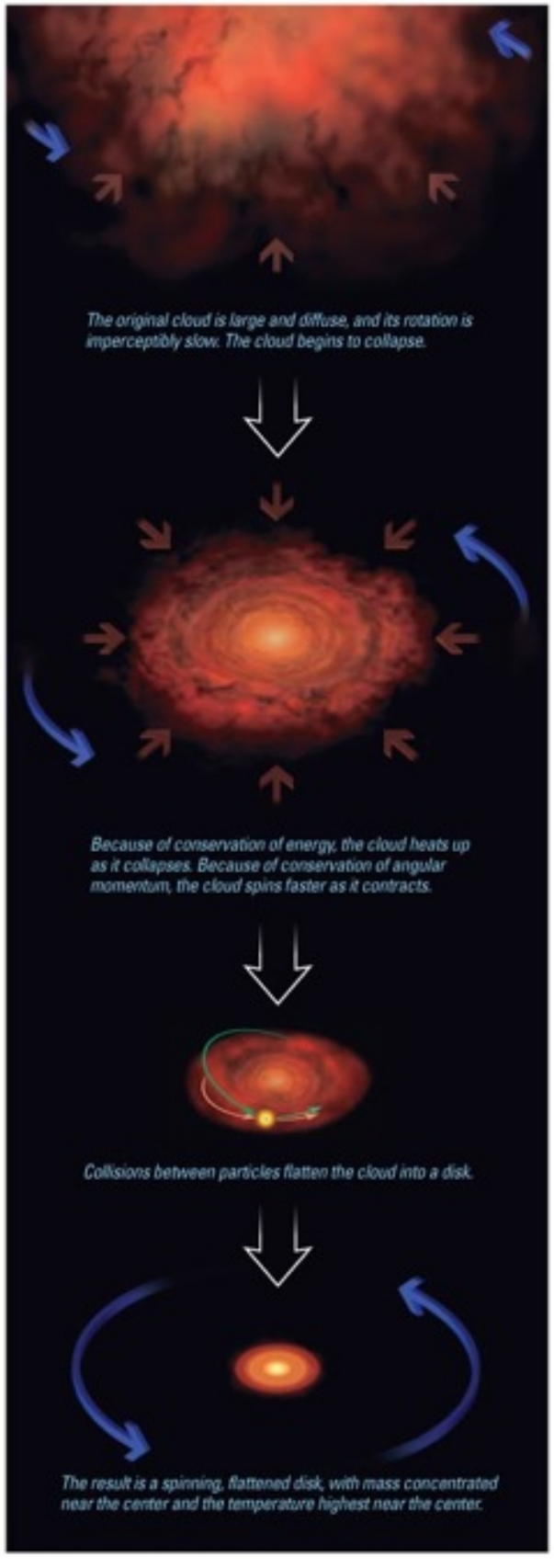
What properties of our solar system must a formation theory explain?

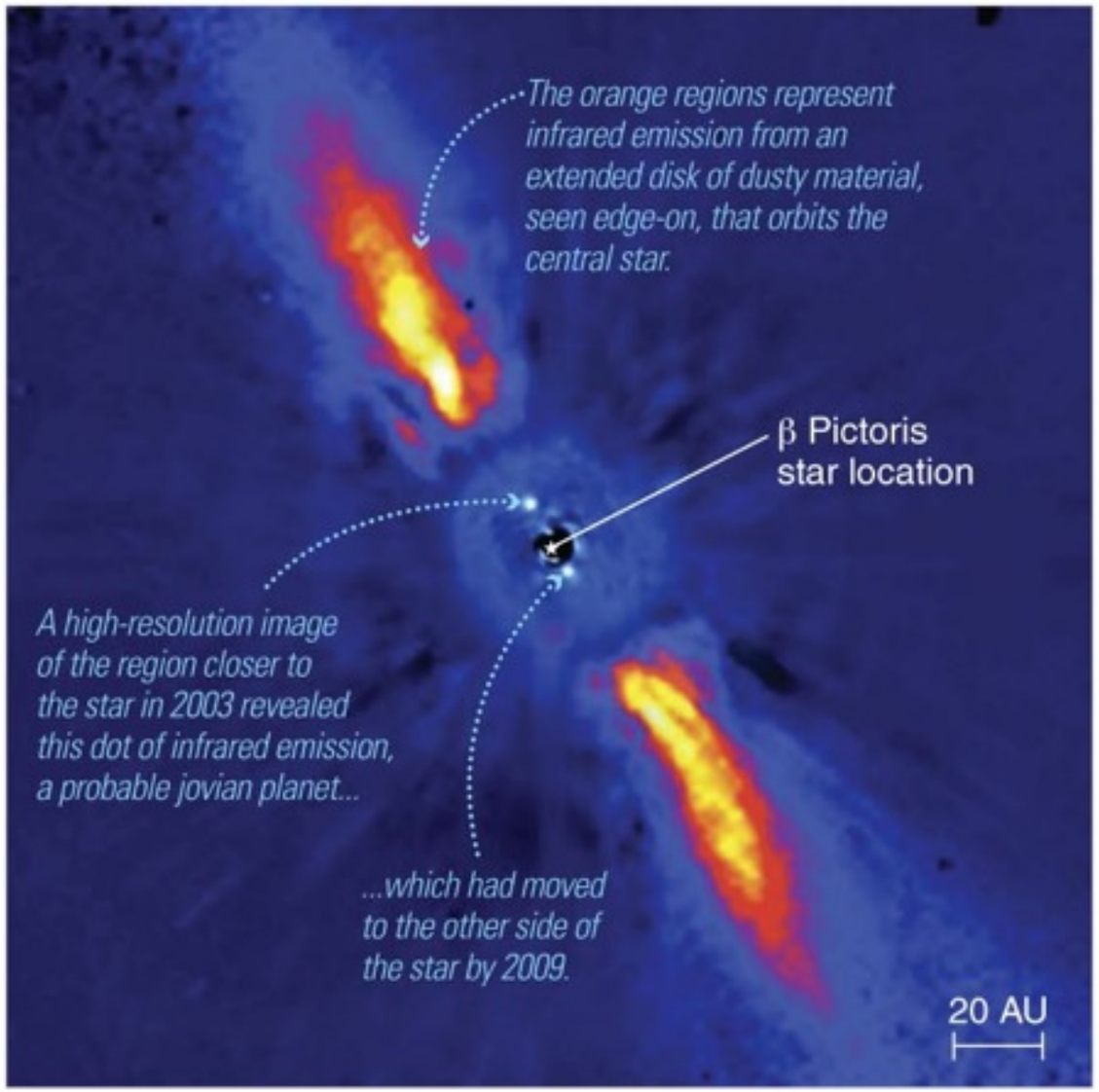
1. Patterns of motion of the large bodies
   - Orbit in same direction and plane
2. Existence of two types of planets
   - Terrestrial and jovian
3. Existence of smaller bodies
   - Asteroids and comets
4. Notable exceptions to usual patterns
   - Rotation of Uranus, Earth's Moon, etc.

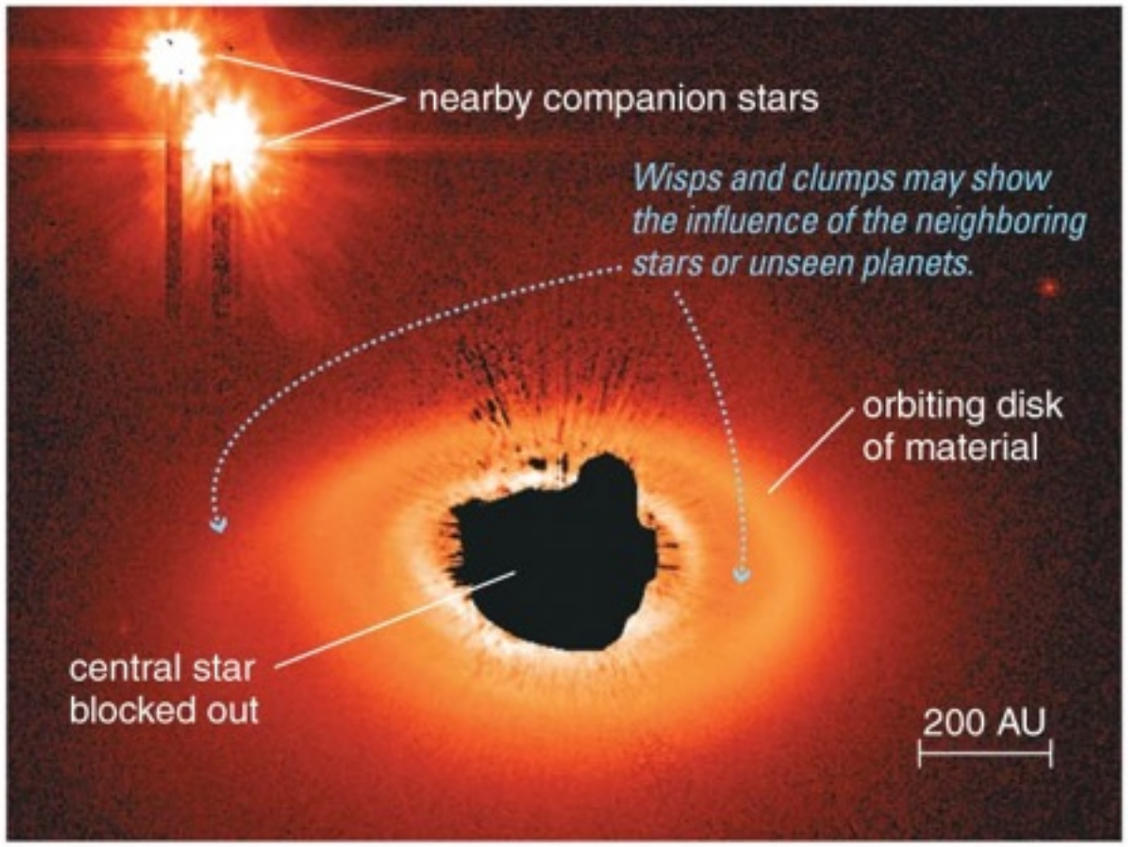
Flattening



- Collisions between particles in the cloud caused it to flatten into a disk.

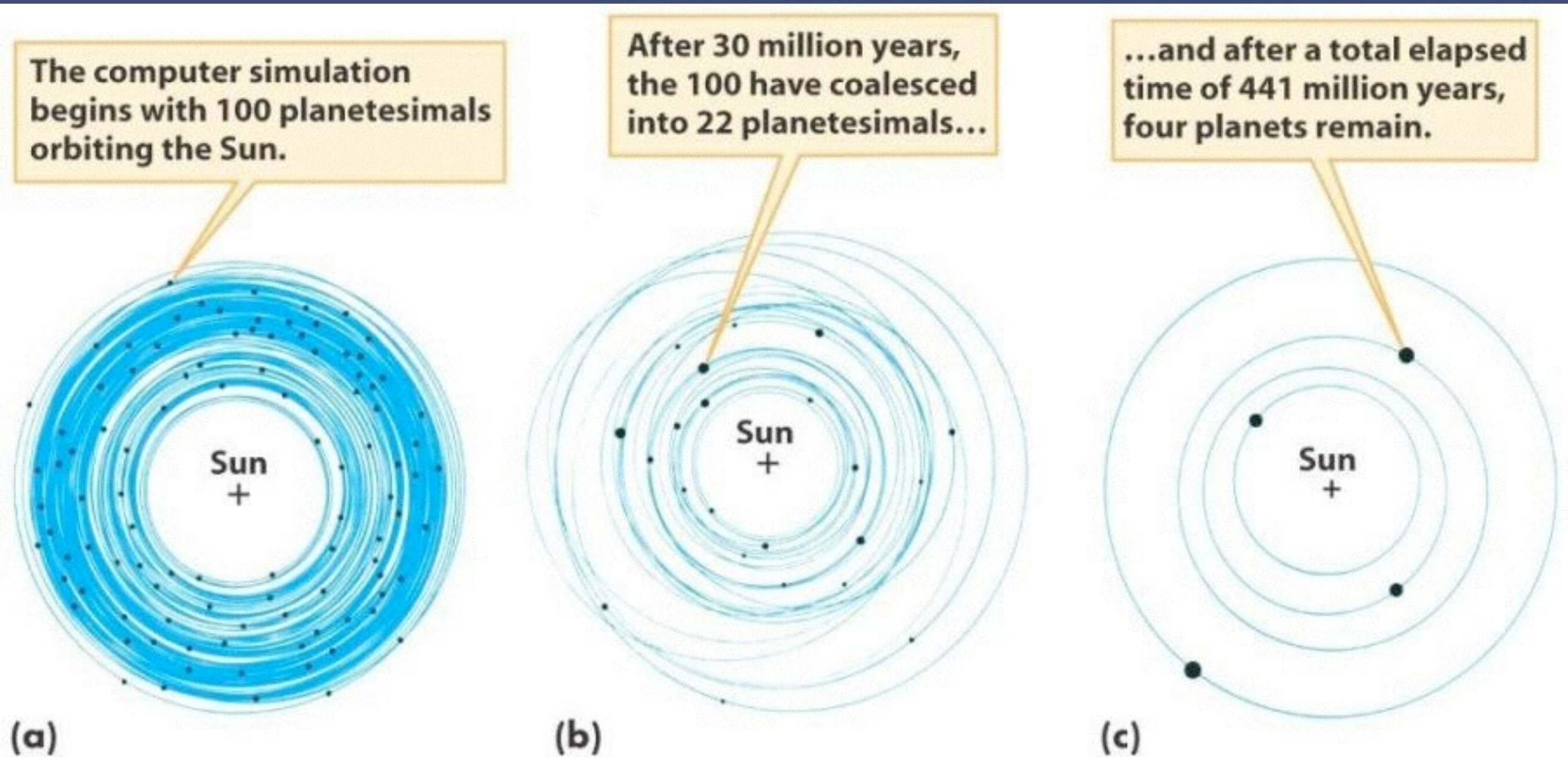
Disks around Other Stars



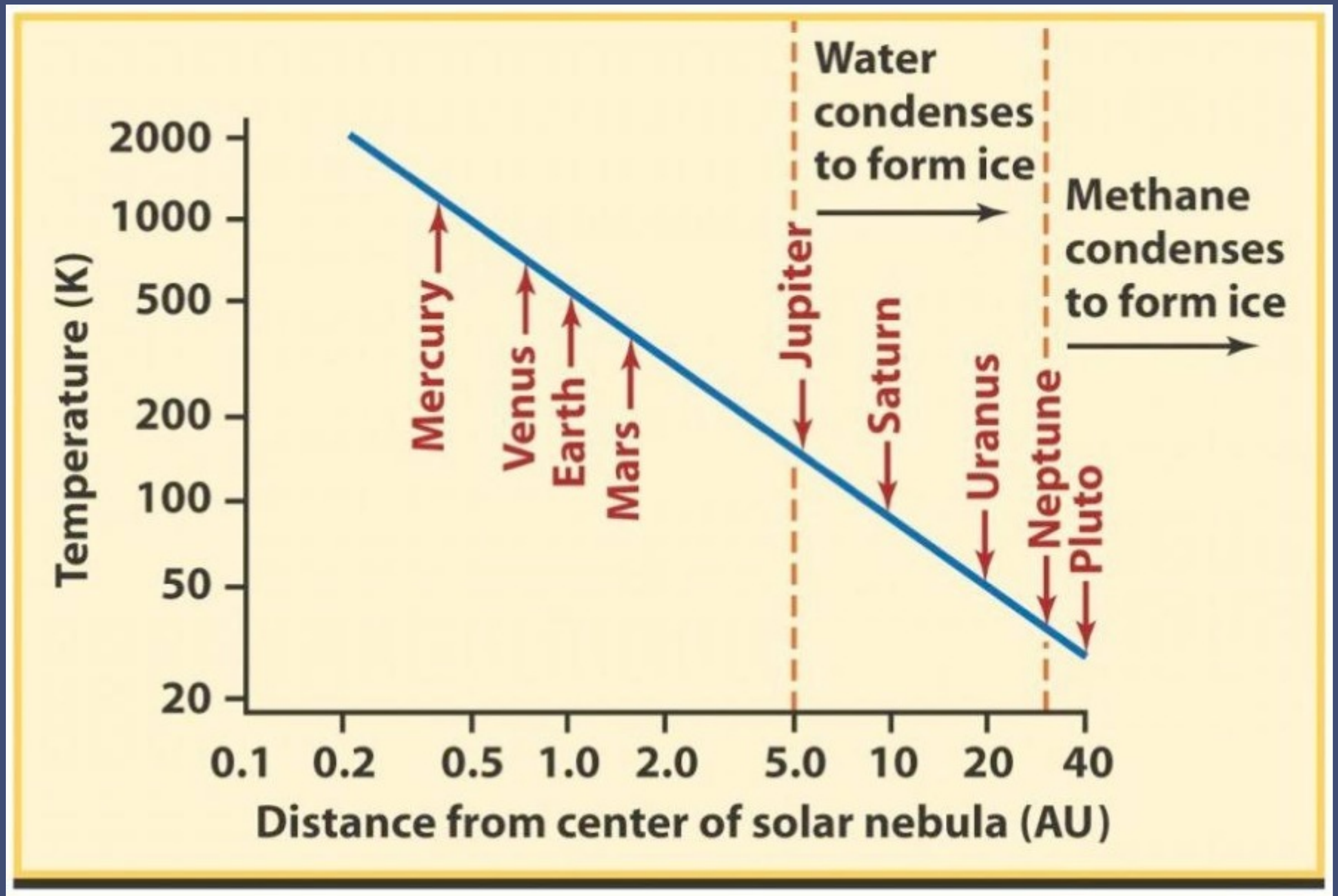


- Observations of disks around other stars support the nebular hypothesis.

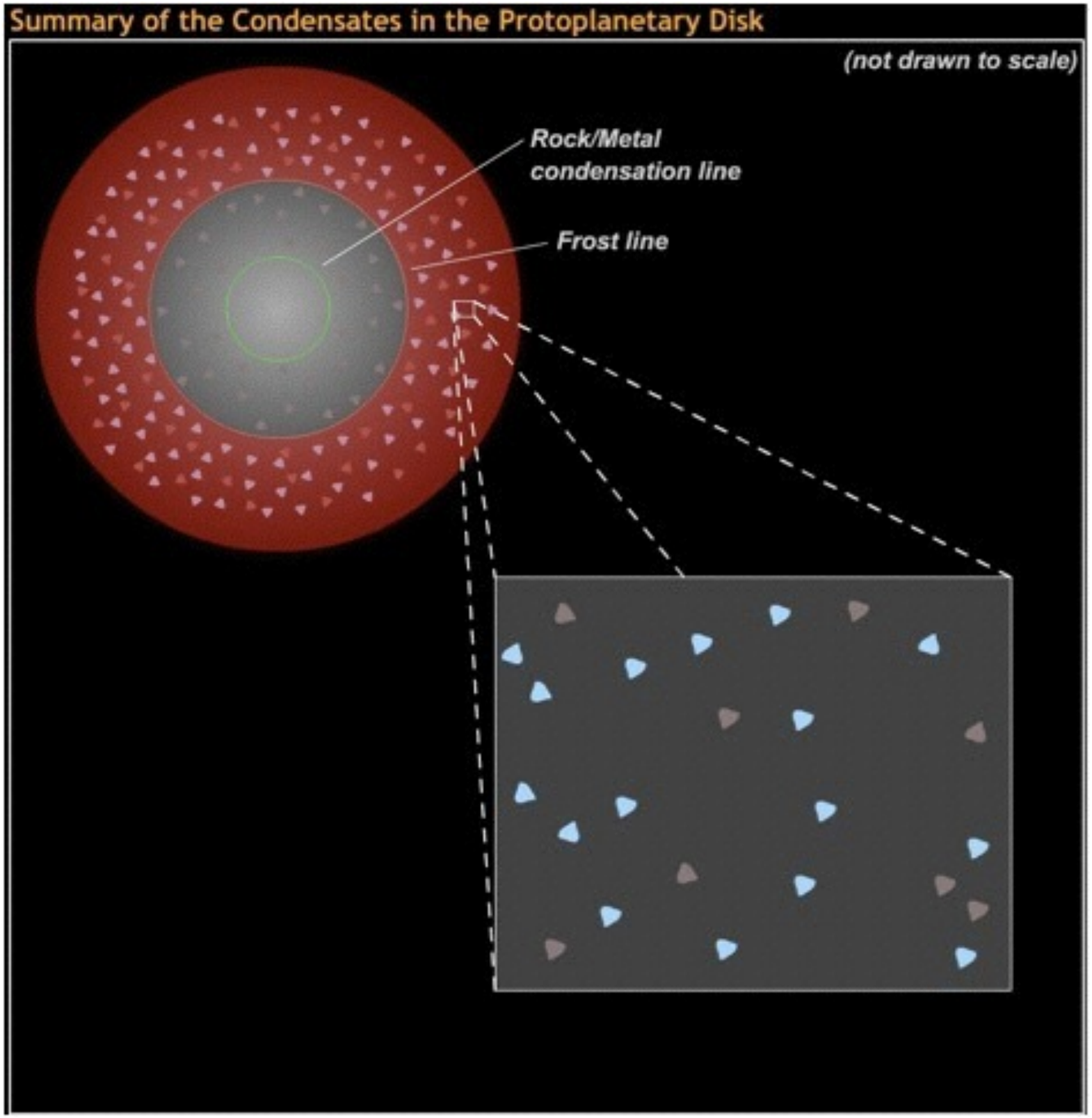
Formation of Solar System



Temperature Profile



How did the terrestrial planets form?

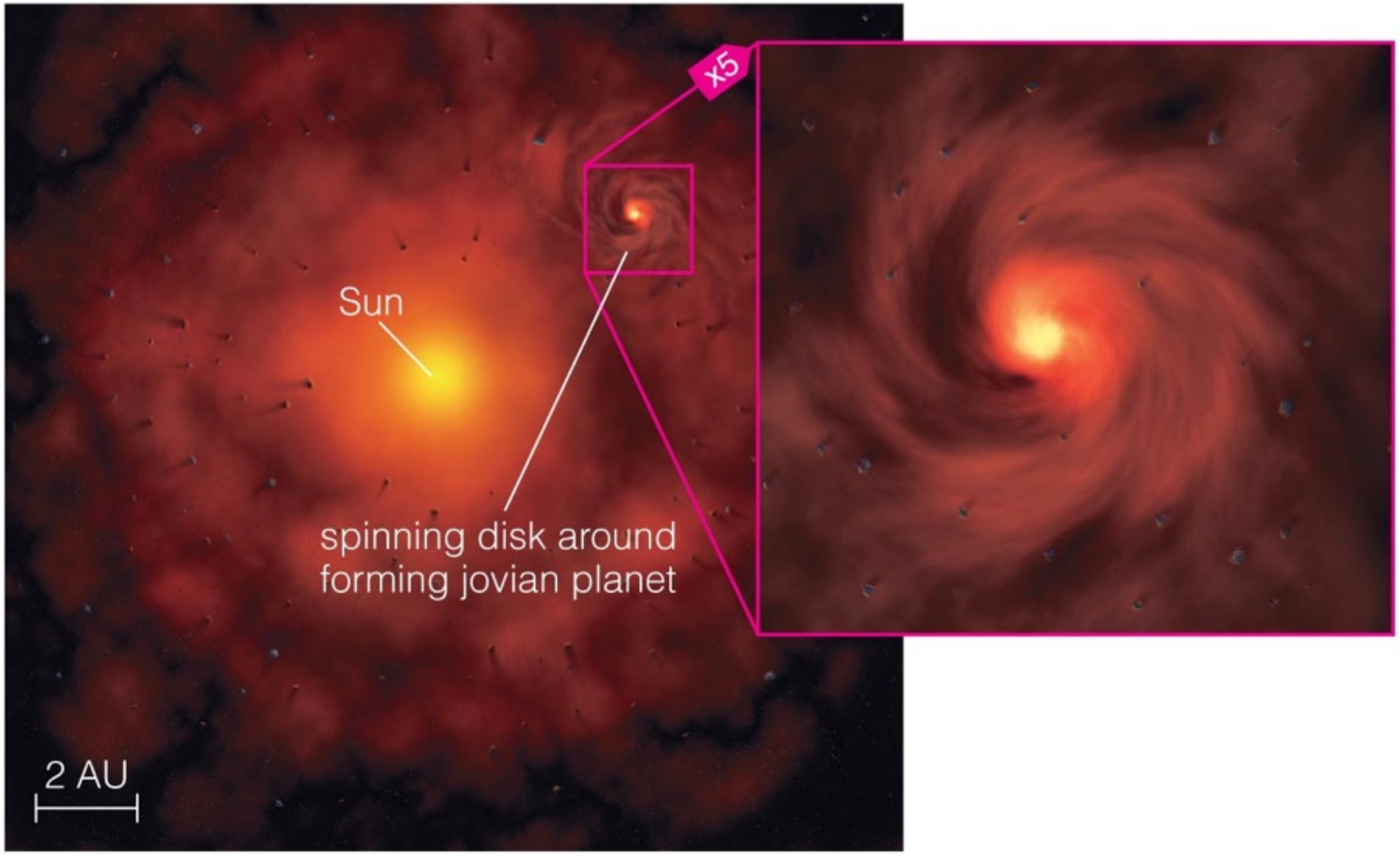


- Gravity draws ***planetesimals*** together to form planets.
- This process of assembly is called ***accretion.***

Formation of Solar System

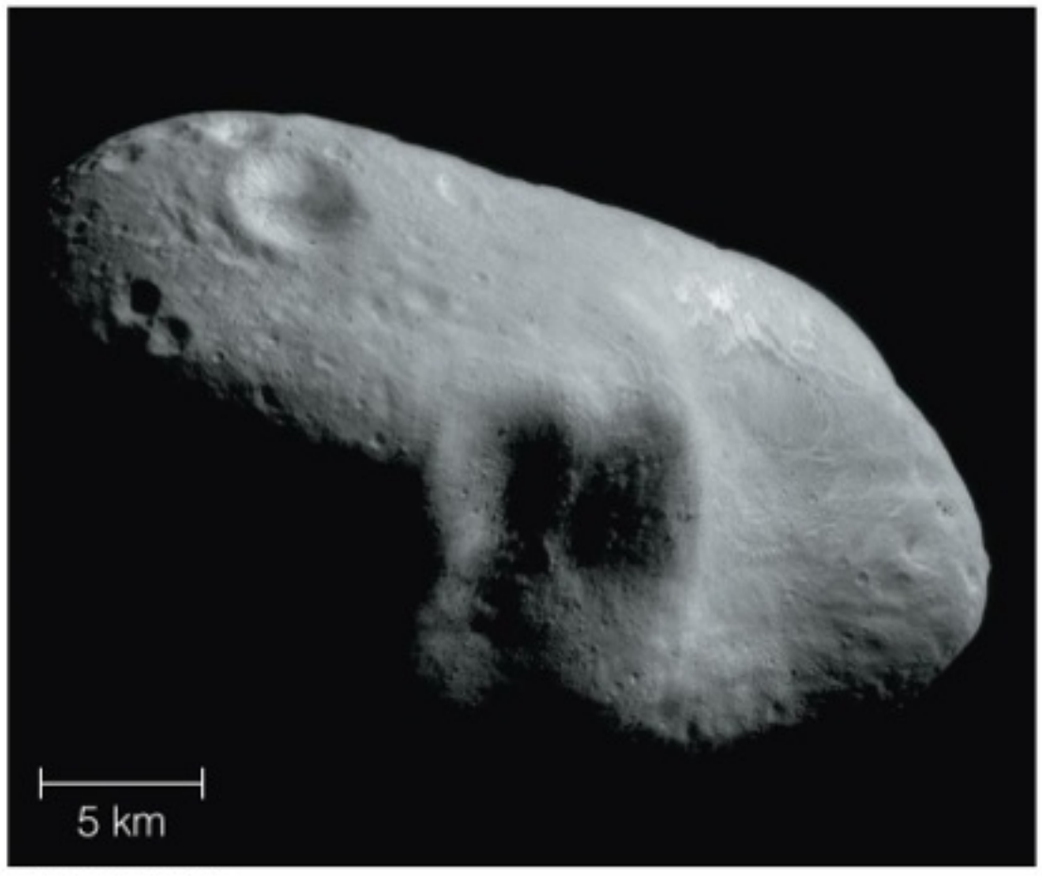
- How might the distance from the Sun affect the formation of planets?
  - Temperature
    - temperature drops off with distance from the Sun
    - temperature of a gas is a measure of its average random speed
      - H & He existed as gas throughout the solar nebula
      - close to Sun H & He moving too fast (too hot) to be captured by planets
      - further from Sun H & He are moving slow enough to be captured by planets
      - may be another reason why the outer planets are much more massive than the inner ones
      - also explains why Jovian planets are made mostly of H & He whereas the terrestrial planets have almost no H nor He

How did the jovian planets form?



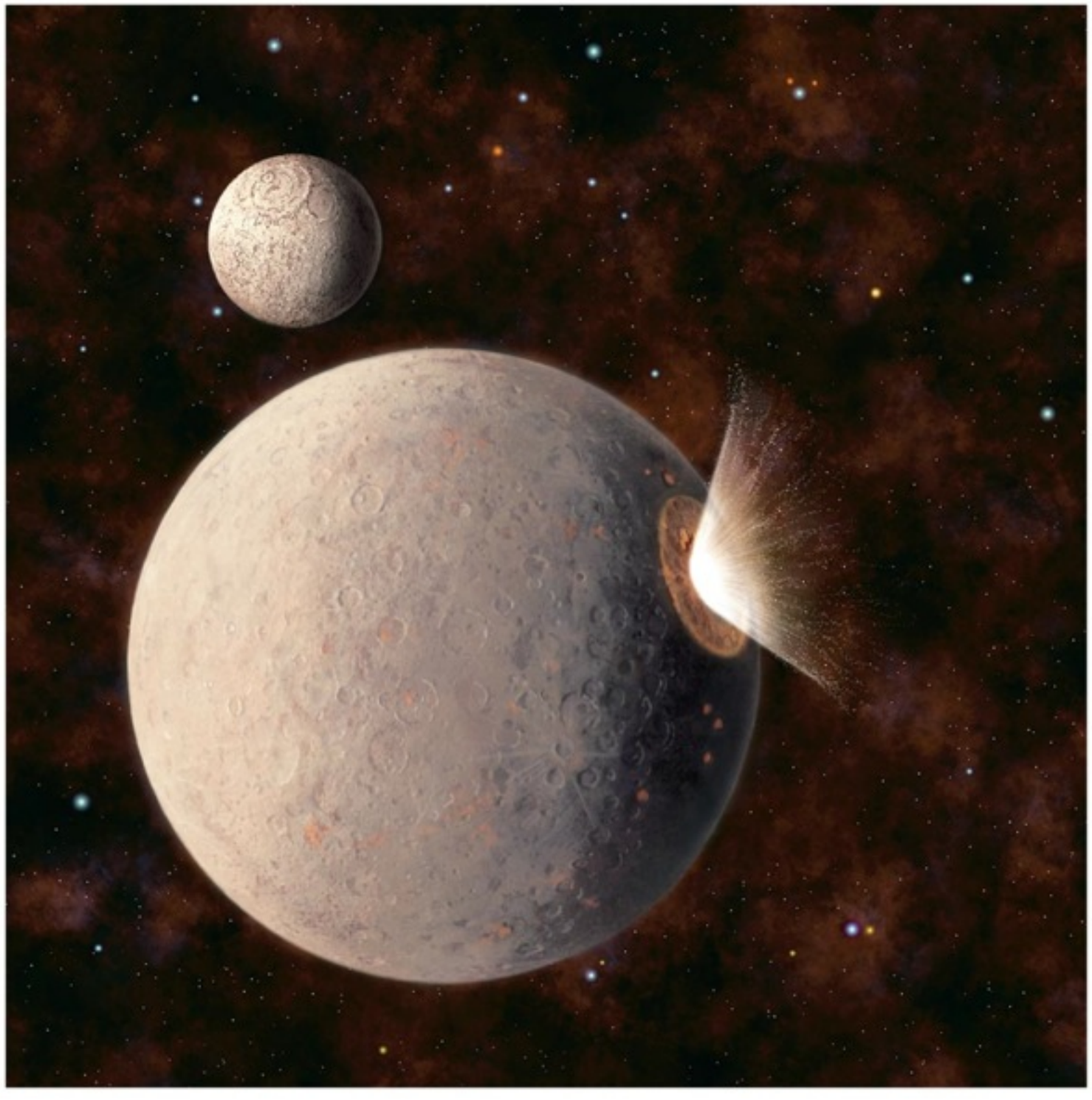
- Moons of jovian planets form in miniature disks.

Where did asteroids and comets come from?



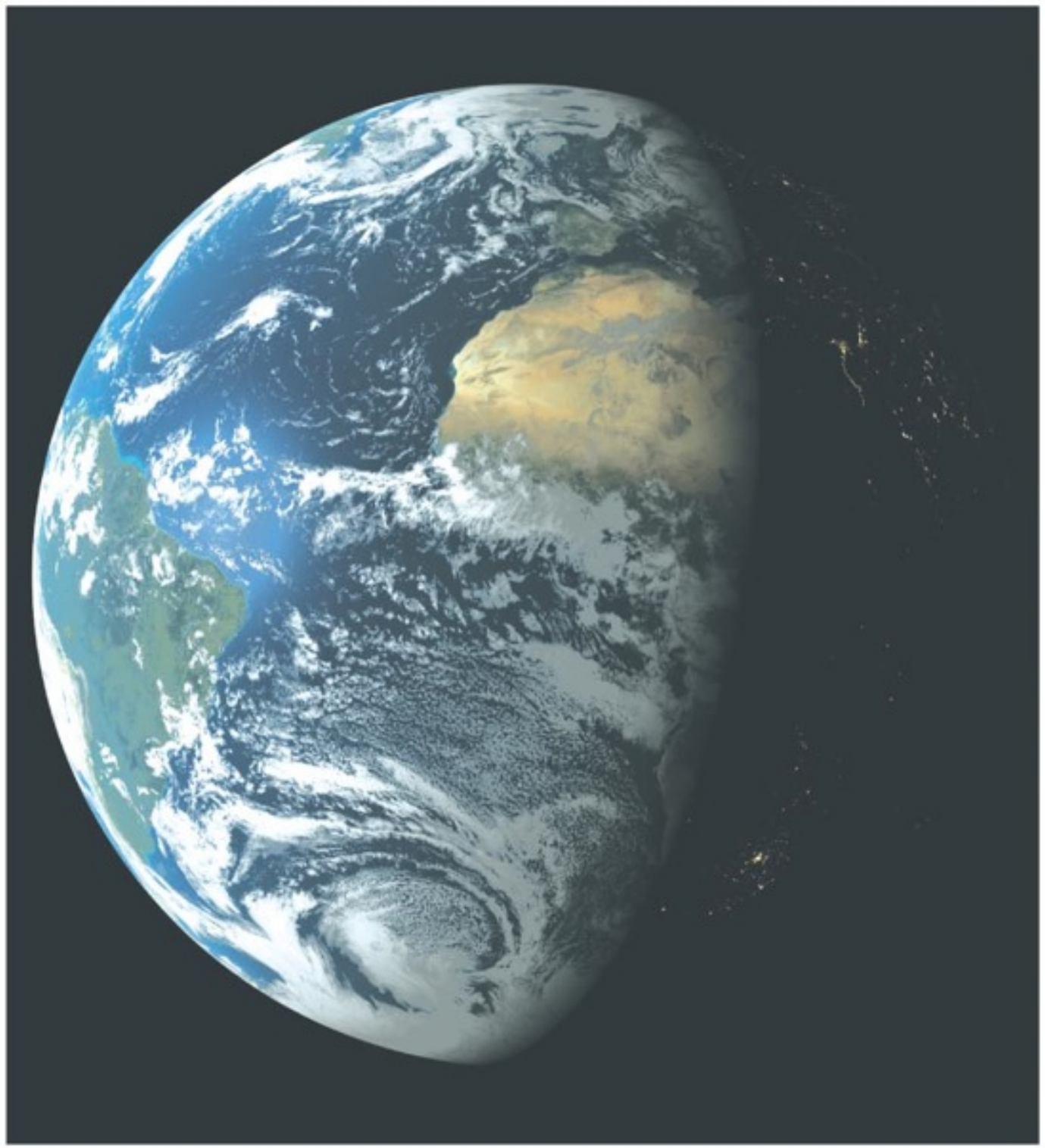
- Leftovers from the accretion process
- Rocky asteroids inside frost line
- Icy comets outside frost line

Heavy Bombardment



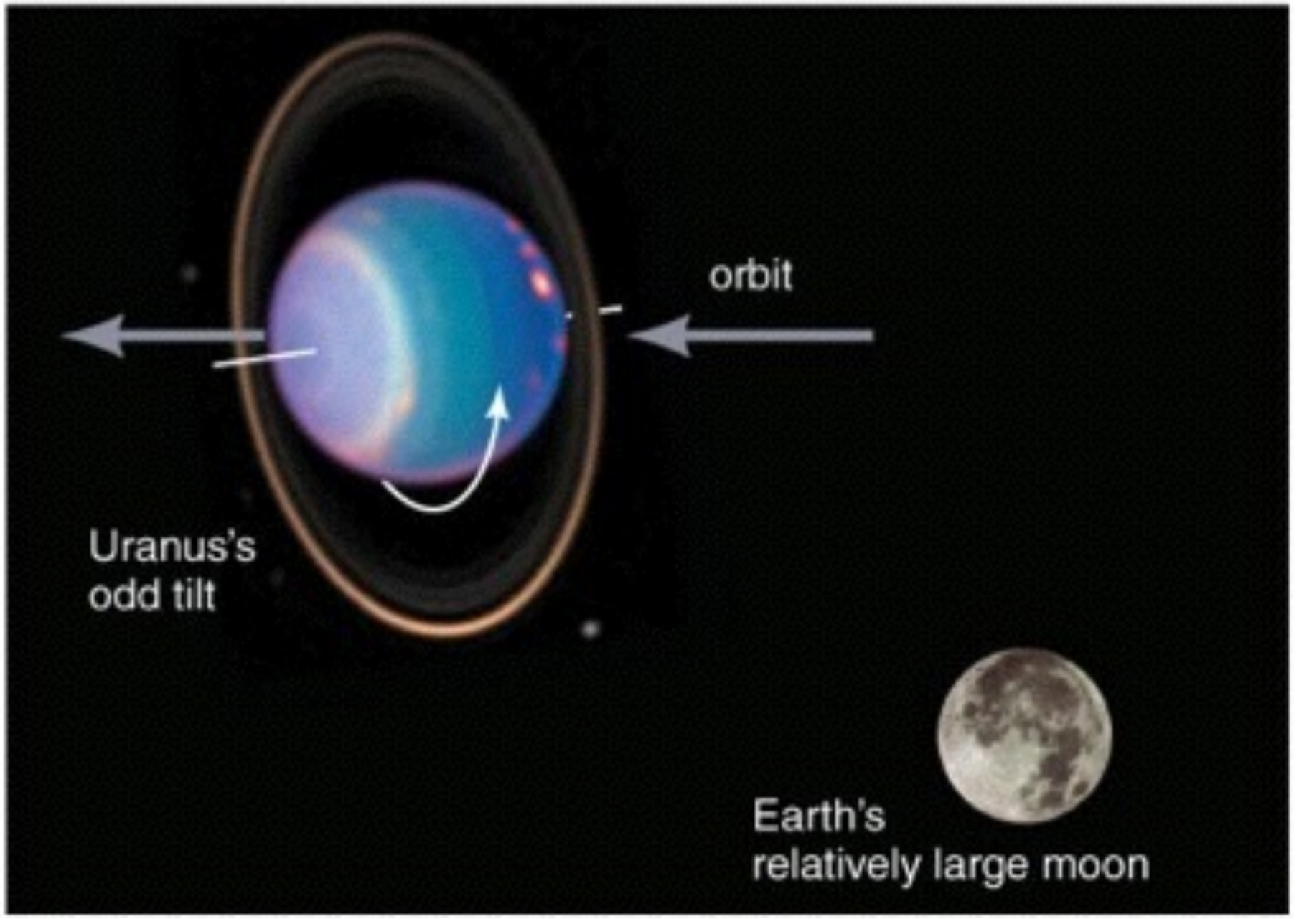
- Leftover planetesimals bombarded other objects in the late stages of solar system formation.

Origin of Earth's Water

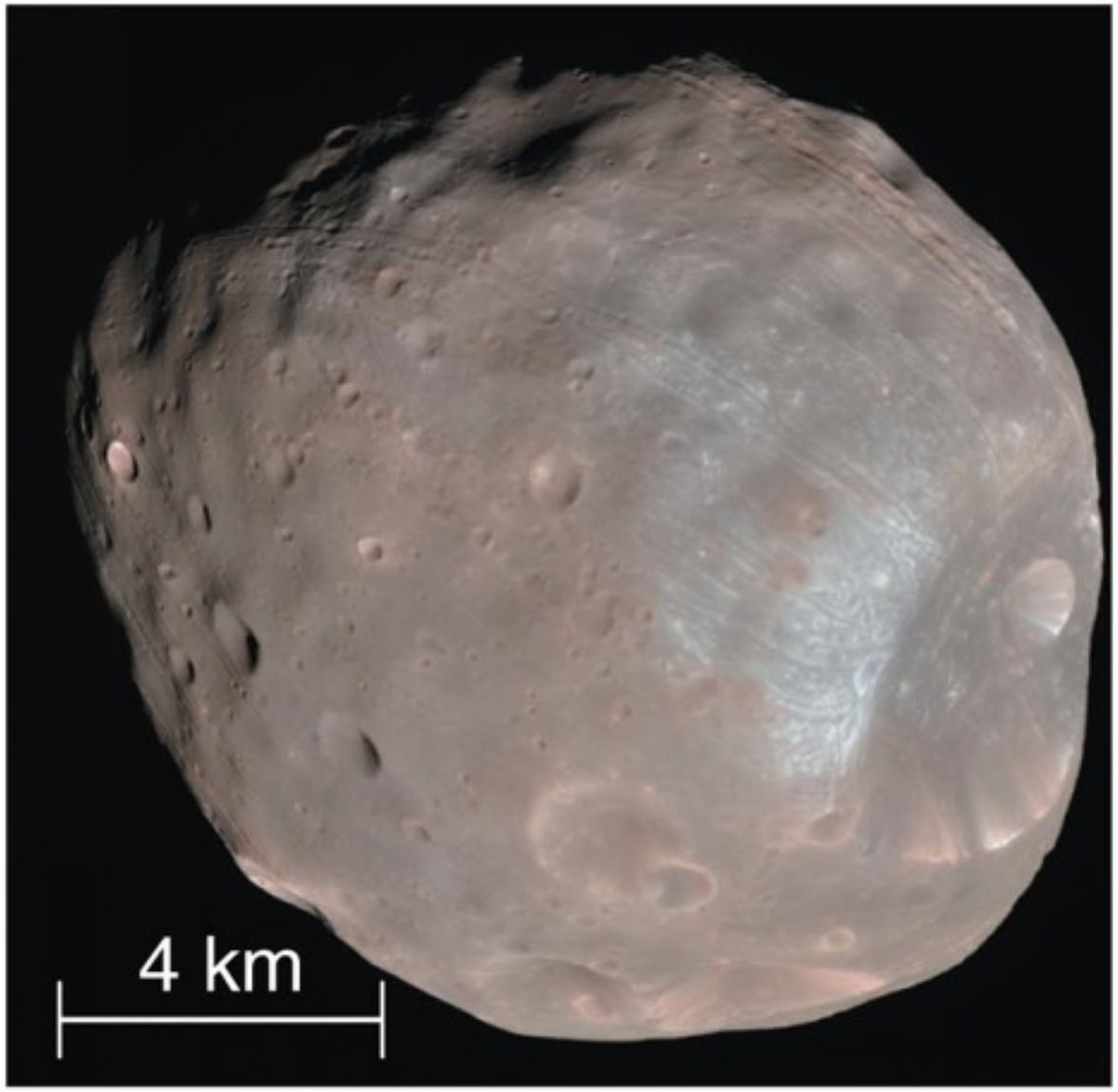


- Water may have come to Earth by way of icy planetesimals.

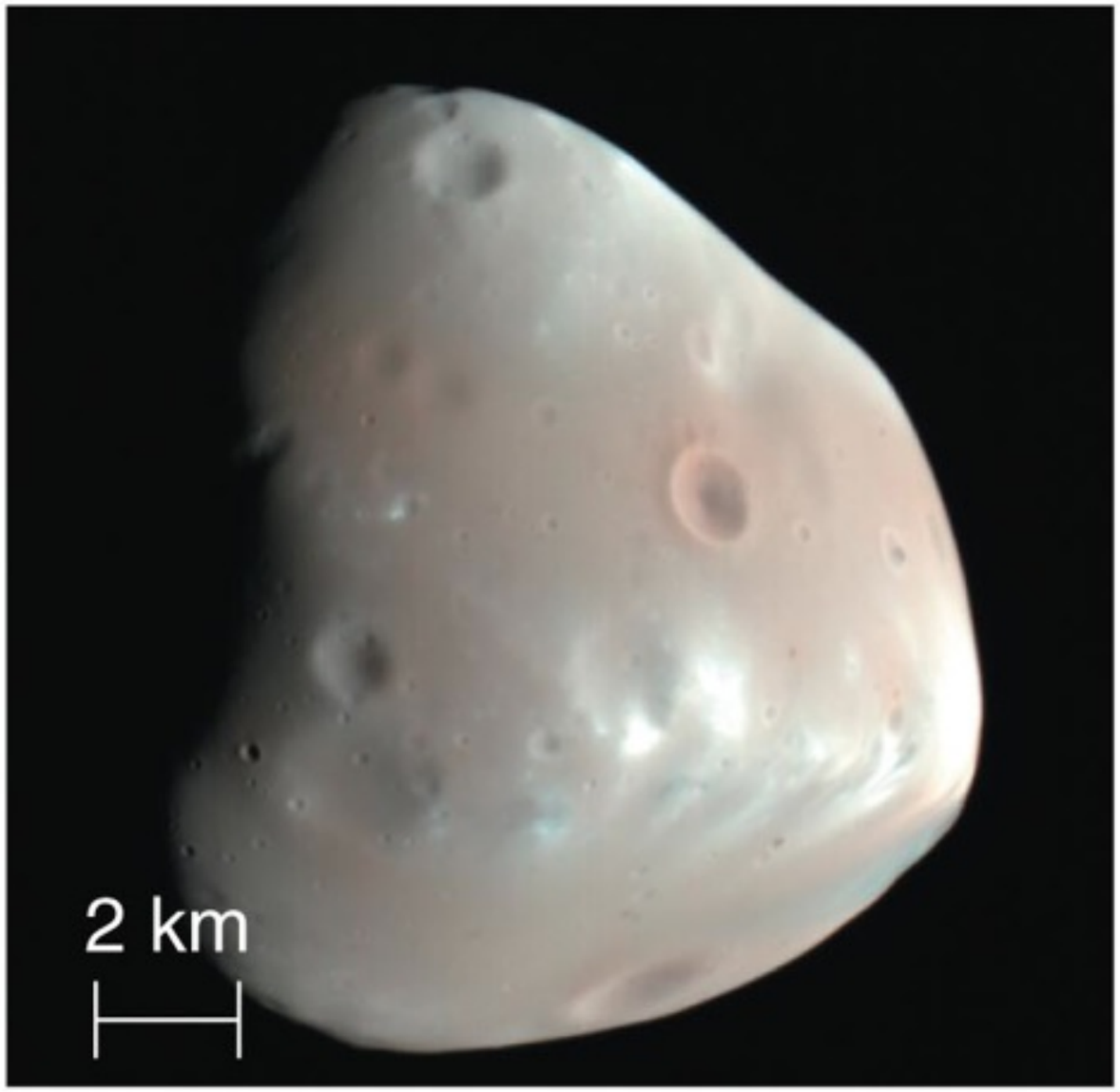
How do we explain "exceptions to the rules"?



Captured Moons



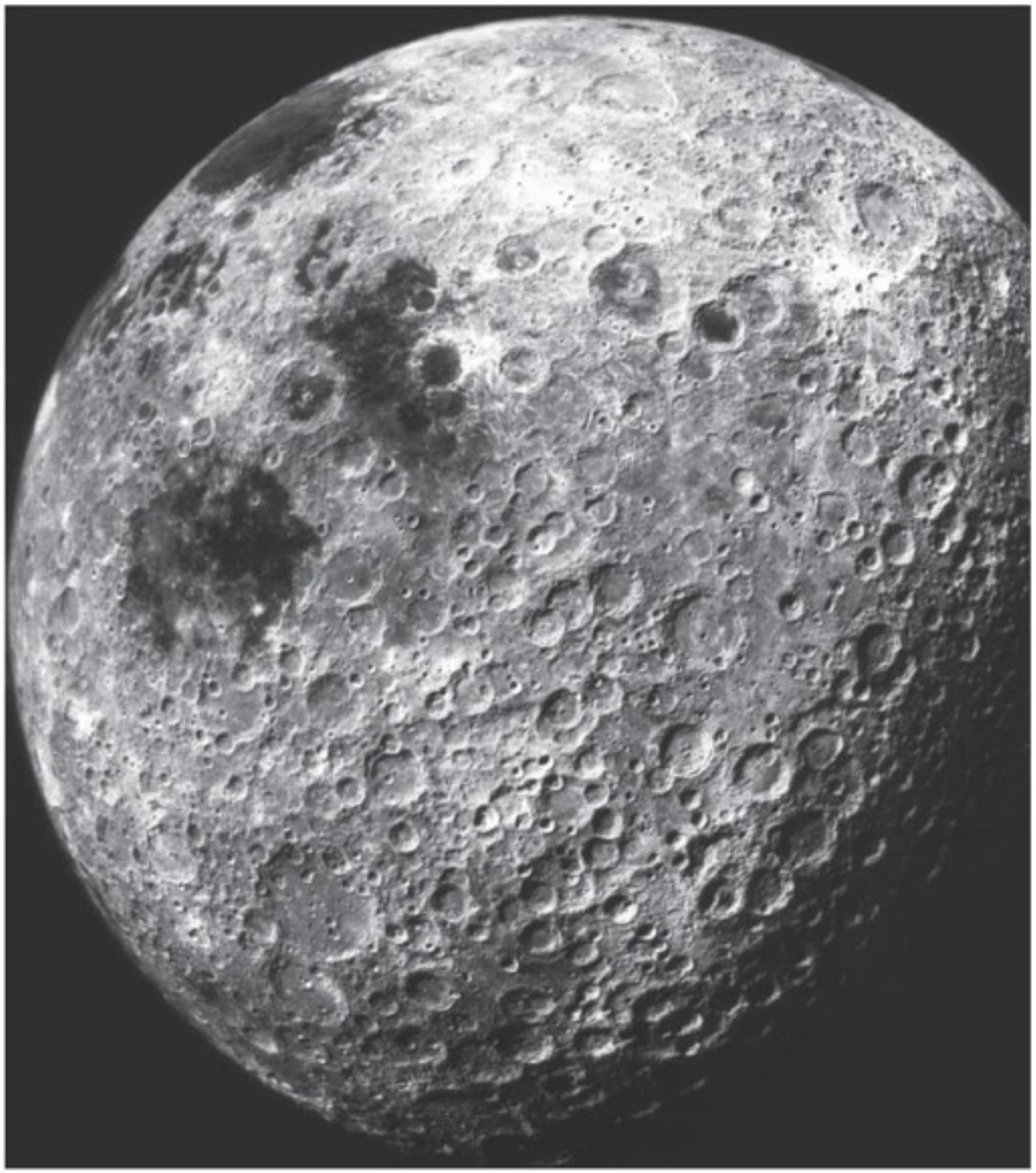
a Phobos



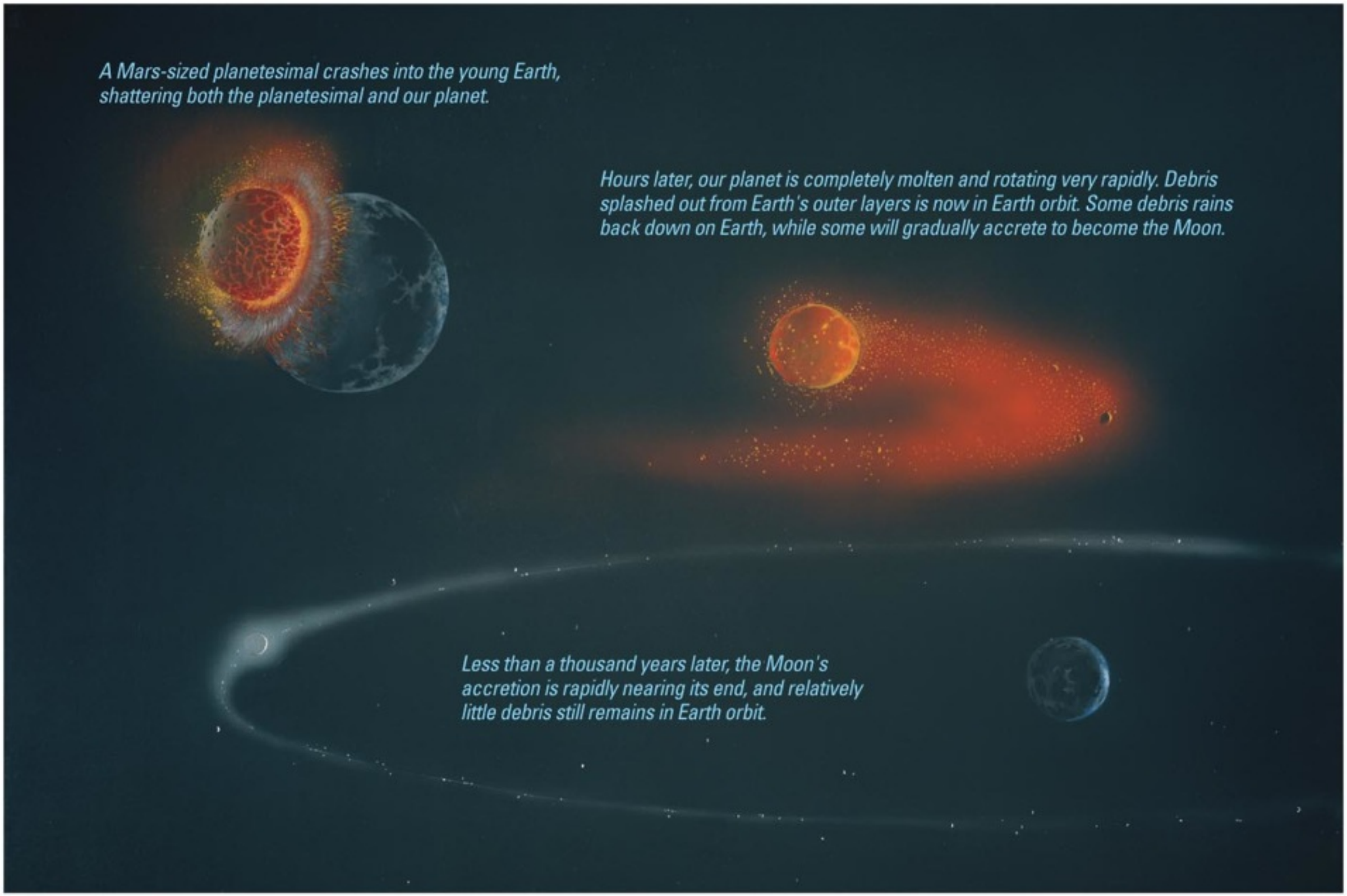
b Deimos

- Unusual moons of some planets may be captured planetesimals.

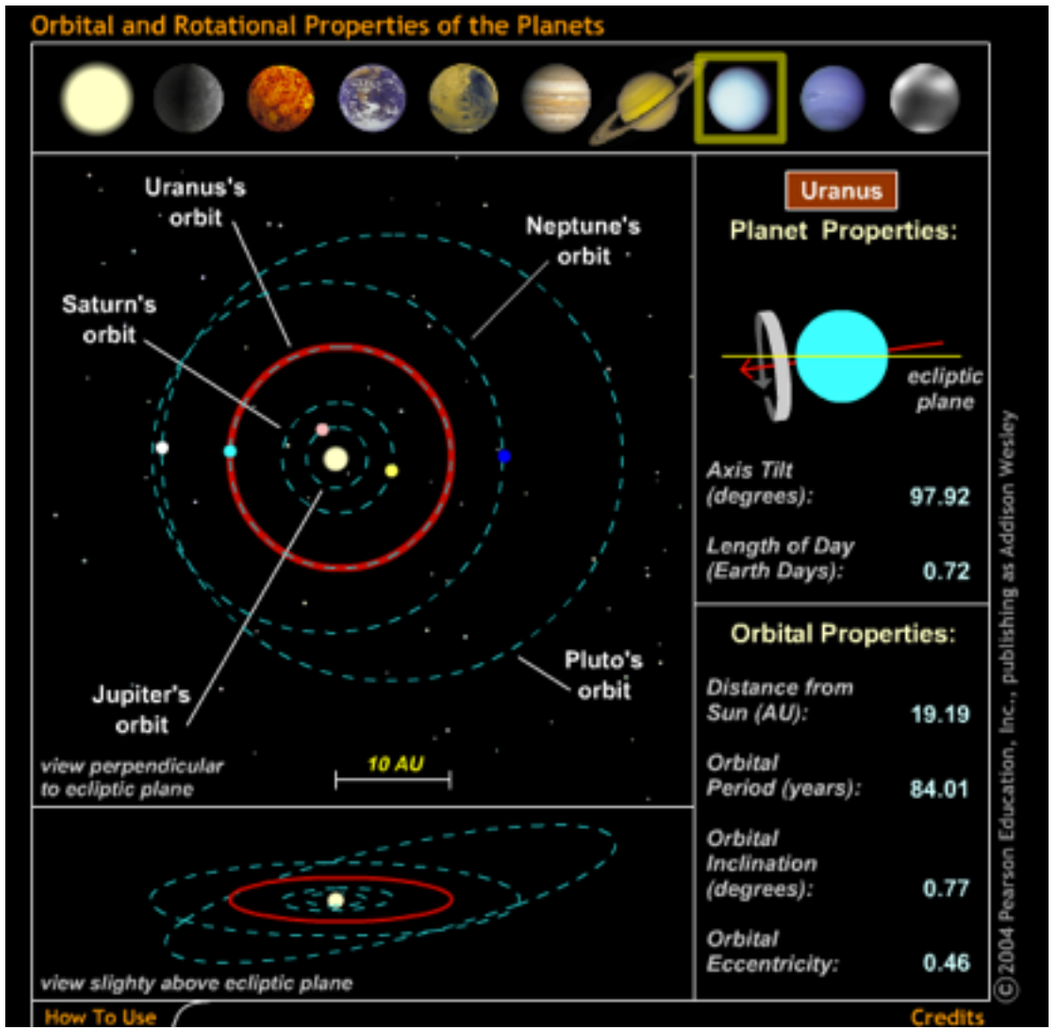
How do we explain the existence of our Moon?



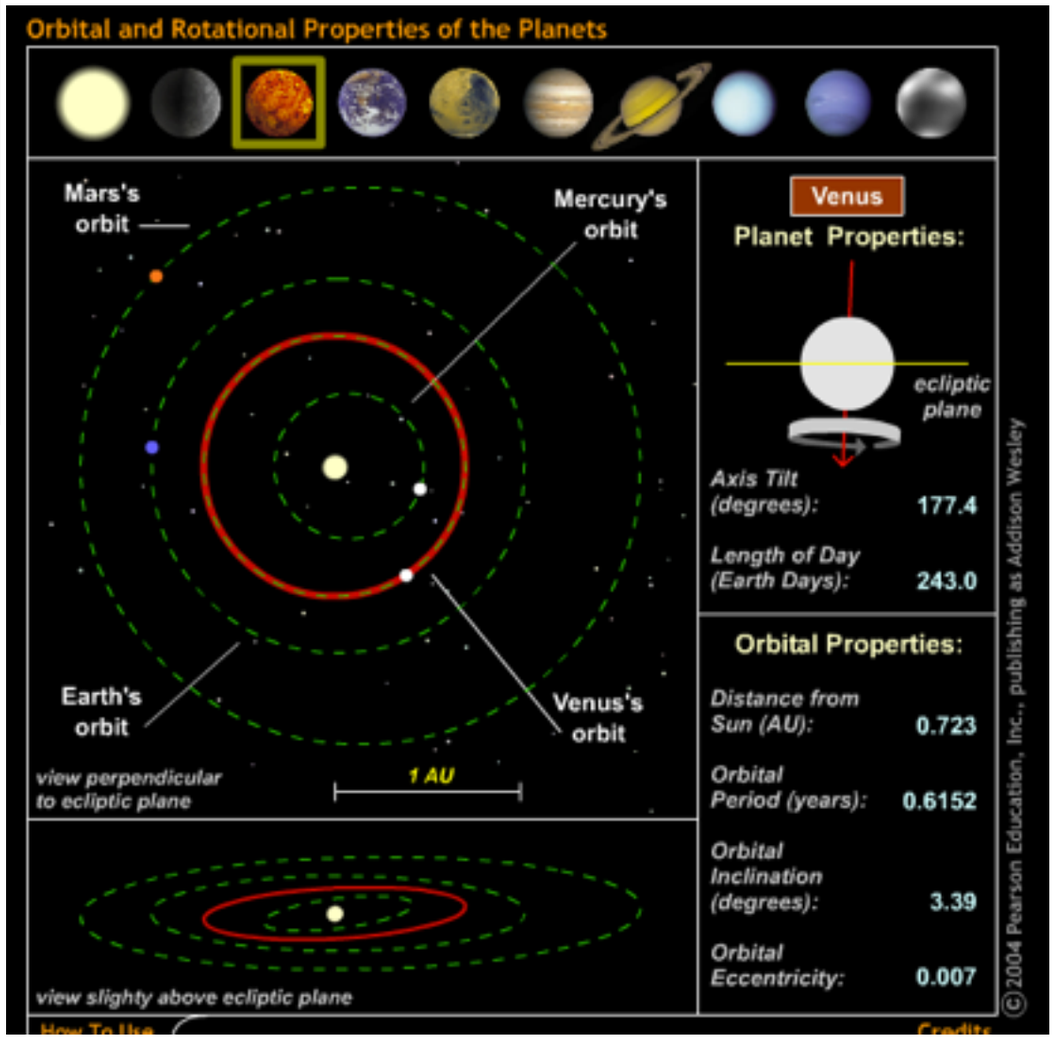
Giant Impact



Odd Rotation



- Giant impacts might also explain the different rotation axes of some planets.



Thought Question

How would the solar system be different if the solar nebula had cooled, with a temperature half its actual value?

a) Jovian planets would have formed closer to Sun.
b) There would be no asteroids.
c) There would be no comets.
d) Terrestrial planets would be larger.

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Thought Question

Which of these facts is NOT explained by the nebular theory?

a) There are two main types of planets: terrestrial and jovian.
b) Planets orbit in same direction and plane.
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d) Number of planets of each type (four terrestrial and four jovian).

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