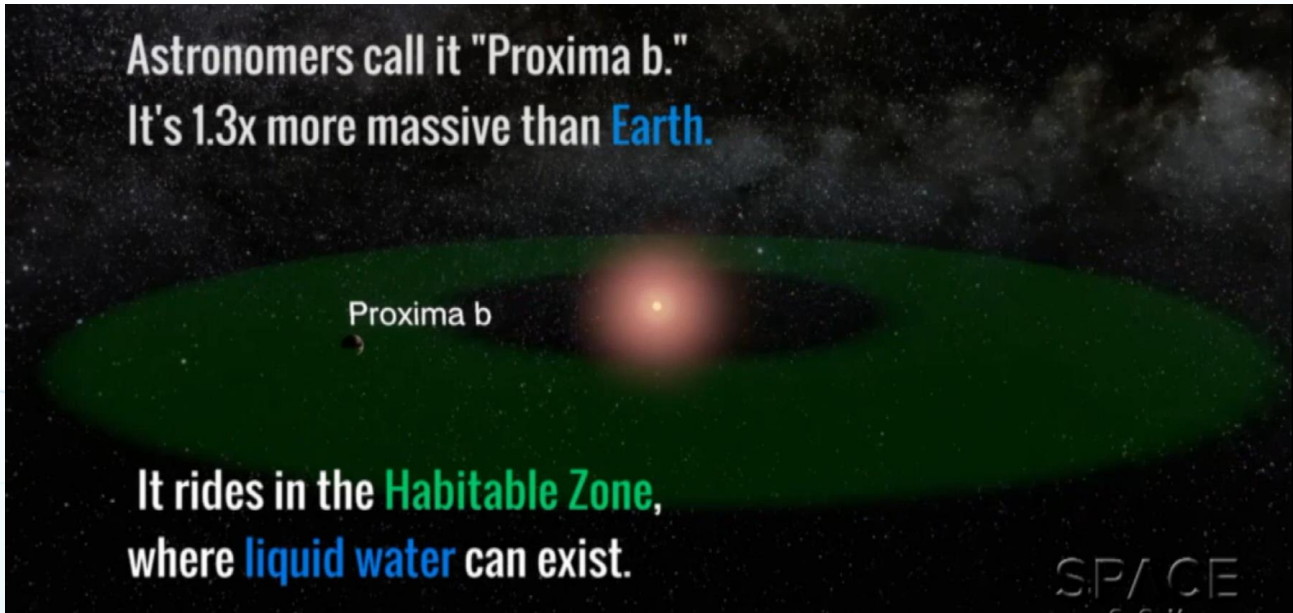
Our Neighbor….

TH: The closest star to the Sun also has an Earth-like planet orbiting around it. True or false?

Astronomers have discovered a roughly Earth-size alien world around **Proxima Centauri**, which lies just **4.2 light-years** from our own solar system. What's even more exciting is that the planet, known as **Proxima b**, circles in the star's "habitable zone" — the range of distances at which liquid water could be stable on a world's surface.



For more info (link on SUCourse):

Space.com > Search for Life

Found! Potentially Earth-Like Planet at Proxima Centauri Is Closest Ever

By Mike Wall, Space.com Senior Writer | August 24, 2016 01:01pm ET

56 4 MORE

https://www.space.com/33834-discovery-of-planet-proxima-b.html#ooid=tlcWZpNTE6ZWYMbu4dSz-HgURsvvYI25

UNV Week 1: What is life? Where do we come from? Our planet and the solar system

This Week's Learning Objectives:

By the end of this week, you should be able to:

Recognize Earth as a biosphere, and describe its position and motion in a larger structure such as the Solar system, an environment that hosts a habitable planet

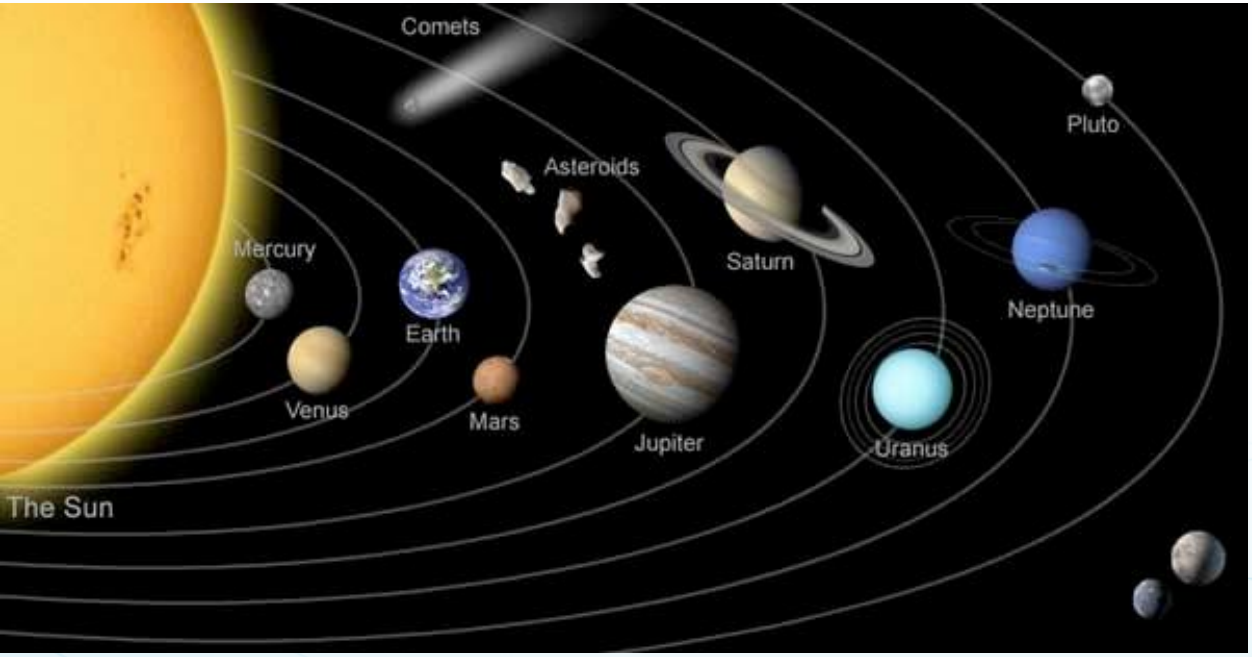
1. Distinguish **"living"** from "non-living" by evaluating their essential characteristics
2. Identify and differentiate the constituents of our **solar system**, and describe our position (uniqueness) in the universe
3. Explain the difference between **vector** and **scalar** quantities by giving examples
4. Analyze a simple motion of an object by correctly calculating the **position**, **velocity** and **acceleration** values/functions at given instances, given any one of the functions
5. Given the **graph** of any one of position, velocity or acceleration as a function of time, sketch the graph of other parameters as a function of time

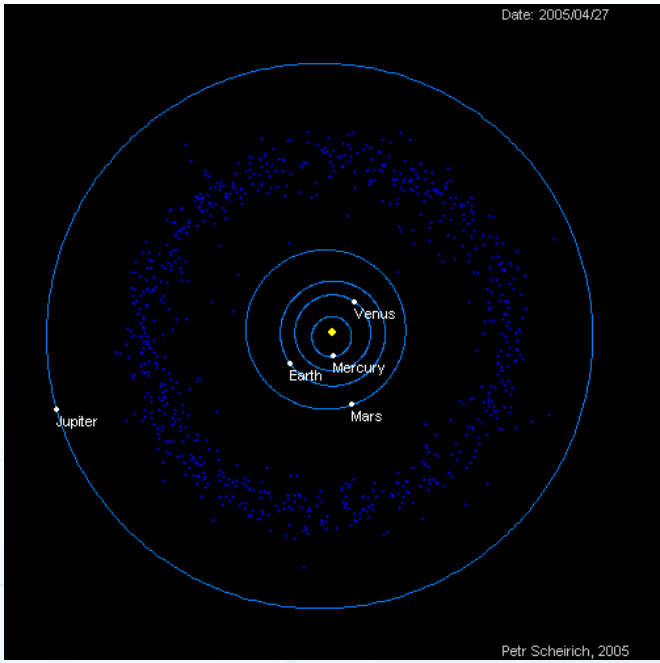
NS 101 – Are we alone in the Universe?

Where do we come from?

Life, the Earth and the Solar system

Describing motion





OUR Criteria of Life

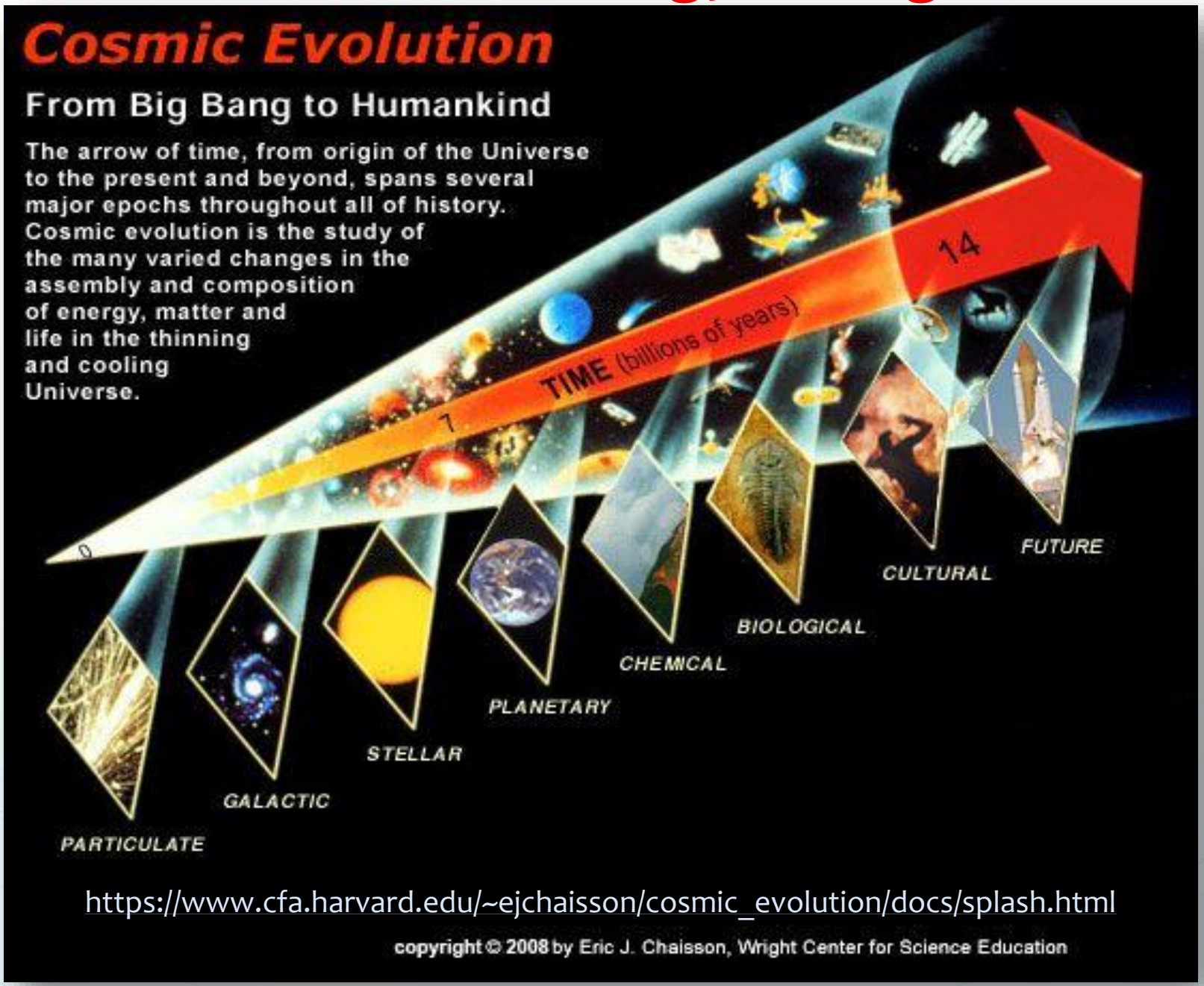
Living organisms have all of the following traits:

1. **Organization:** Exhibit complex but ordered organization (cells → tissues → organs) see figure
2. **Regulation:** Regulate their internal environment to maintain the conditions needed for cell function (e.g., body temperature)
3. **Response to environment:** Change properties reacting to environment / stimulus (mimosa plant)

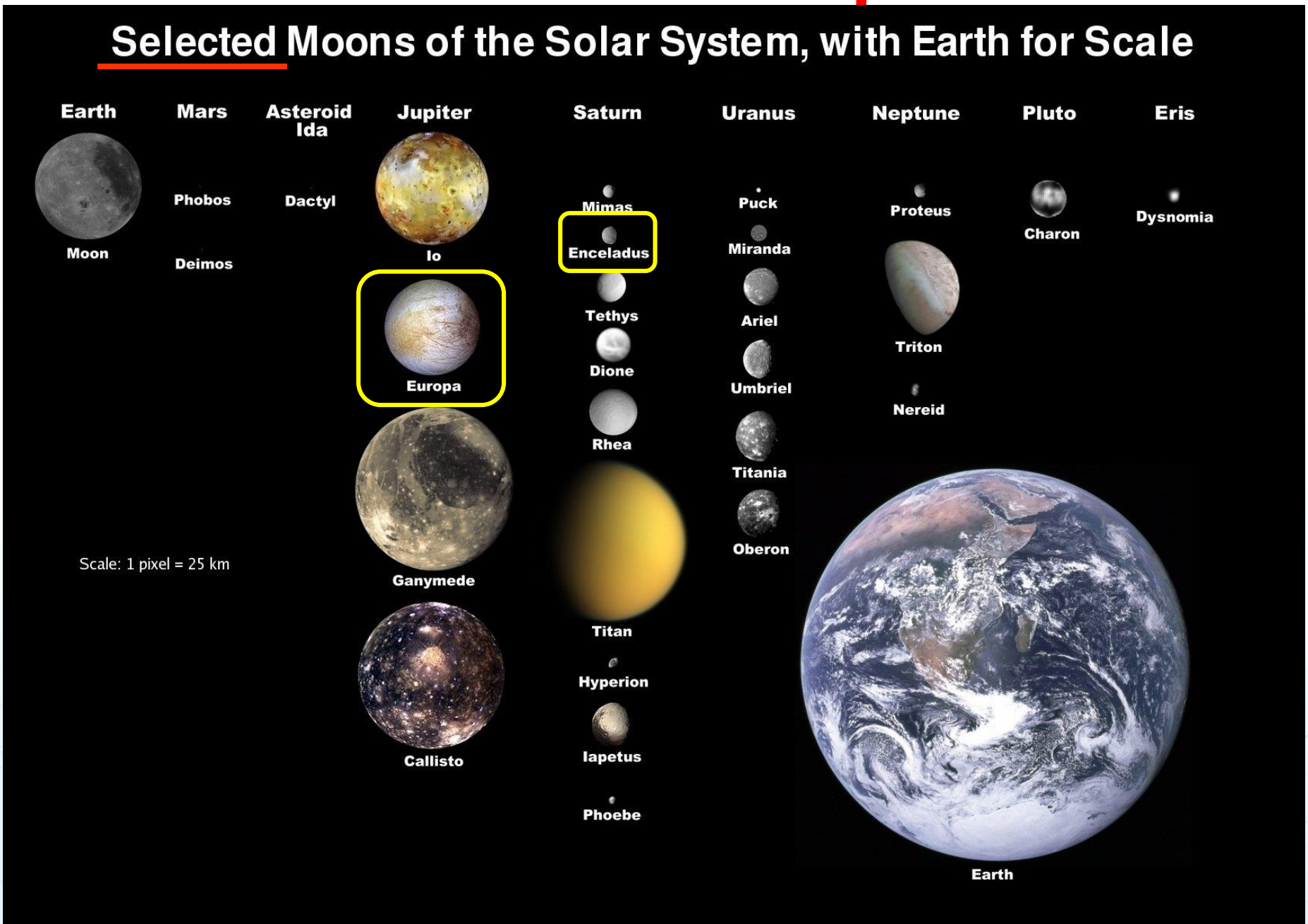
4. **Growth and Development:** Information carried by genes controls the pattern of growth and development
5. **Energy utilization:** Use energy to function (chemical reactions = "metabolism")
6. **Reproduction:** Reproduce to carry on their own kind
7. **Evolution:** Capacity of populations to change (evolve) over time for the survival of the species

Note: *More details of all criteria of life at the cellular level in ABR module*

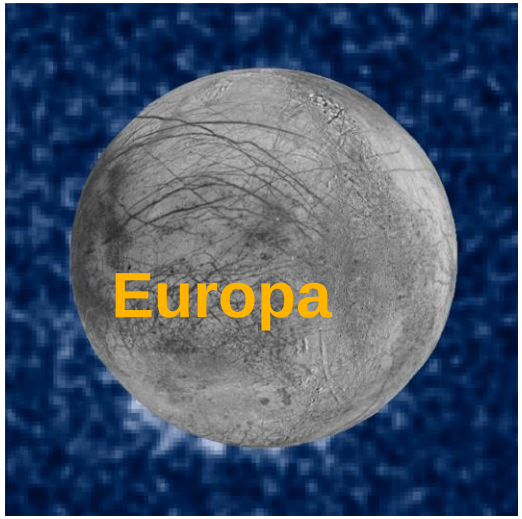
How did life and technology emerged on Earth?

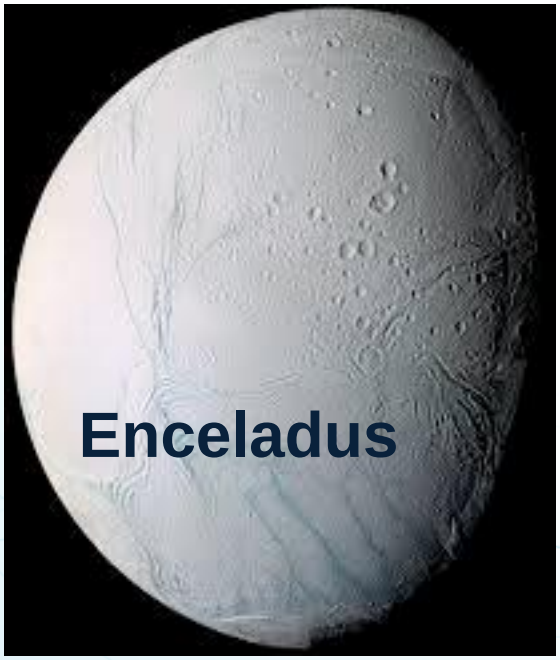


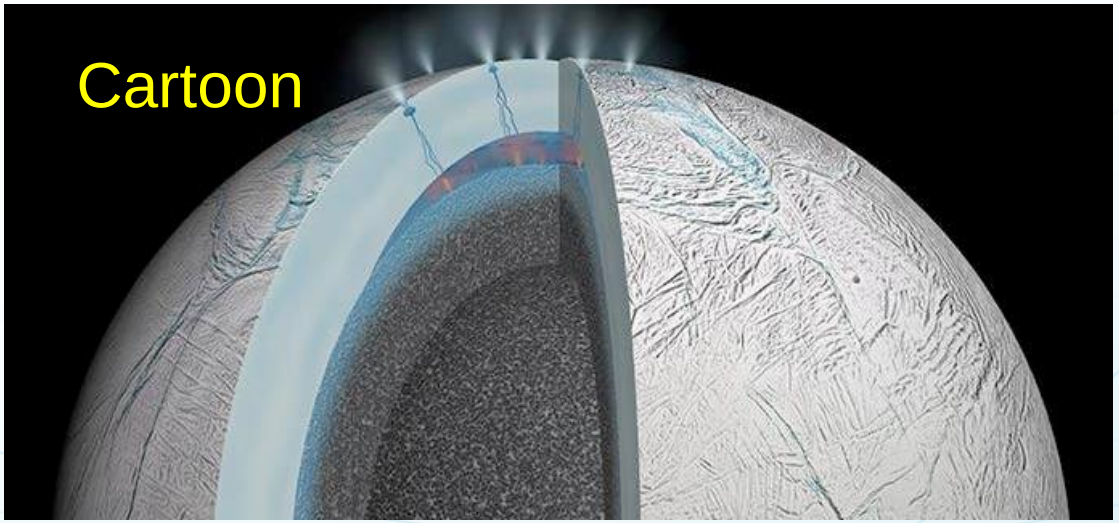
Life on satellites of planets?



Recent discoveries of water on moons!







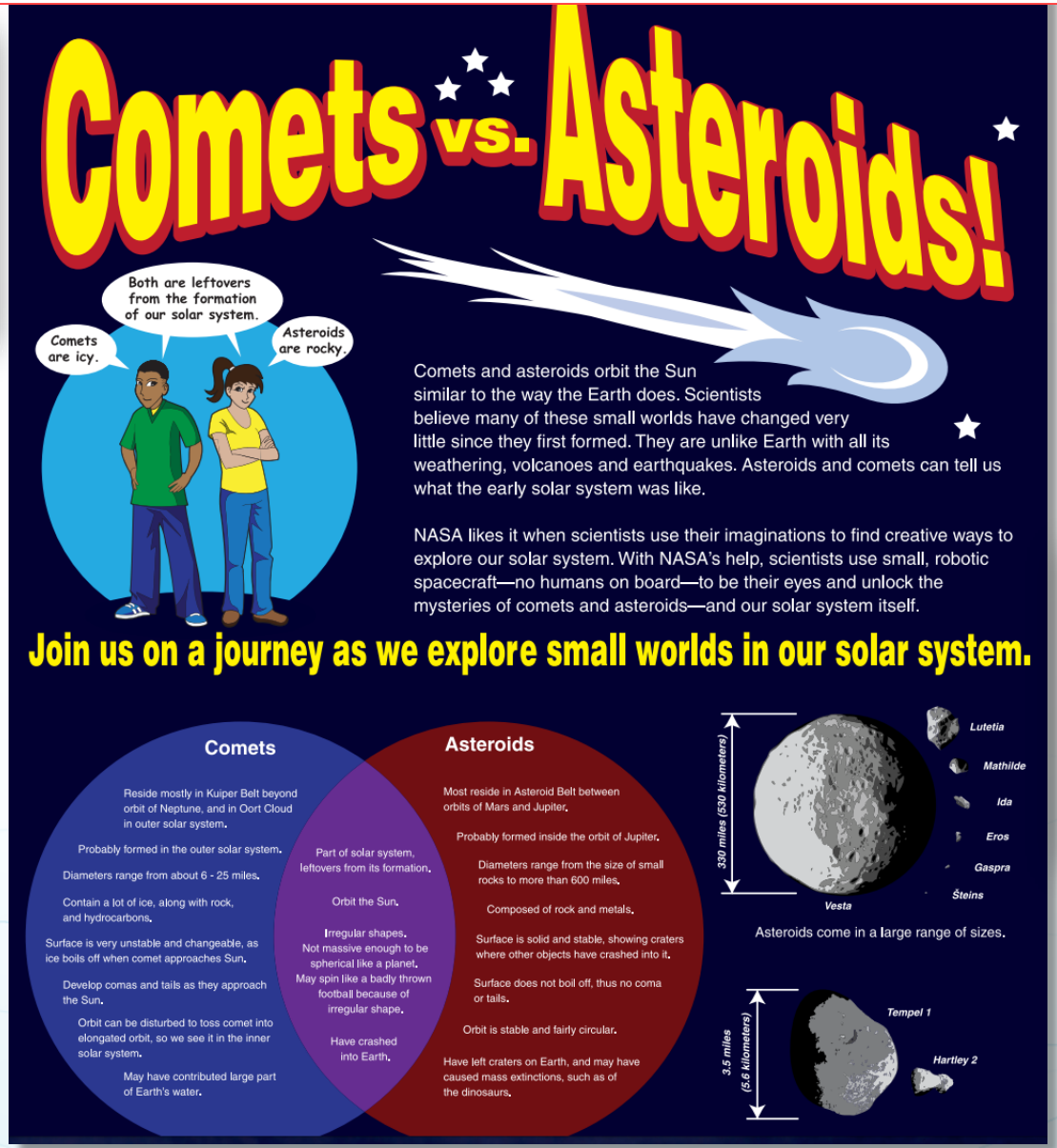
https://www.nasa.gov/press/2015/march/spacecraft-data-suggest-saturn-moons-ocean-may-harbor-hydrothermal-activity
http://www.nasa.gov/content/goddard/hubble-europa-water-vapor

From this week's VL…

https://solarsystem.nasa.gov/docs/Comet_factsheet_4-25-12_b.pdf

See also: http://solarsystem.nasa.gov/planets/meteors

Icy, "dirty snowball"

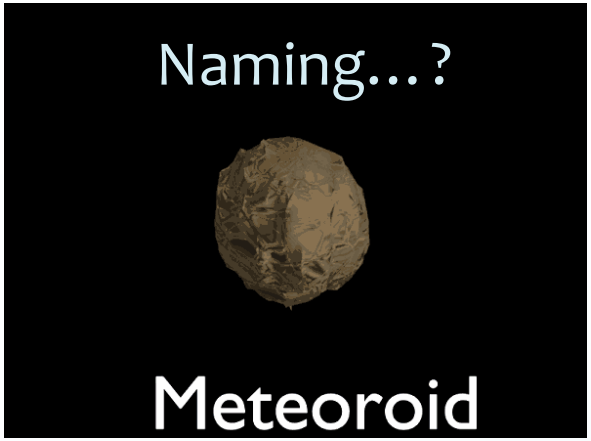


rocks+metals "space potato"

Meteors, asteroids can hit the Earth!

Most **meteors** burn out completely as they hit the atmosphere, but some reaches the ground. Some of these **meteorites** carry valuable materials (metals and maybe evidence of life???).

More discussions later…



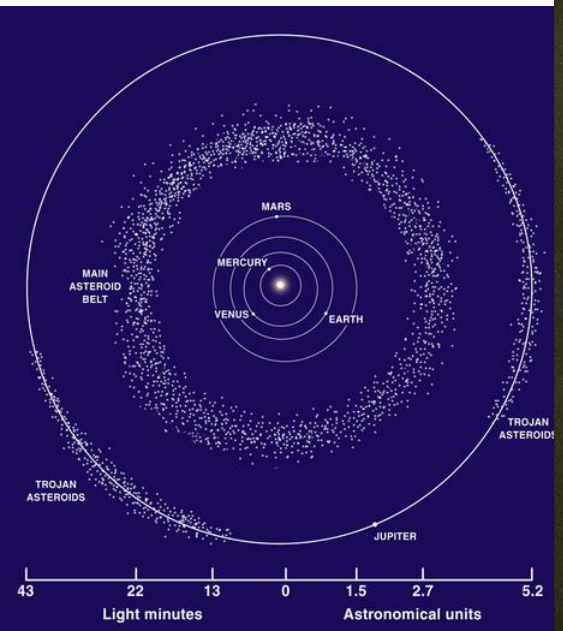
Meteor hitting Russia (Feb, 2013)

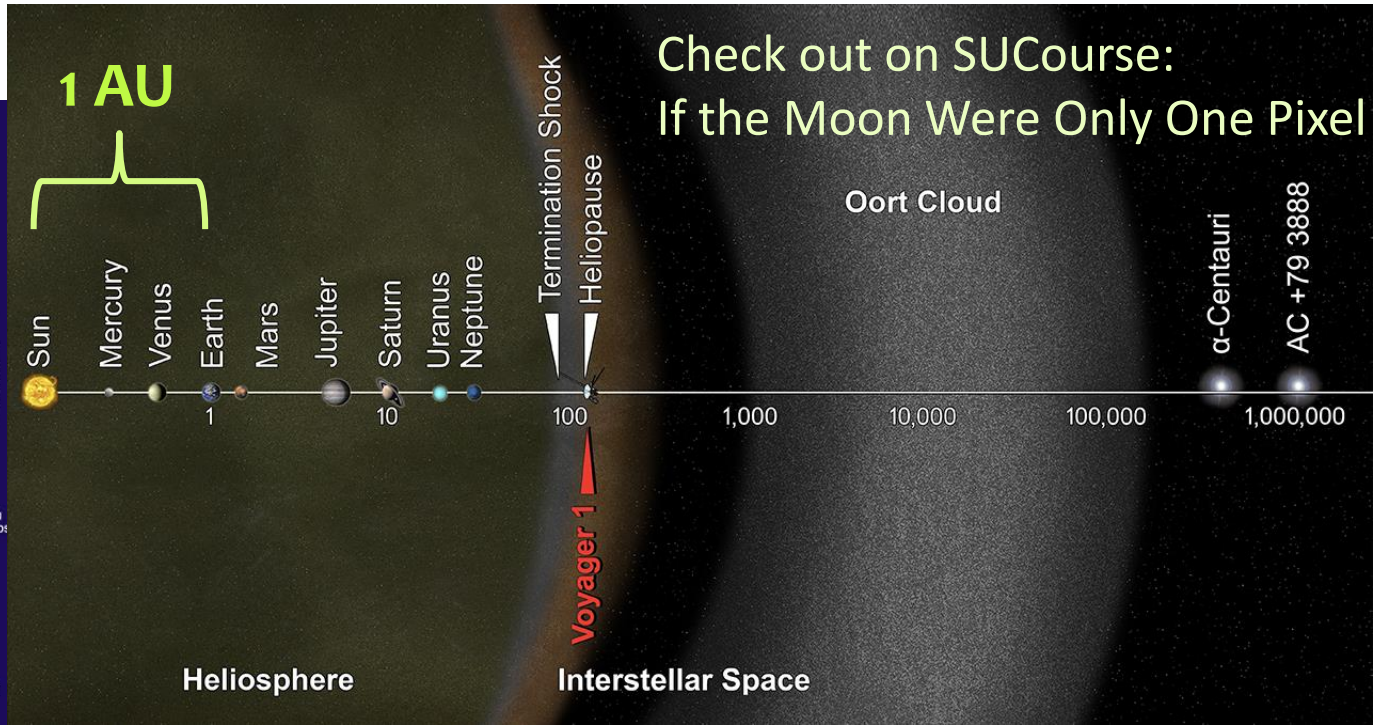
https://www.youtube.com/watch?v=RrL-cWaYdno

Distance scale in solar system

* **1 light year**
  = Distance traveled by light in a year (remember recitation?)
  = 300000 km/s x 365 days x 86400 s/day ~ 10 trillion (10^{13}) km
* The distances in the solar system can be expressed in terms of

1 Astronomical Unit (AU) = 150 000 000 000 m = 1.5×10^{11}m
~ 8 light-minutes

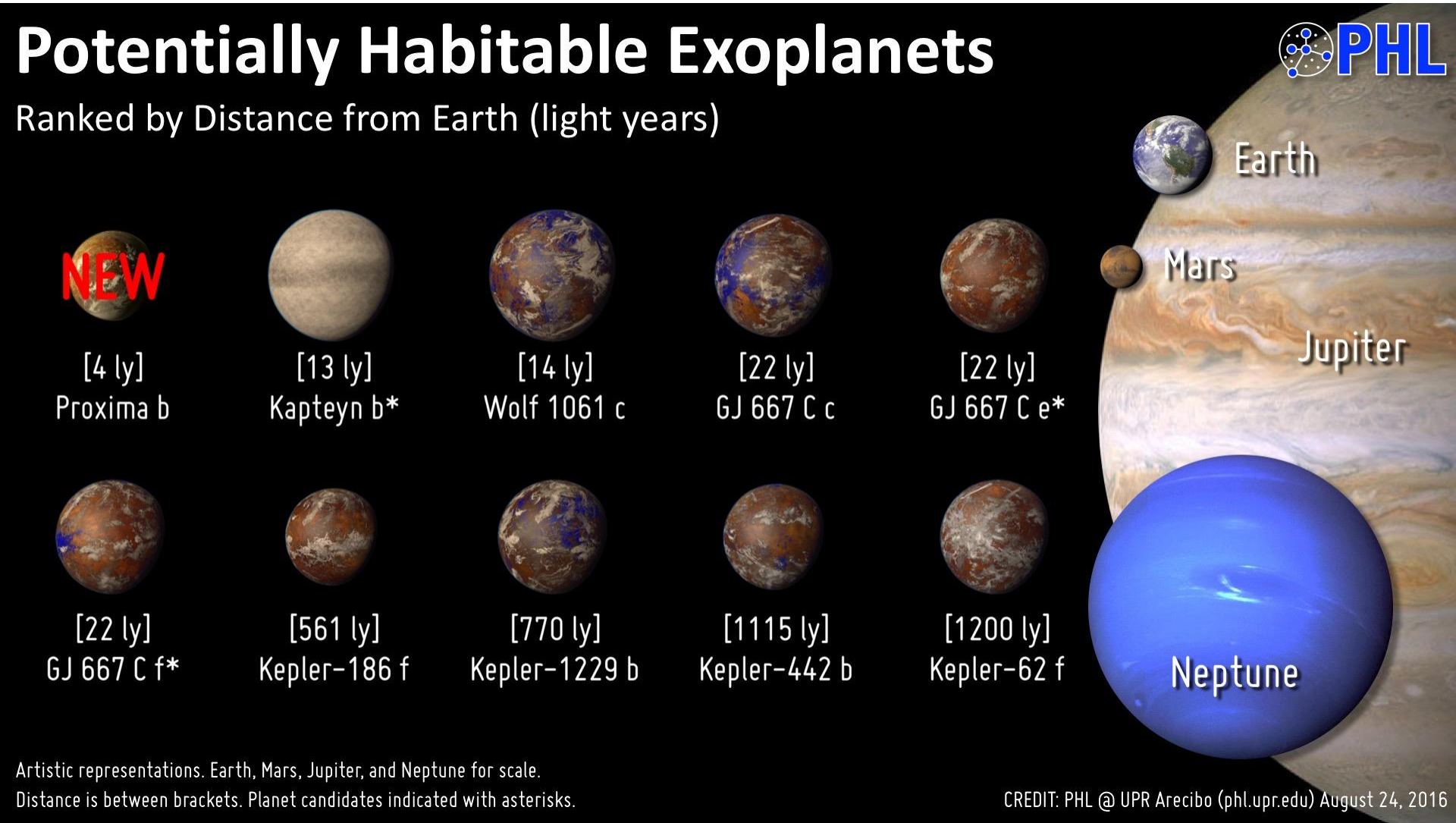




Check out on SUCourse:
If the Moon Were Only One Pixel

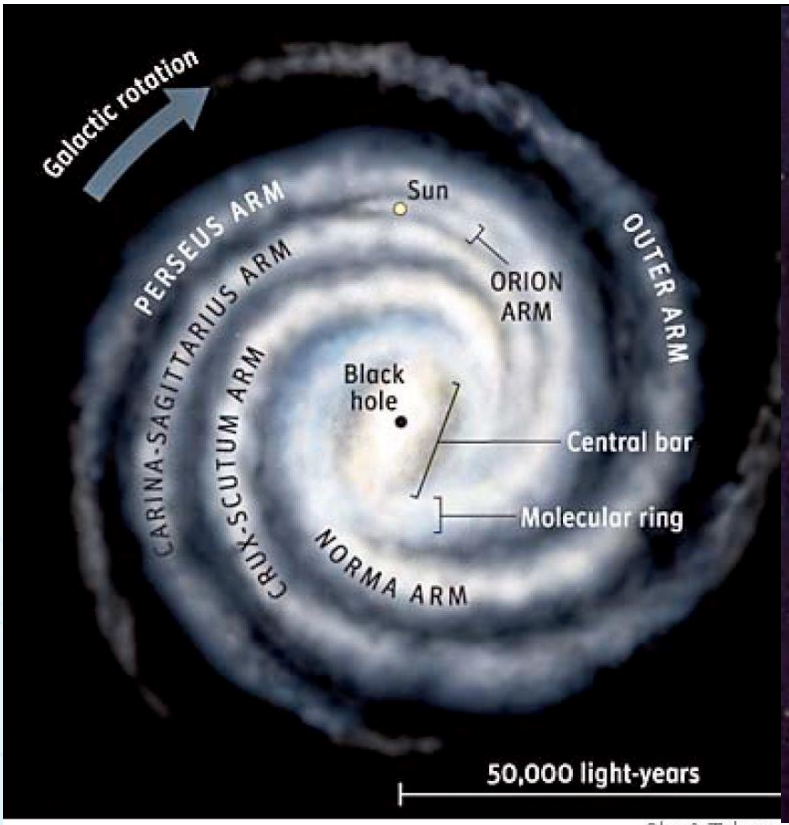
EXOPLANETS, other planetary systems in our Galaxy!

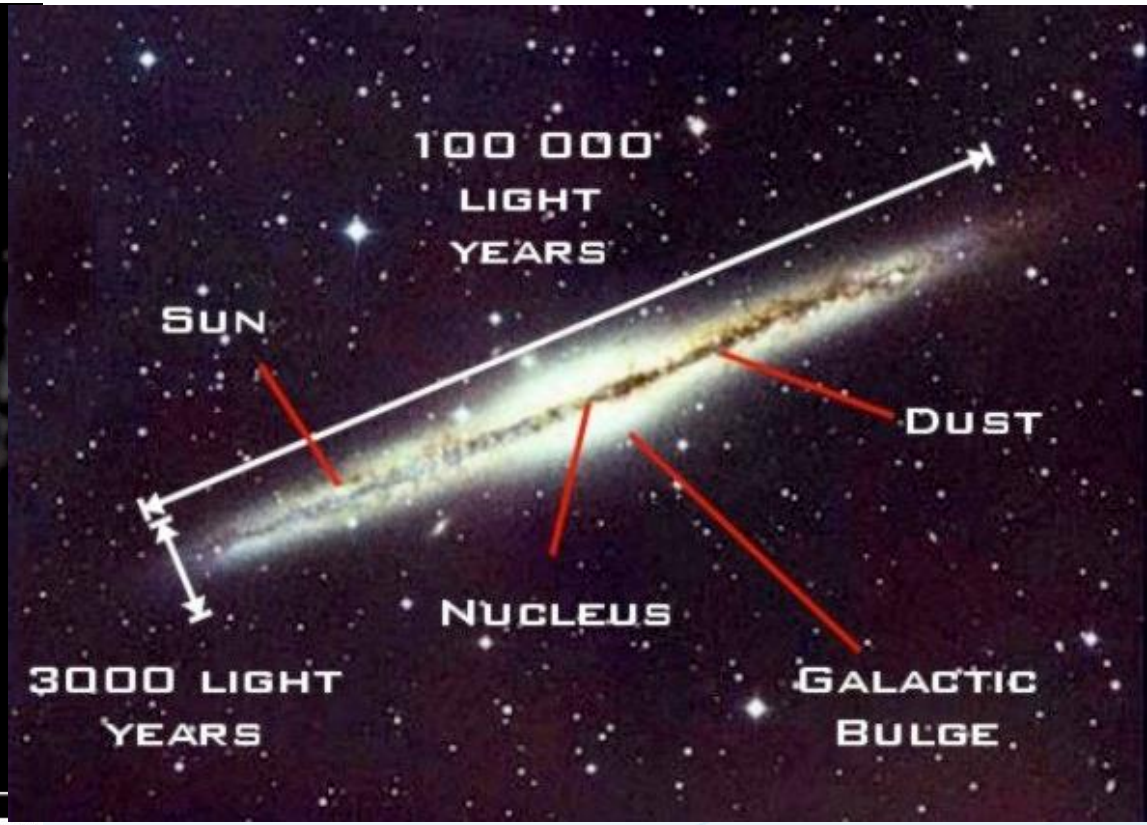
http://phl.upr.edu/projects/habitable-exoplanets-catalog



Where are we?

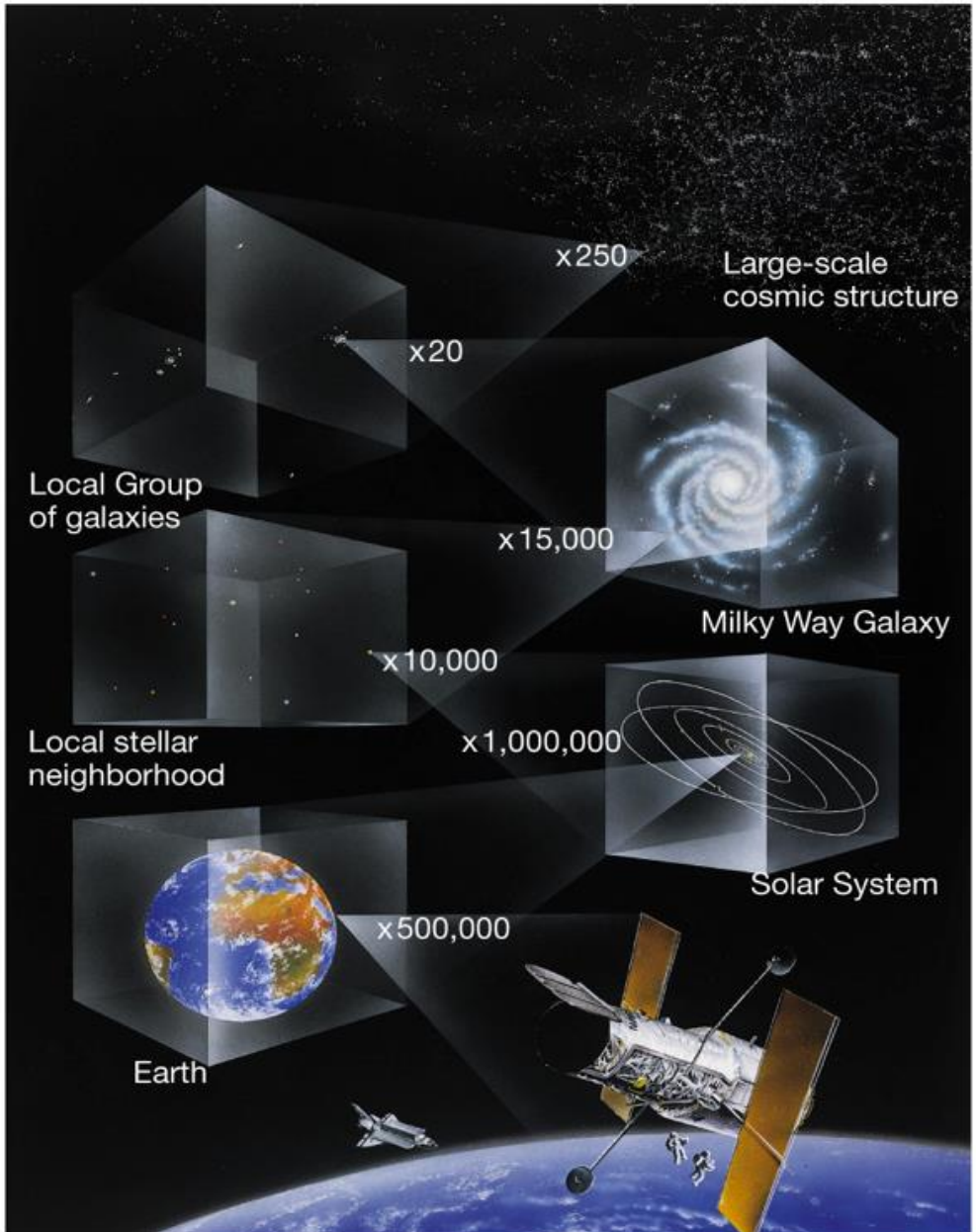
Our Solar system is located 28,000 ly away from the center of the Galaxy, in the Galactic plane, on Orion Arm.





Sky & Telescope

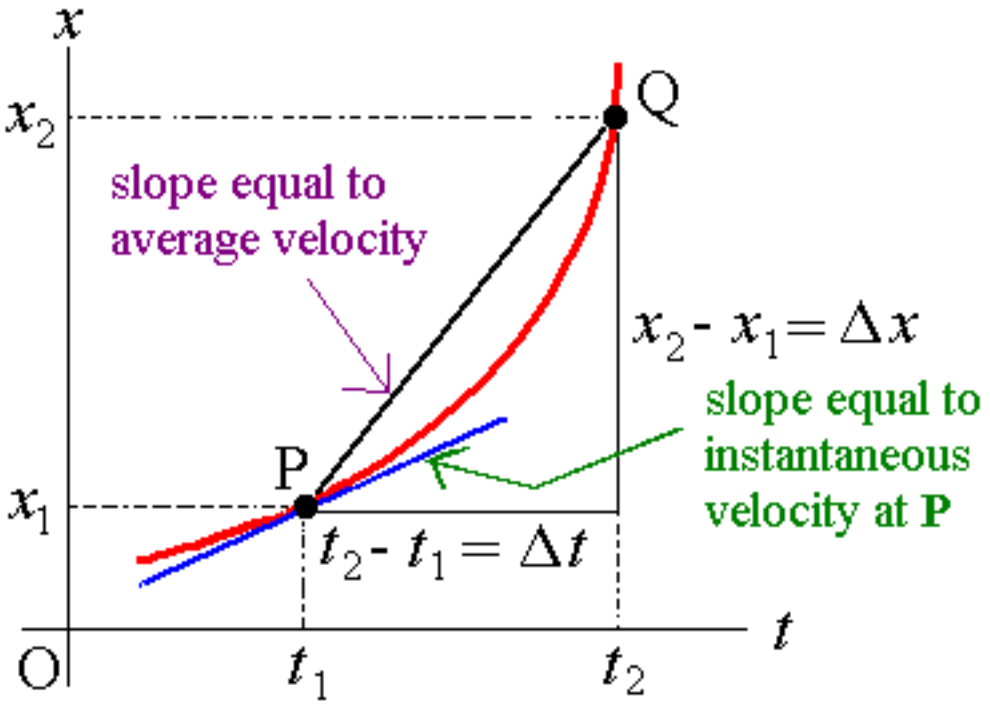
Our place in the Universe?

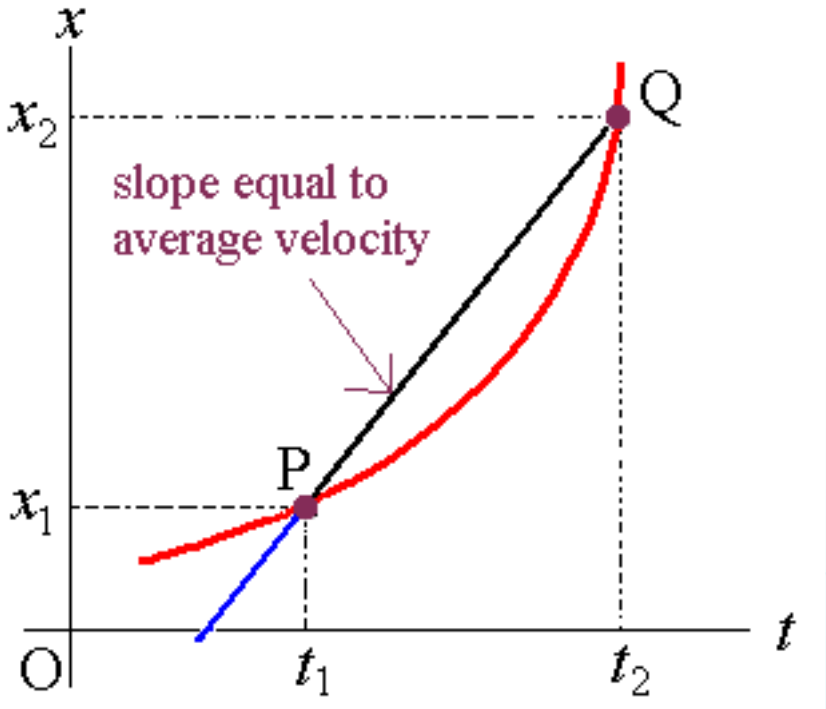


Terms for describing motion

Quantity	Definition	Vector/ Scalar	SI Unit
Position $(\vec{x})$	The position (location) of the object with respect to a reference point (origin)	**Vector**	m
Distance (x)	How much path the object has covered (every step counts!)	Scalar	m
Displacement $(\Delta\vec{x})$	Change in position $[\Delta\vec{x} = \vec{x}_f - \vec{x}_i]$	**Vector**	m
Speed (v)	*Distance* traveled **per unit time**	Scalar	m/s
Velocity $(\vec{v})$	Change in position (= displacement) **per unit time** $[= \Delta\vec{x}/\Delta t]$	**Vector**	m/s
Acceleration $(\vec{a})$	Change in velocity **per unit time** $[=\Delta\vec{v}/\Delta t]$	**Vector**	m/s^2

Instantaneous velocity on a graph



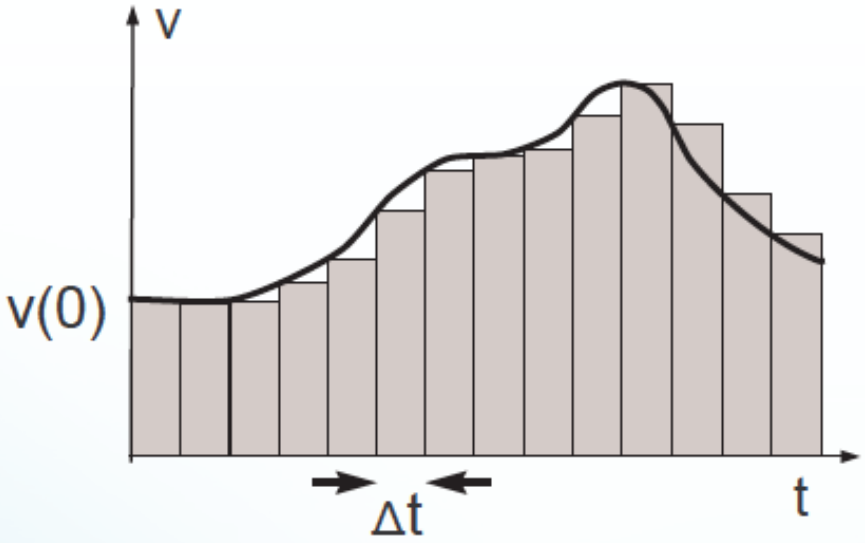


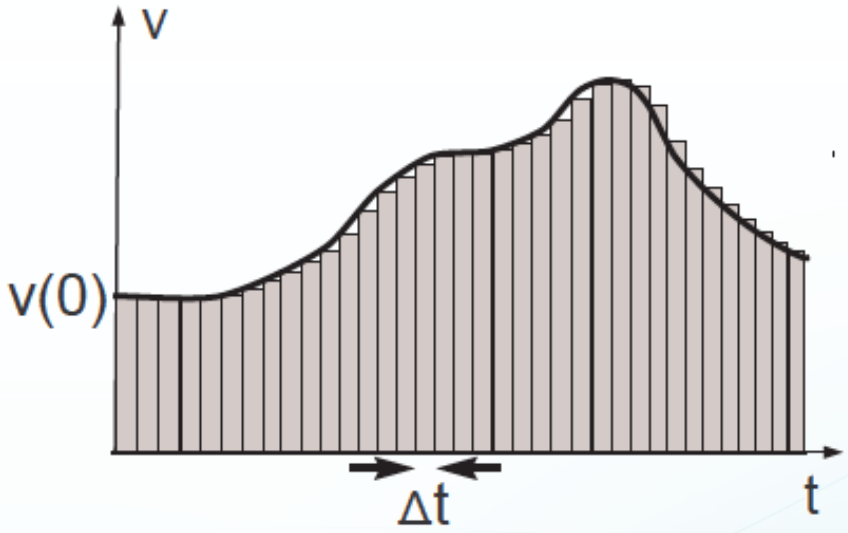
check the steepness of the slope;
steeper means higher speed.

$$\mathbf{v}_{\text{inst}} = \lim_{\Delta t \to 0} \frac{\Delta \mathbf{x}}{\Delta t} = \boxed{\frac{d\mathbf{x}}{dt}}$$

Derivative!

INTEGRAL and AREA under the CURVE





$$x(t) - x(0) = \lim_{\Delta t \to 0} \sum_{n=0}^{N-1} v(n\Delta t)\Delta t = \int_0^t v(t')dt'$$

Integral!

5-Step Problem Solving Strategy

(1) Comprehend the problem

the group agrees on quantitative description of the problem

(2) Represent the problem in formal terms

the group agrees on givens, unknowns, and qualitative description of what they need to find, by also listing related concepts to be applied in the problem

(3) Plan a solution

the group agrees on how to solve the problem quantitatively

(4) Execute the plan

each student solves the problem **individually** first, and then compare the solutions with the other members of the group

(5) Interpret and evaluate the solution

the group discusses what they found, which one is correct, if the answer makes sense, etc.

Group Problem

You go to the Moon and throw a ball. Choosing the +*y* direction upwards, the vertical velocity as a function of time is given by $v_y(t) = -1.6t + 12$ m/s (assume that the ball moves only in y direction).

a) Sketch the vertical velocity vs. time graph for $t = 0$ to 15 s.
b) Find the acceleration and position of the ball at $t = 10$ s.
c) Describe the ball's motion at $t = 10$ s.
d) Find the average speed and average velocity between $t = 0$ and $t = 15$ s.

Answers: (b) $a = -1.6$ m/s^2 = g_{moon}
$Y = 40$ m
(d) Avg speed = 6 m/s
Avg velocity = 0 m/s