Classifying Solar System Objects

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Classifying Solar System Objects

Big Ideas:

- Humans group objects to help them understand and describe the world around them.
- The way scientists categorize things may depend on the manner in which they are studying them.
- Objects in the Solar System can be grouped by physical and dynamical properties.

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Classifying Solar System Objects

Key Concept:

- Objects can be classified by their properties, but there may be more than one "correct" answer.

Essential Questions:

- How are planets, dwarf planets, asteroids, comets, moons/satellites classified?
- Do all objects in the same class have all of the same properties?
- Are there properties of objects that overlap classes?

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Classifying Objects

Humans put objects into groups because it helps them better understand and describe the world around them:

Shapes, plants, animals, cats, dogs

We have a picture in our mind!

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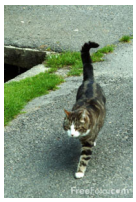
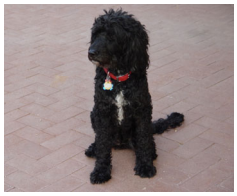
Classifying Objects

We have a picture in our mind!



Cat

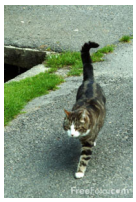


Dog

5

Classifying Objects

As our knowledge grows, our "image" may change.



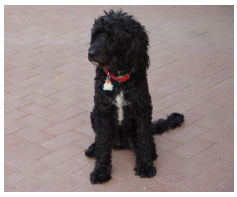
Cat

Bobcat

6

Classifying Objects

As our knowledge grows, our "image" may change.



Dog

Coyote

7

Classifying Objects

As our knowledge grows, our "image" may change.

Pig

Javelina/Collared Peccary

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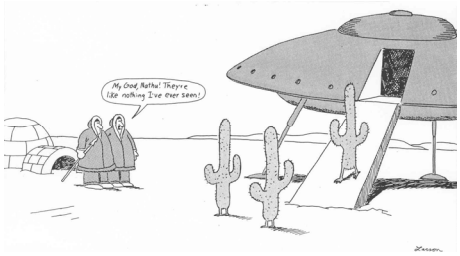
Classifying Objects

Sometimes what we see is unexpected or unknown.



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Classifying Objects

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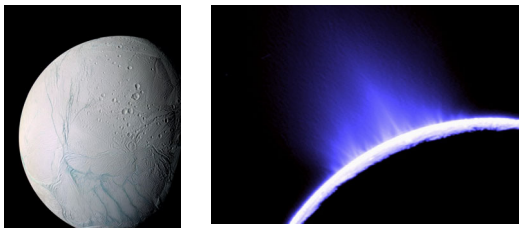

Ice geysers on Saturn's moon Enceladus.
Another possible subsurface ocean?

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Classifying Objects

As a small group, do the following:

I have given you 12 objects. Sort them by their properties, such as color (there may be more than one answer).

Discuss your answers with the whole group.

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Why We Classify Things

Our ability to compare (same and different), find patterns, and categorize are just some of the thinking processes that help us bring order to the Universe and enable us to apply our understanding more widely.

Bill Schmitt, science educator

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Why We Classify Things

- People/scientists have been classifying and categorizing the objects in the sky for thousands of years–planets (including the Sun and Moon), stars, meteors, and comets.
- But as our knowledge grew, so did the way that we classify these objects–planets (including the Earth), other moons (satellites), rings, asteroids, and meteoroids, for example.

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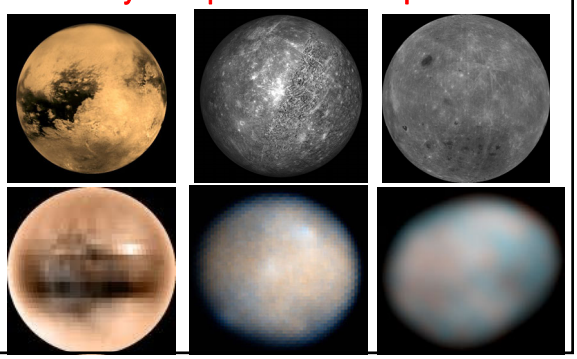
What is a Planet?

Context may be important. Pick the planet:



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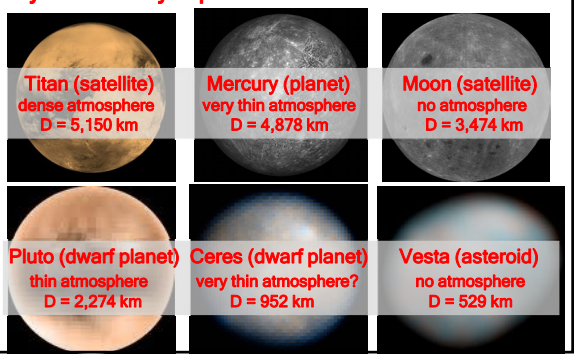
What is a Planet?

Why is Mercury a planet while Titan is not?



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Classifying Solar System Objects

In groups of 2 to 3, list 3 to 4 characteristics of these Solar System (and beyond) objects:

- Planets
- Dwarf planets
- Asteroids
- Comets
- Moons/satellites
- Extra-solar planets

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Classifying Solar System Objects

- What are the things we are considering?
- What are their characteristics?
- How are they similar or different?
- Are there obvious or logical groupings?
- Not all objects will have all of the characteristics.

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Early Earth-Moon Comparative Planetology

- "Suppose that the moon, like the island of Crete, is composed of a white soil (as Lucian said that the moon is a cheese-like land). We shall have to admit that the soil shines by sunlight more vividly than the seas....however little they may be tinges with black.
- "My book, consequently, does not prevent me from agreeing with [your]...brilliant and irrefutable logic. Certainly the bright areas are broken up by many cavities; the bright areas are bounded by an irregular line; the bright areas contain great peaks, on account of which they light up sooner than the neighboring region. Where they face the sun, they are bright; where they face away from the sun, they are dark. All these characteristics suit a dry, solid, and high material, but not a fluid. On the other hand, the dark spots, known since antiquity, are flat. The dark spots light up later–a fact which proves their low elevation....when the surrounding peaks are already aglow far and wide....The boundary of the illumination in the dark area is a straight line at half-moon. These characteristics, in turn, belong to a liquid, which seeks the lowest levels....
- "By these arguments, I say, you have proved your point completely. I admit that the spots are seas, I admit that the bright areas are land."

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Classifying Solar System Objects

- Do you know of any examples of objects that have been reclassified or that took on new characteristics as we learned more about them?
  - Sun: planet ⟶ star
  - Earth: center of Universe ⟶ planet
  - Moon: planet ⟶ moon/satellite
  - Galilean satellites: planets ⟶ moons
  - Ceres, etc.: planets ⟶ asteroids
  - Ceres: asteroid ⟶ dwarf planet
  - Pluto: planet ⟶ dwarf planet
- We will now take a tour of the Solar System and look at how astronomers have classified objects in the Solar System.

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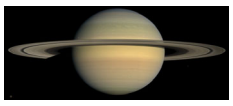
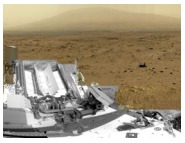
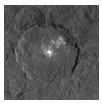
Planets (8) and Dwarf Planets (5) as Seen Close Up



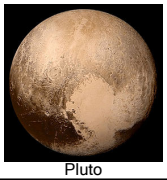
Saturn



Mars



Ceres



Pluto

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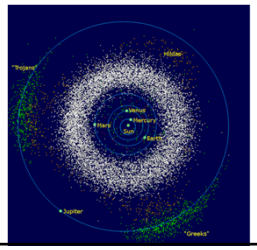
Asteroids

Asteroids (minor planets; nearly 790,000)

- Orbit the Sun
- Not big enough for gravity to make them round
- Larger than a meter



Two Ongoing Sample Return Missions

162173 Ryugu, Japan
equitorial diameter =
1000 meters

101955 Bennu, US
equitorial diameter =
550 meters

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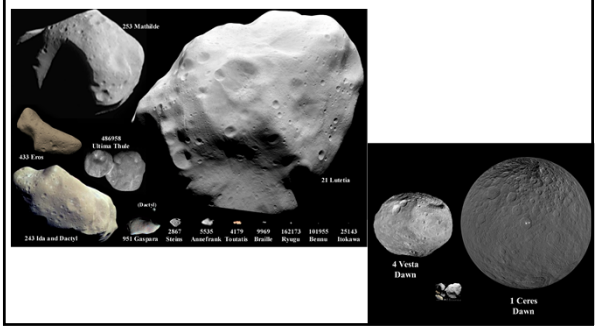
Asteroids

Asteroids imaged by spacecraft



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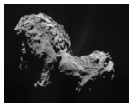
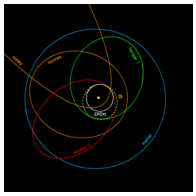
Comets

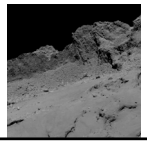
Comets (4,065)

- Orbit the Sun
- Not big enough for gravity to make them round
- Will have a coma when close to the Sun
- Icy



67P/Churyumov-Gerasimenko





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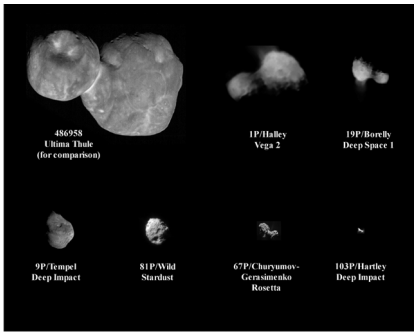
Comets

Comets imaged by spacecraft



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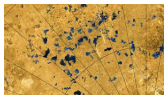
Moons/Satellites

Moons/Satellites (194 including dwarf planets)

- Orbit a planet or asteroid (no official minimum size; asteroid satellites)
  - 19 round enough to be planet/dwarf planet if orbited Sun
  - Volcanoes, atmospheres, lakes, and subsurface oceans
- About 361 orbit 348 asteroids!
- Ring systems: 4 planets, 2 asteroids



Earth's Moon, Mars' Phobos, and Saturn's Titan

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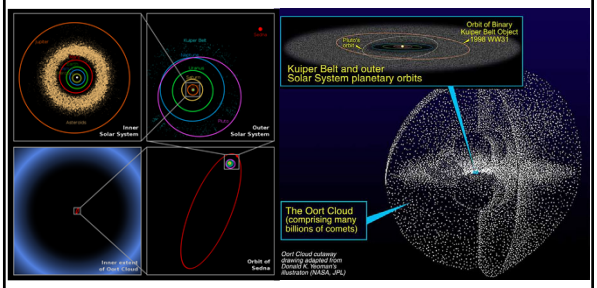
Edge of the Solar System



Trans-Neptunian Objects (3,629)
Kuiper Belt–Observed; Oort Cloud–Inferred from Comets

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Extrasolar Planets

- Over 4,050 confirmed (3,026 stars)
  - 1610: Galileo saw "planets" orbiting Jupiter (moons); Moon a place
  - Copernican system had our Sun orbited by planets, Earth no longer center of Universe!
  - If other stars are "suns," would they, too, have planets? Could they have life?

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