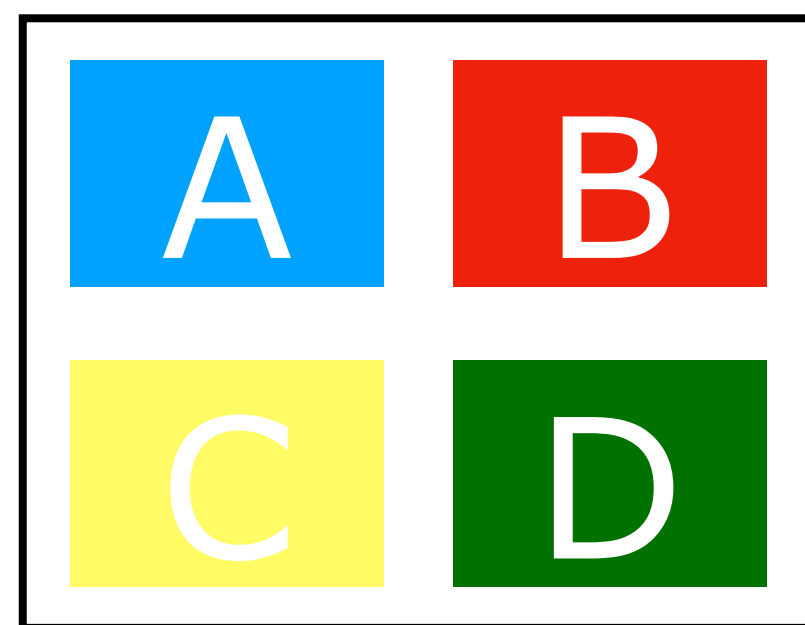


ASTR/PHYS 1060: The Universe

Welcome!

Be sure to grab an ABCD page
by an entrance or up front



(Hint: it looks like this)

Visit/Bookmark/Write down the course webpage:

<http://www.astro.utah.edu/~wik/courses/astr1060fall2019/>

(Also linked to in Canvas, which we will also use)

What is the *Universe*?

What *isn't* the Universe?

Why *study* the Universe?

Consider again that **dot**. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar", every "supreme leader", every saint and sinner in the history of our species lived there - on a mote of dust suspended in a sunbeam.

The Earth is a very small stage in a vast cosmic arena. Think of the rivers of blood spilled by all those generals and emperors so that, in glory and triumph, they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner, how frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds.

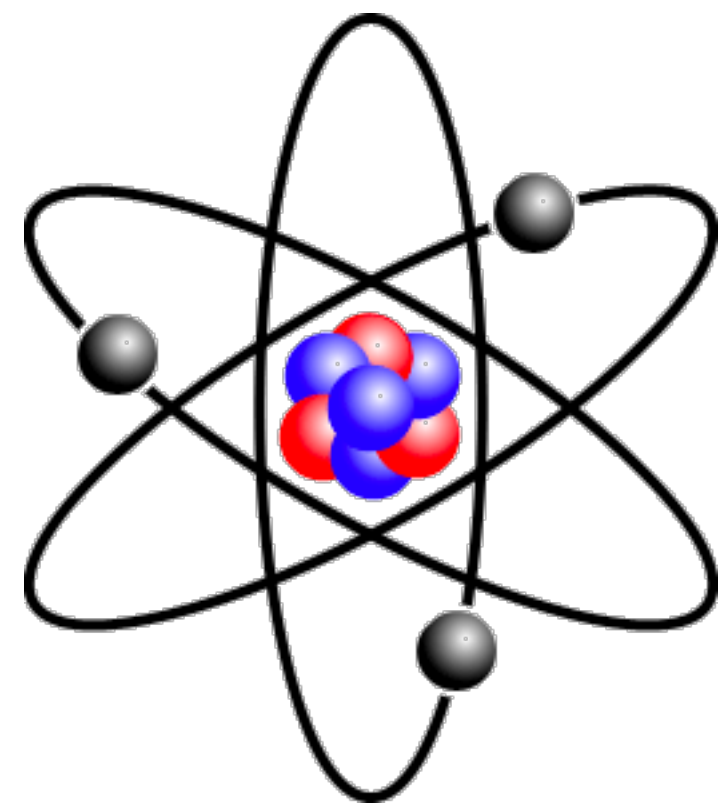
Our posturings, our imagined self-importance, the delusion that we have some privileged position in the Universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves.

The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand.

It has been said that astronomy is a humbling and character-building experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known.

-Carl Sagan (1934-1996)

About what percentage of the Universe is composed of atoms (and particles that make up atoms) like those that make up everything in the solar system, including us?



A) 100%

B) 50%

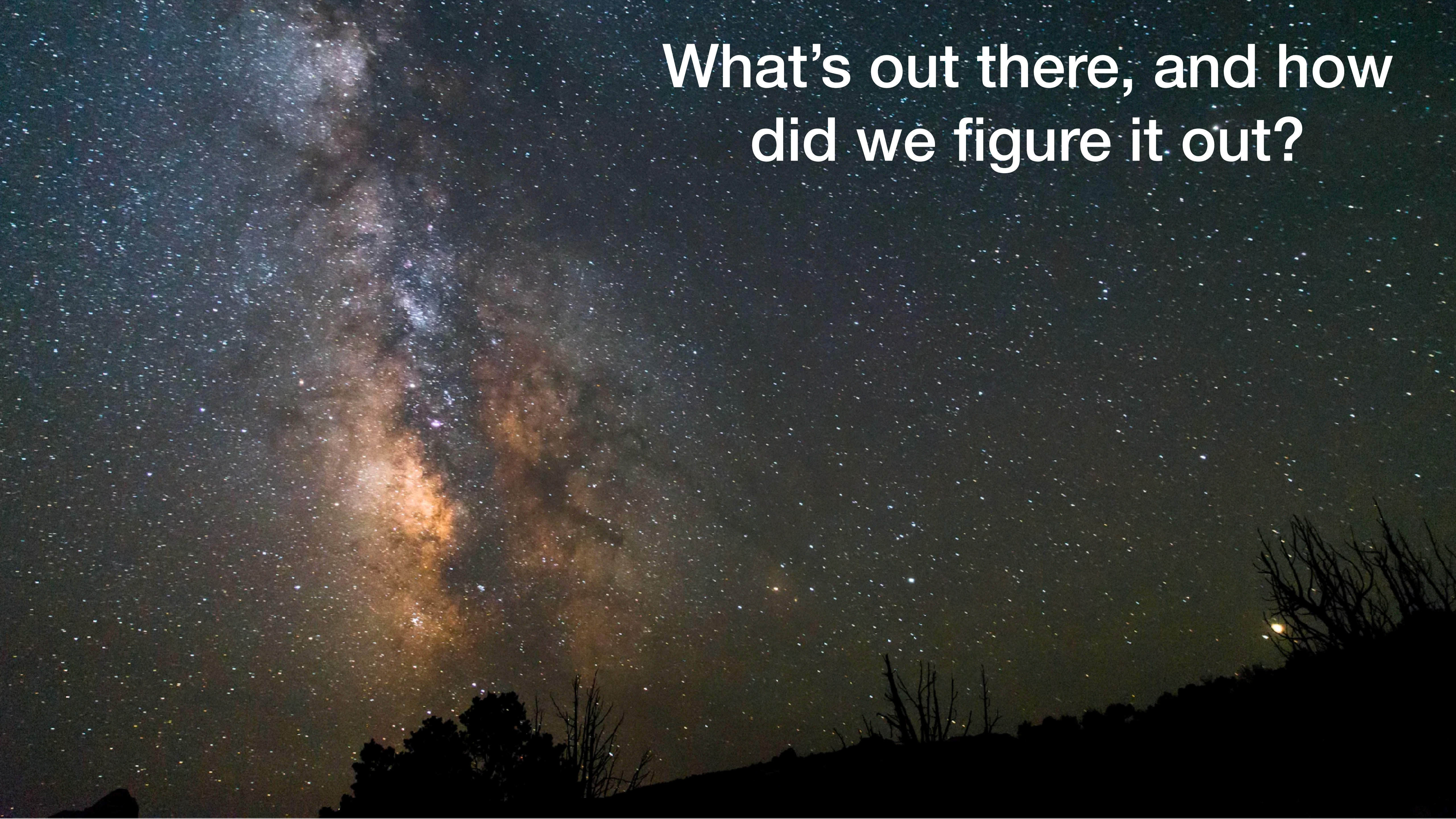
C) 25%

★ D) 5%

If the entire history of the Universe were crammed into 1 calendar year, when would human beings have appeared on Earth?



- A) Sept. 8th
- B) Dec. 19th
- ★ C) Dec. 31st, at 11:52pm
- D) Dec. 31st, at 11:59:15pm



What's out there, and how
did we figure it out?

A little about your tour guide...



John Wick



Dan Wik

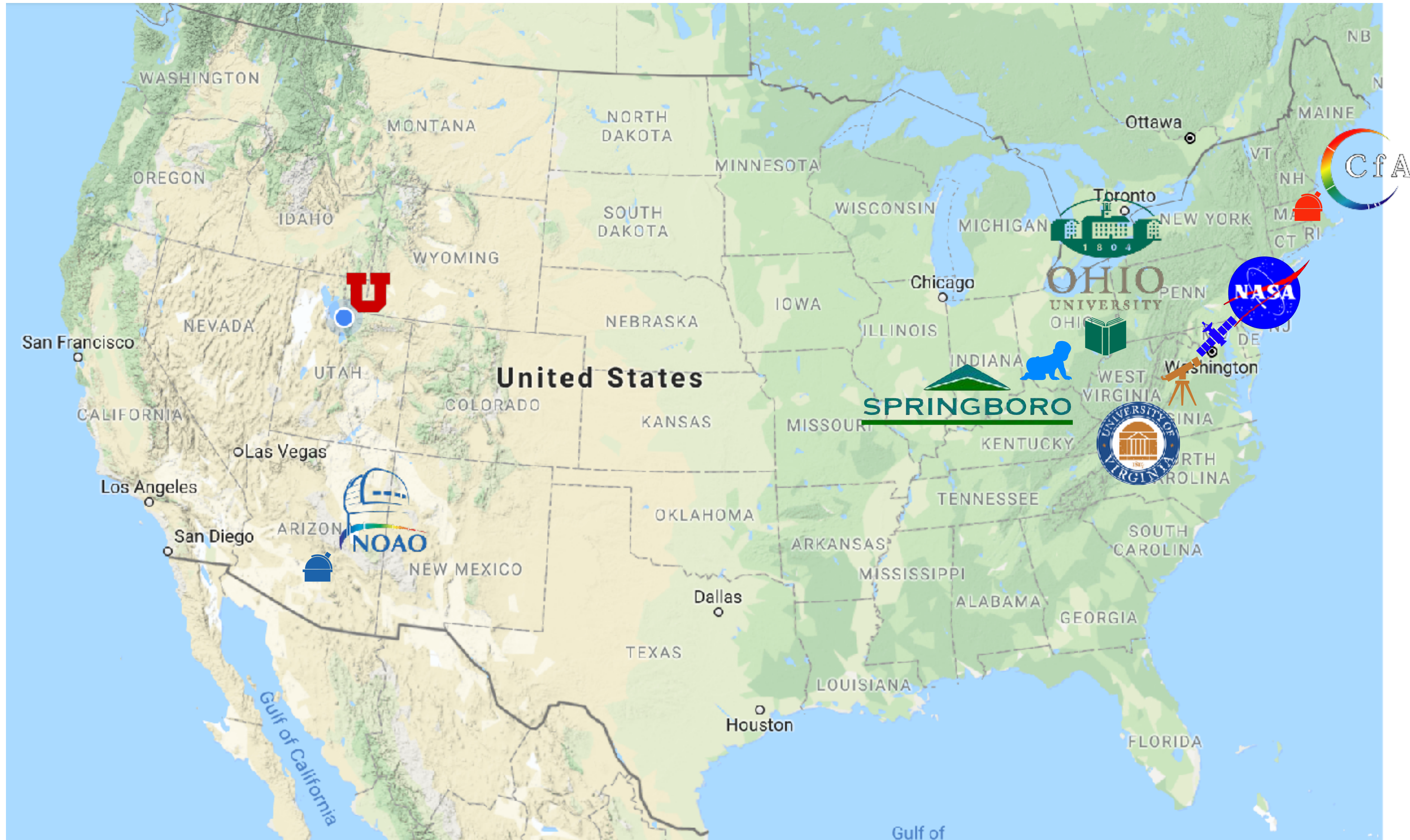
A little about your tour guide...



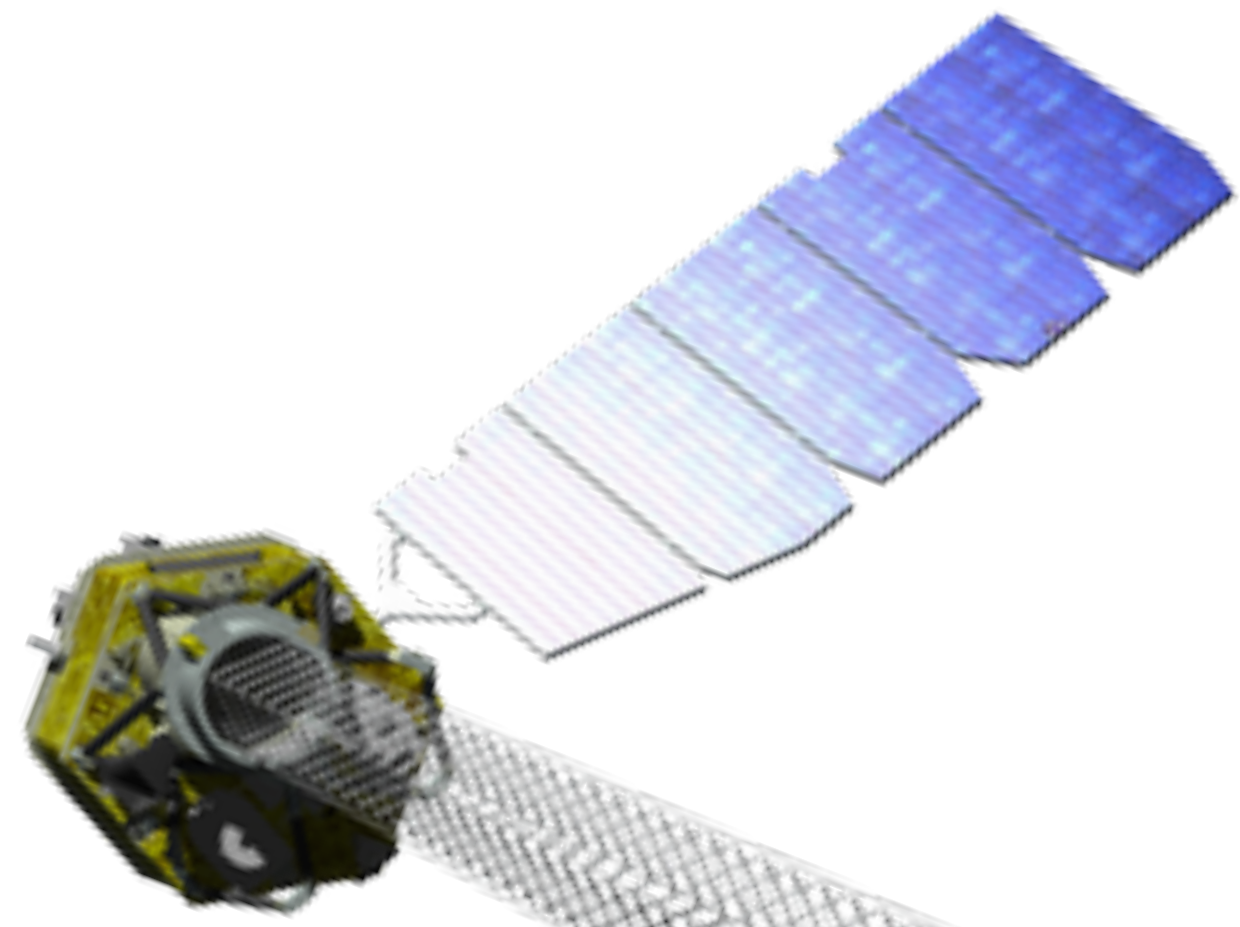
A little about your tour guide...



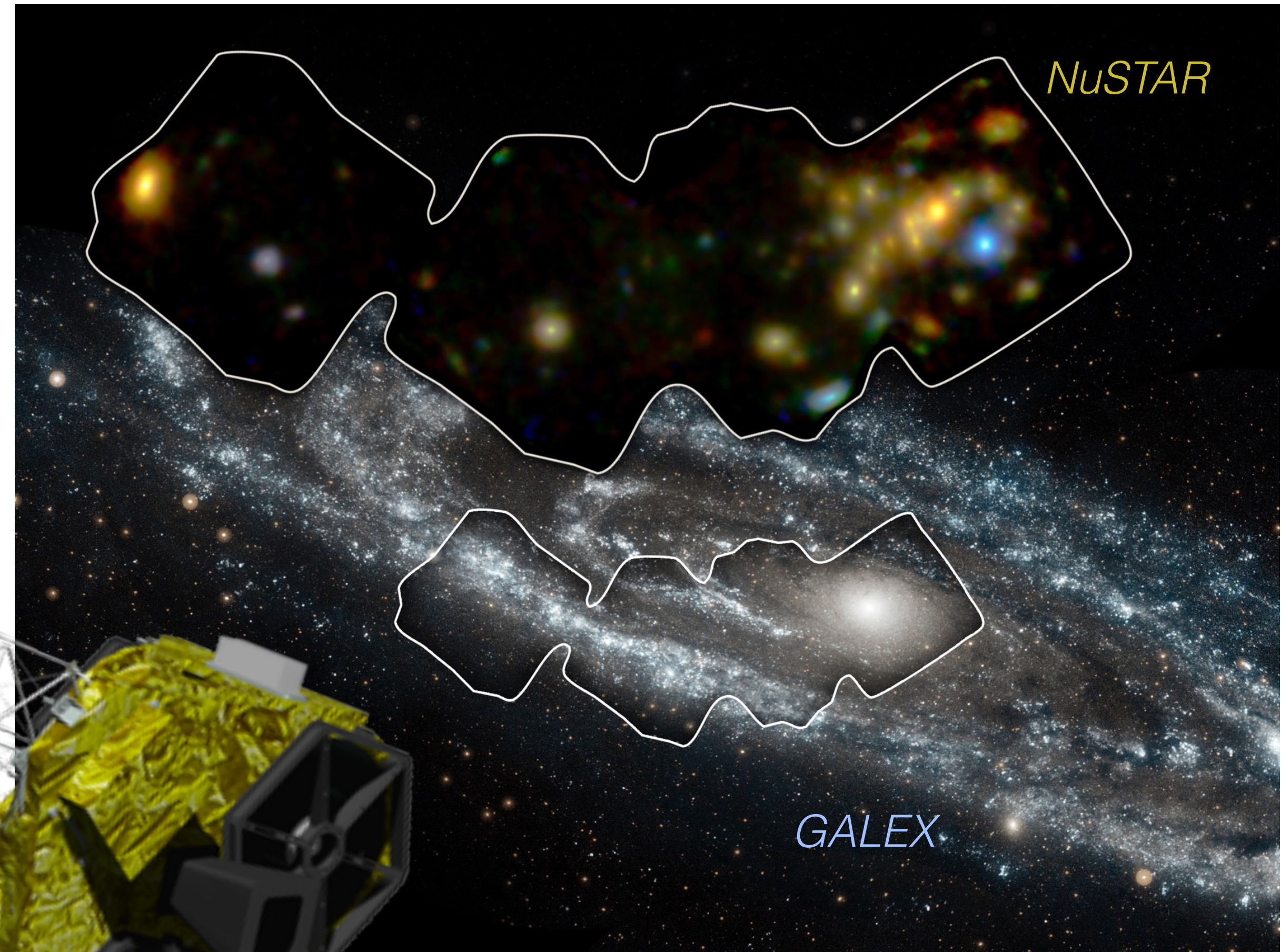
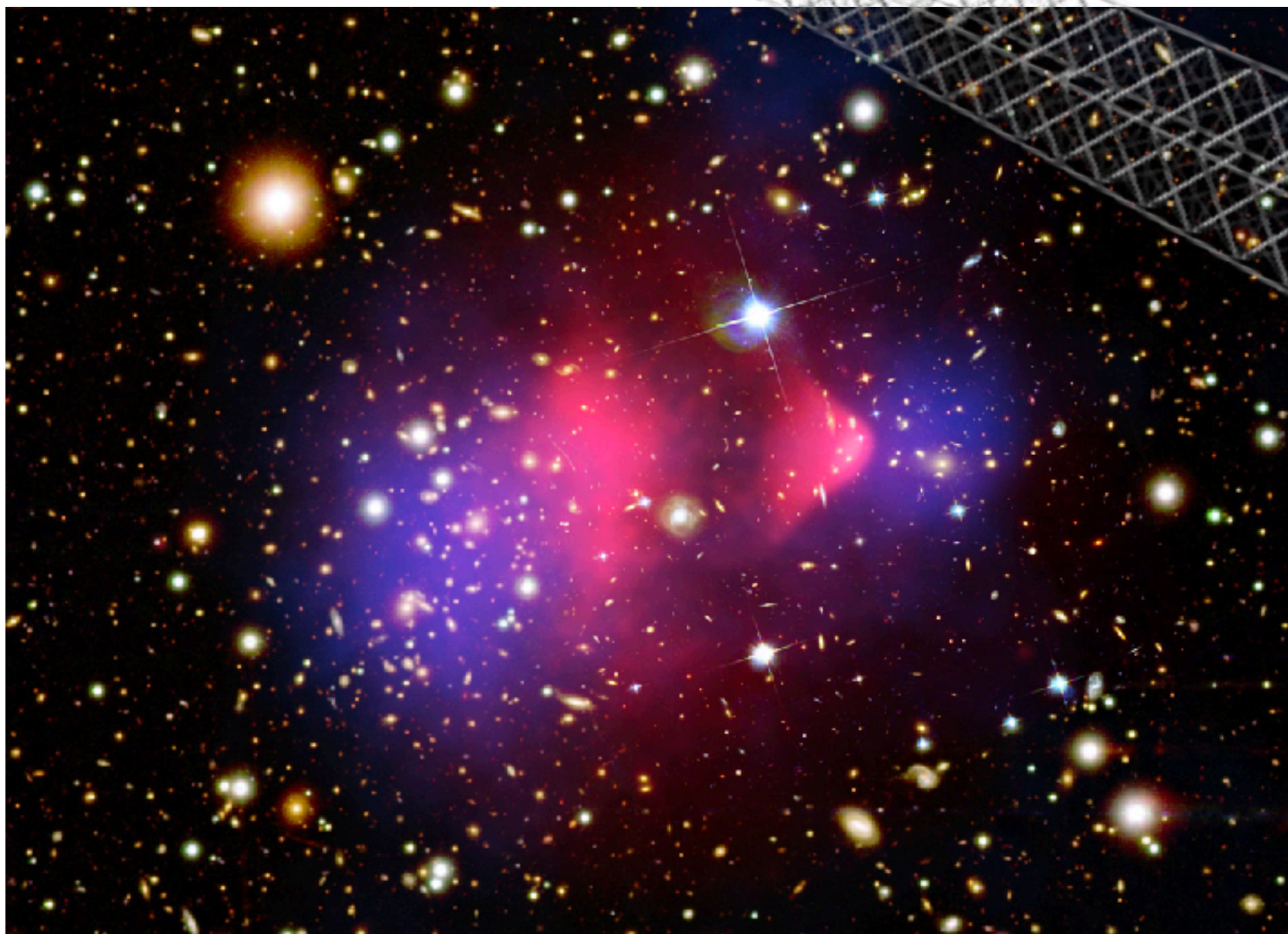
A little about your tour guide...



I'm an X-ray Astronomer



Bullet Cluster

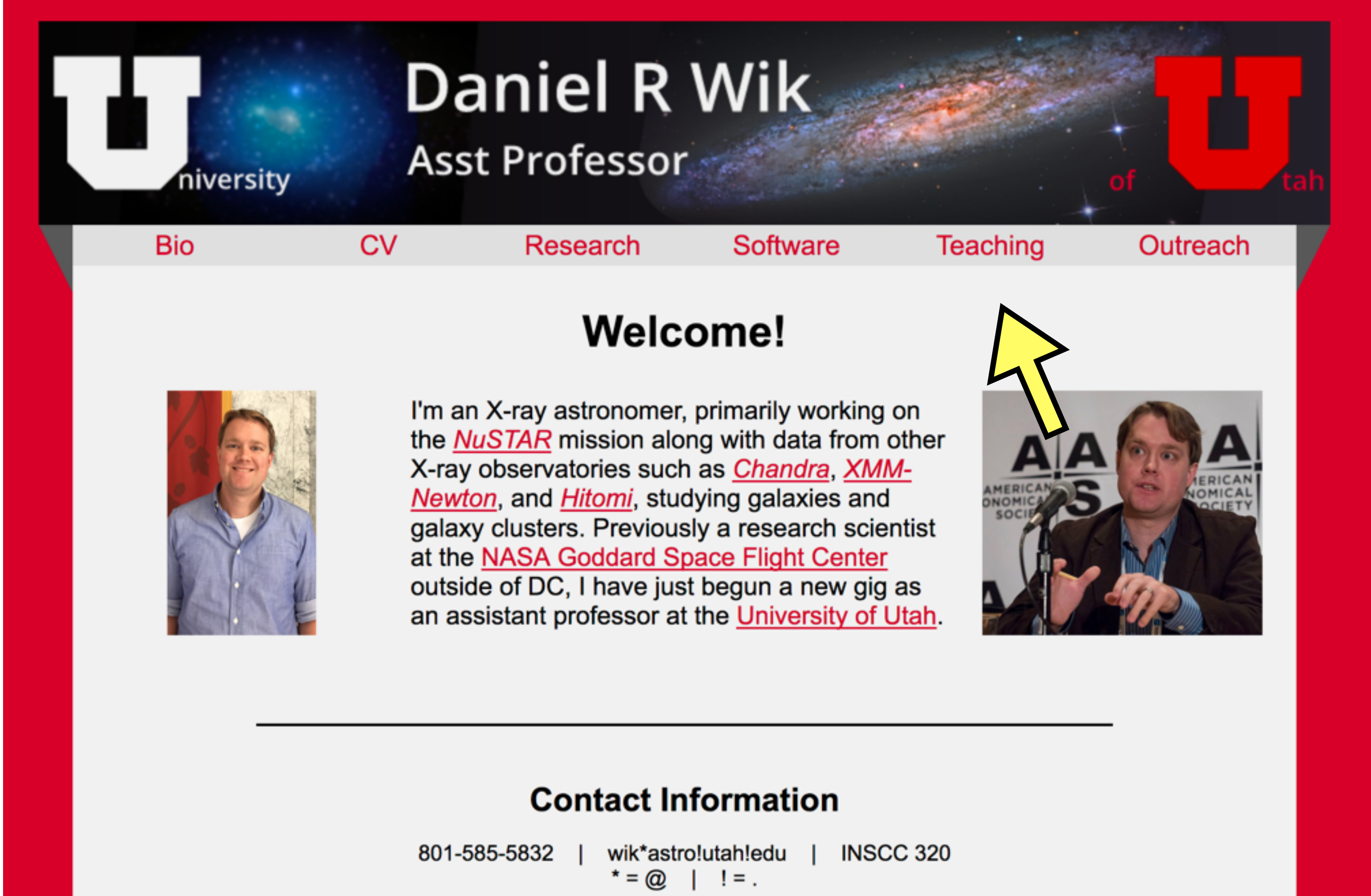


Andromeda Galaxy

<https://the-nightly-news.com/blog/blog-87-secrets-of-the-high-energy-x-ray-universe>

How this course will work

<http://www.astro.utah.edu/~wik>



The screenshot shows a website for Daniel R Wik, an Assistant Professor at the University of Utah. The header features the University of Utah logo and a background image of a galaxy. Below the header is a navigation menu with links for Bio, CV, Research, Software, Teaching, and Outreach. The main content area includes a 'Welcome!' section with a photo of Wik, a bio paragraph, and a photo of him speaking at a podium. A yellow arrow points to the 'Teaching' link in the navigation menu. The 'Contact Information' section at the bottom provides phone, email, and location details.

University of **U**tah

Daniel R Wik
Asst Professor

Bio CV Research Software Teaching Outreach

Welcome!


I'm an X-ray astronomer, primarily working on the [NuSTAR](#) mission along with data from other X-ray observatories such as [Chandra](#), [XMM-Newton](#), and [Hitomi](#), studying galaxies and galaxy clusters. Previously a research scientist at the [NASA Goddard Space Flight Center](#) outside of DC, I have just begun a new gig as an assistant professor at the [University of Utah](#).

Contact Information

801-585-5832 | wik*astro!utah!edu | INSCC 320
*=@ | !=.

How this course will work

<http://www.astro.utah.edu/~wik/courses/astr1060fall2019/>



**ASTR/PHYS 1060:
The Universe**

[Syllabus](#) [Lectures](#) [Readings](#) [Assignments](#) [Courses](#)

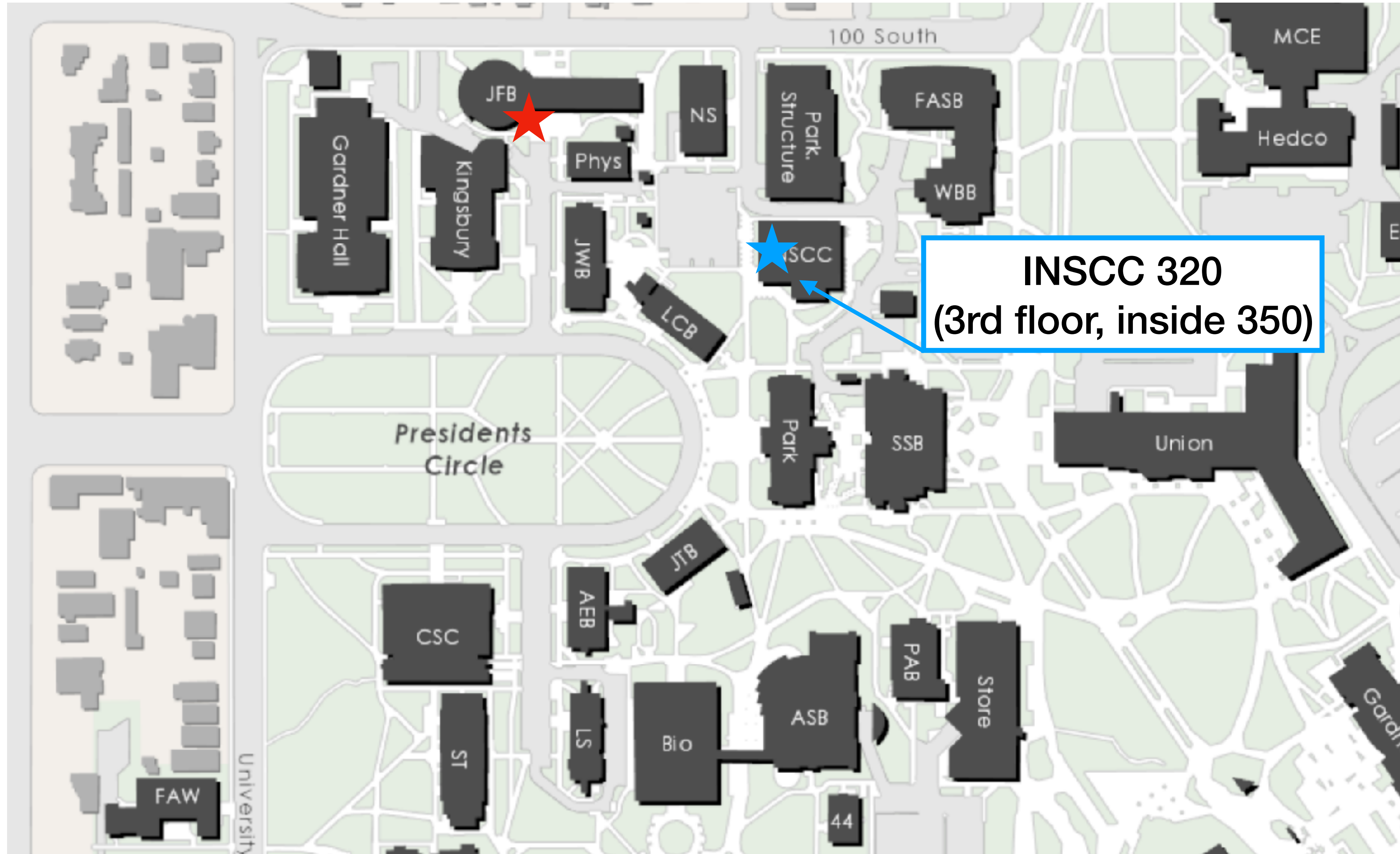
Welcome to THE UNIVERSE!

Ever wonder what the universe is, what it's full of, why the sky is blue, why the night sky is dark and full of stars, and how it all got to be this way? Well, this is the course for you. We'll cover stars, exotic stellar objects (white dwarfs, red giants, neutron stars and black holes), supernova explosions, the origin of atomic elements, galaxies, giant radio sources, quasars, clusters of galaxies, the fabric of space and time, and Big Bang cosmology. The universe is a big place (perhaps the biggest), so it's impossible to cover everything in a single semester, but the goal is for you to understand the cosmos and your relationship to it.

All course requirements are given in the [syllabus](#), which should be referenced for all expectations and policies of the class. The primary resource for the course is the textbook [Understanding Our Universe](#), 2nd edition, by Stacey Palen, Laura Kay, Bradford Smith, and George Blumenthal.

This website hosts useful information for the course, including [lecture slides and related material](#) and [homework assignments](#), for your convenience. Announcements will be posted on this page, which can be reached from any page by clicking on the course name banner at the top. All other pages are linked to via the navigation bar below the banner.

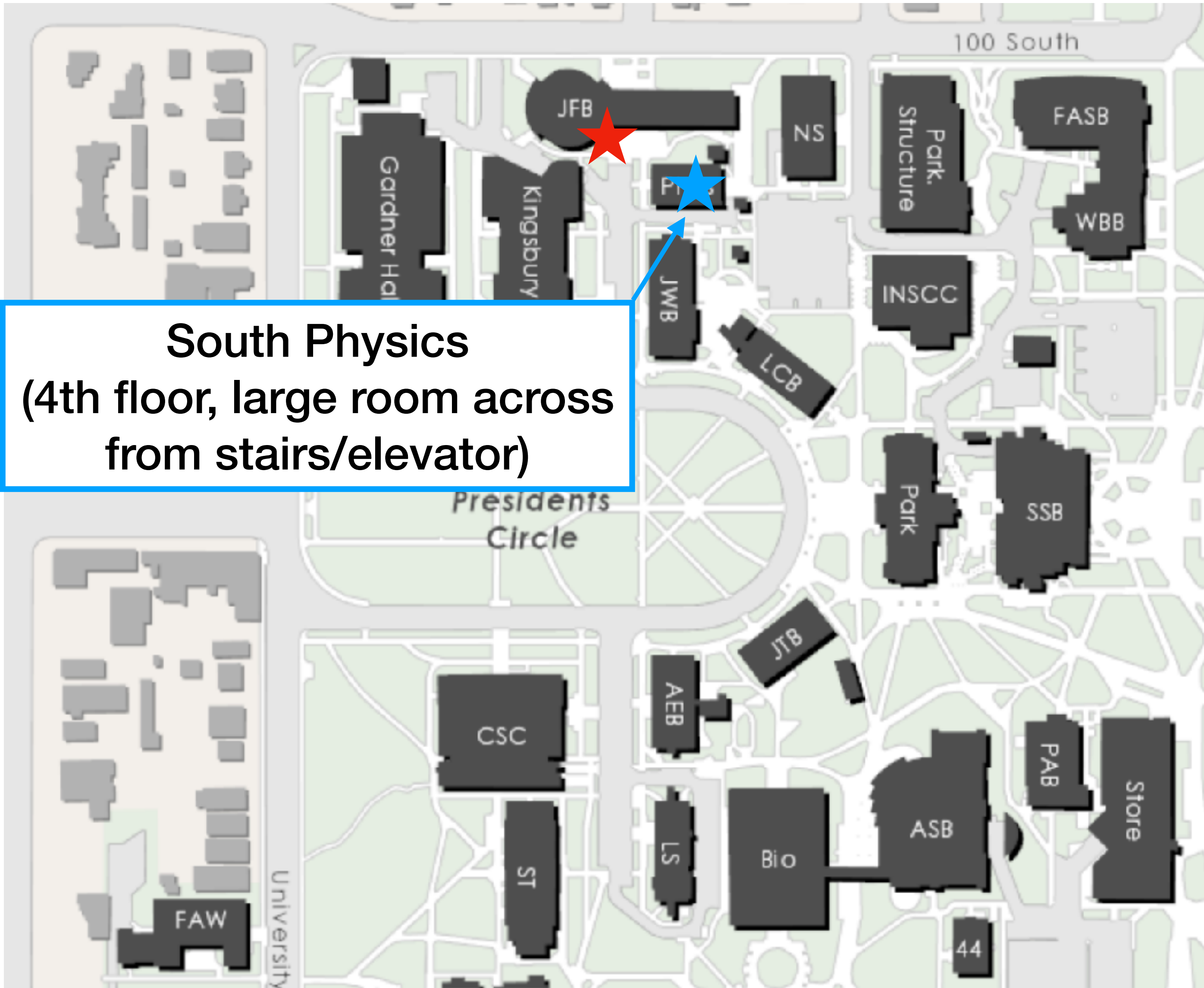
Classroom and my office



Classroom and my office



Class TA and her office



South Physics
(4th floor, large room across
from stairs/elevator)



The Reading is CRUCIAL!

**Intro science courses have as many
new vocabulary words as an intro
foreign language class!**

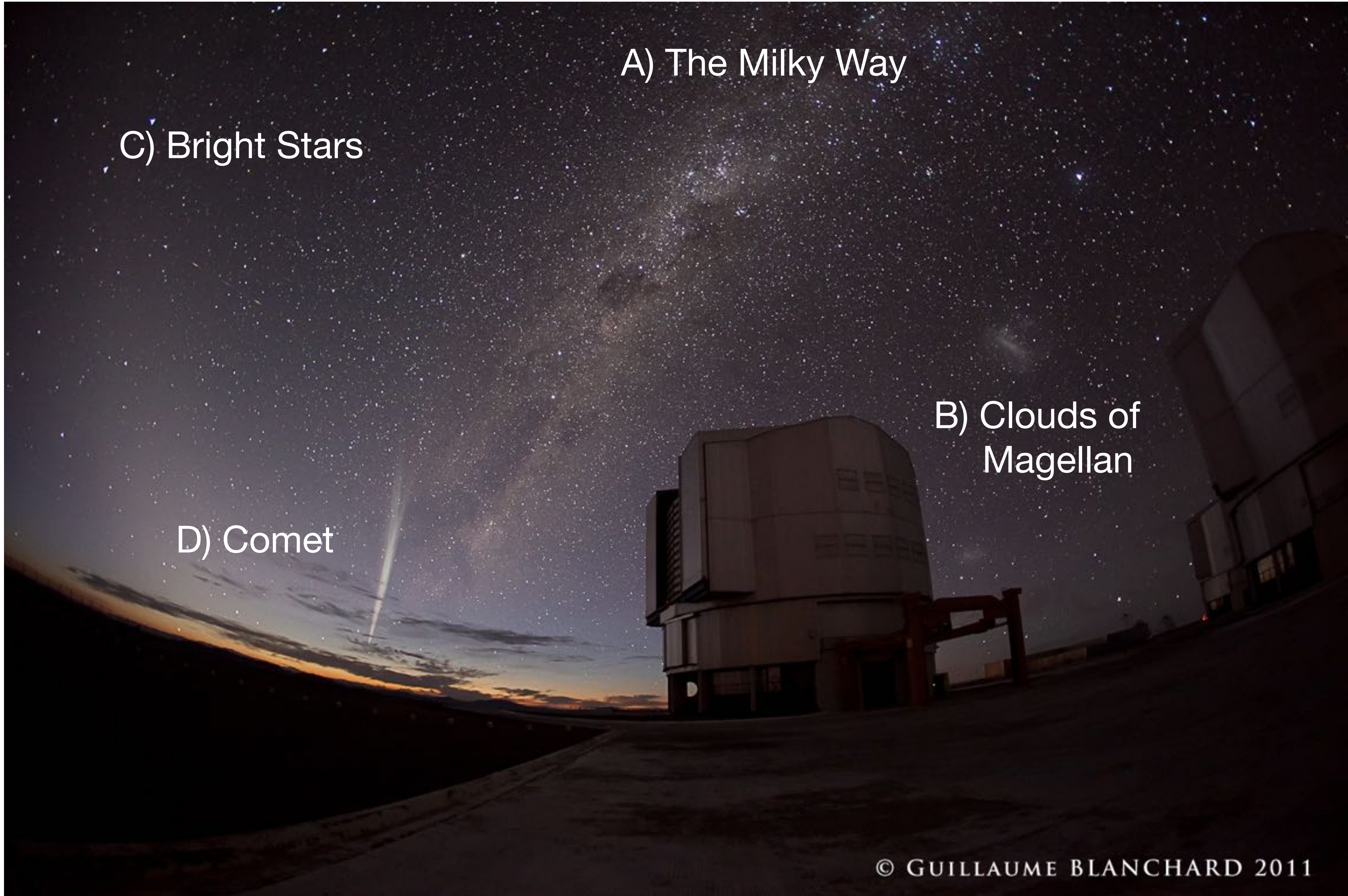
Important Dates:

Last day to add, drop (delete), elect CR/NC, or audit classes:	Friday, August 30
Last day to withdraw from classes:	Friday, October 18
Last day to reverse CR/NC option:	Wednesday, November 27

**Silence cell phones,
don't use 'em,
and use laptops for
note taking only**

Doing other things on devices distracts those around you

**Taking HAND-WRITTEN notes improves retention
(whether or not you ever look at them again)**



A) The Milky Way

C) Bright Stars

B) Clouds of Magellan

D) Comet

© GUILLAUME BLANCHARD 2011

Scale Models



scale model of Manhattan island by Joe Macken

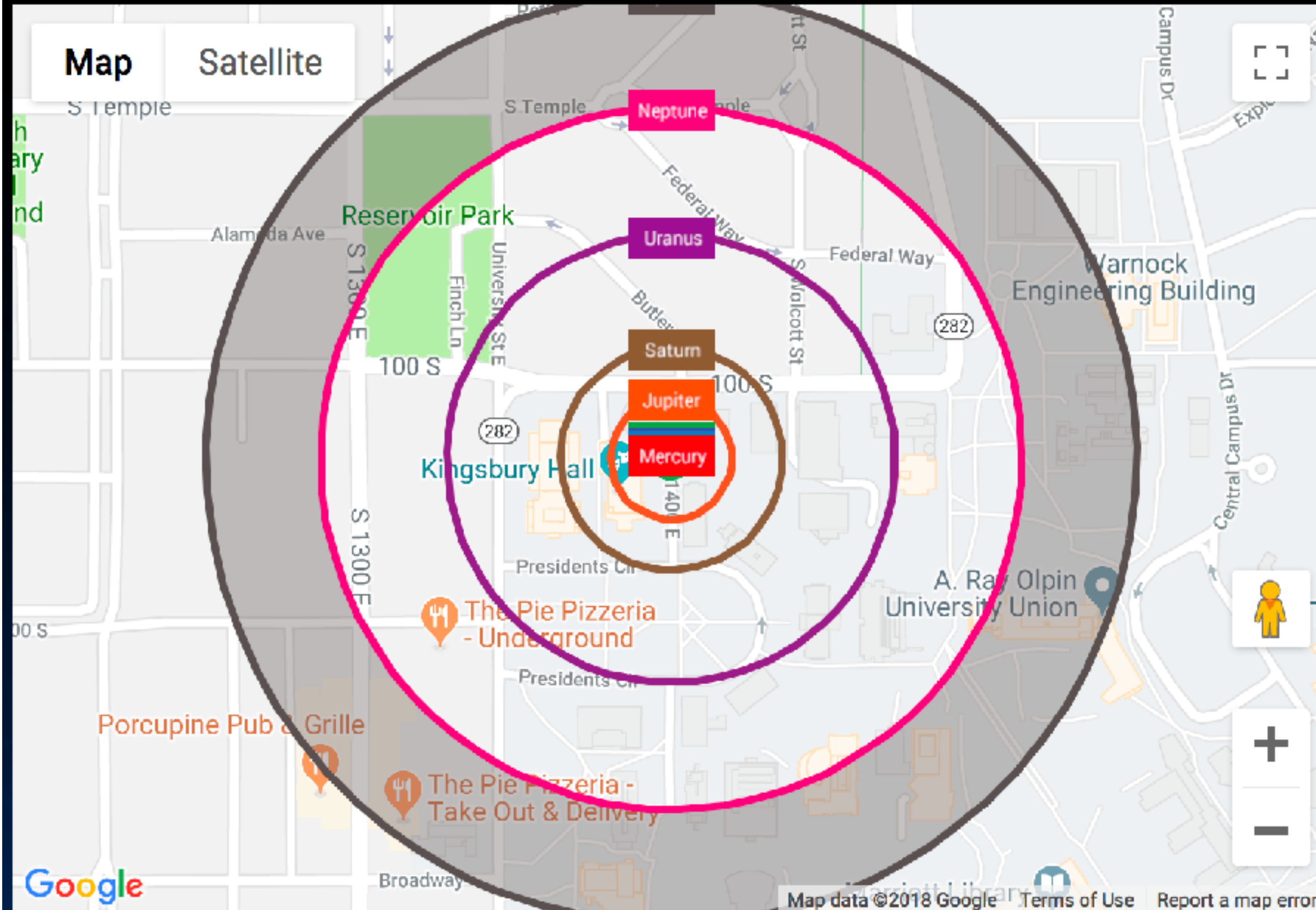
If the Sun were the size of a softball (~4" in diameter), how big would the Earth be?

- A) Golf ball (1.7")**
- B) Coffee bean (0.4")**
- C) Sesame seed (0.1")**
- D) Mustard seed (0.03")**

If the Sun were the size of a softball (~4" in diameter), how far away would the Earth be?

- A) One step (3')**
- B) Across the table (10')**
- C) Across the room (30')**
- D) President's Circle (300')**

Map a Model Solar System



Location

100 1400 East, Salt Lake City, UT, U

INCHES



Sun

4



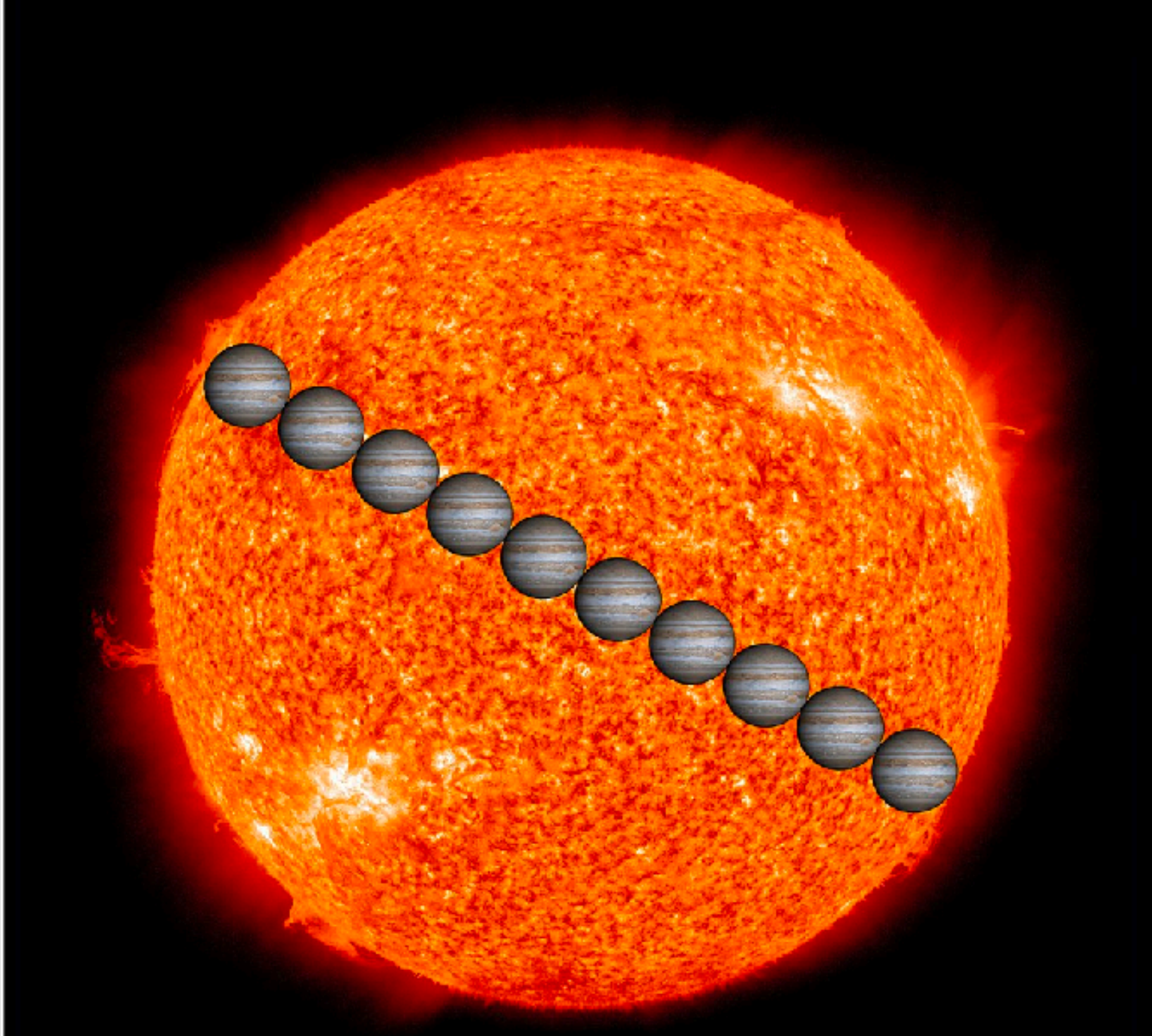
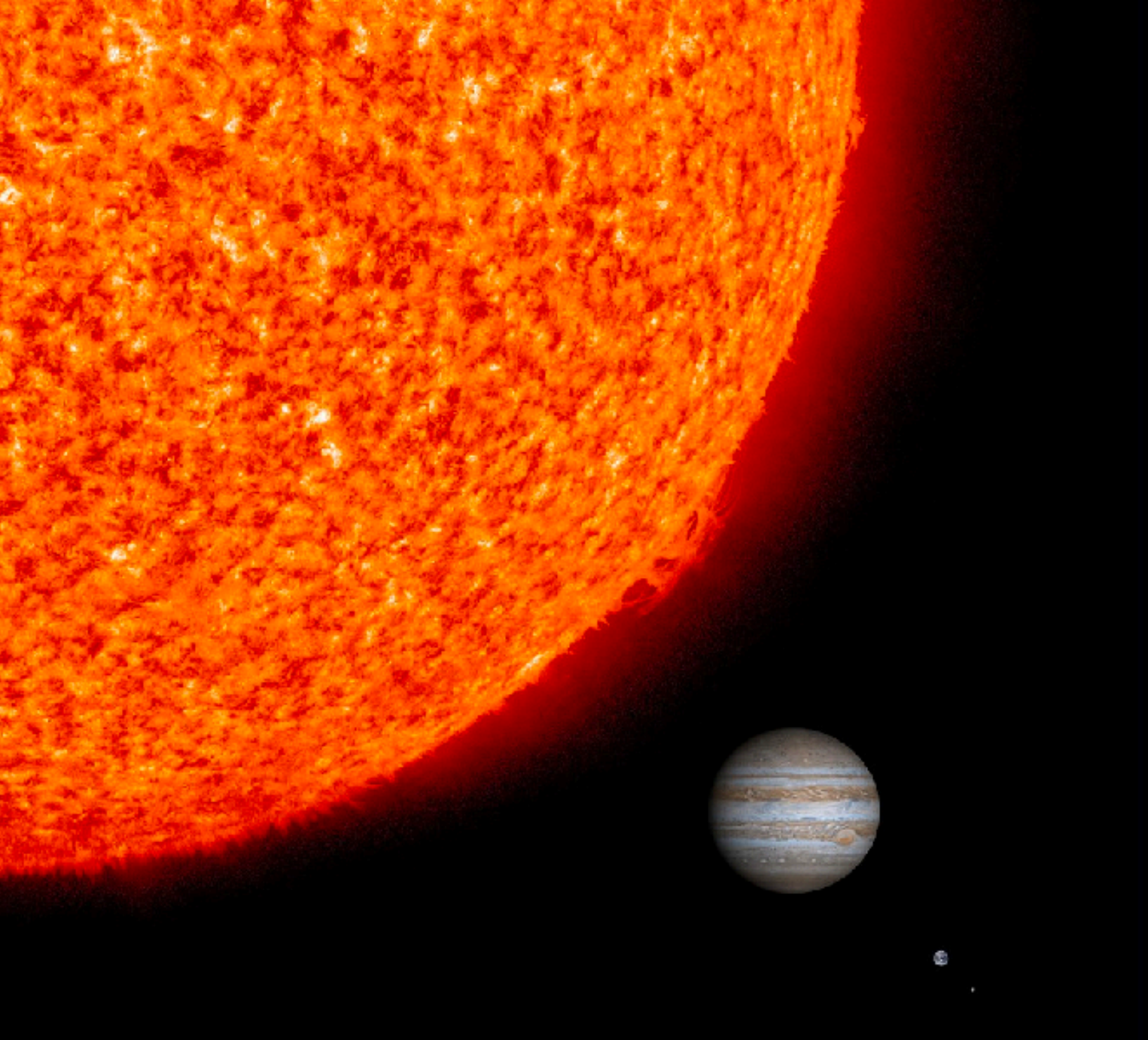
Earth

Go

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Kuiper Belt
Diameter (in) 0.014	Diameter (in) 0.035	Diameter (in) 0.037	Diameter (in) 0.02	Diameter (in) 0.411	Diameter (in) 0.346	Diameter (in) 0.147	Diameter (in) 0.142	Diameter (in) 0.007
Average Orbital Radius (mi) 0.003	Average Orbital Radius (mi) 0.005	Average Orbital Radius (mi) 0.007	Average Orbital Radius (mi) 0.01	Average Orbital Radius (mi) 0.035	Average Orbital Radius (mi) 0.065	Average Orbital Radius (mi) 0.13	Average Orbital Radius (mi) 0.204	Average Orbital Radius (mi) 0.271

Credits

WGBH © PBS LearningMedia 2018



Relative sizes of the Sun, Jupiter, Earth, and the Moon

Jupiter is ~5x farther from the Sun than is the Earth



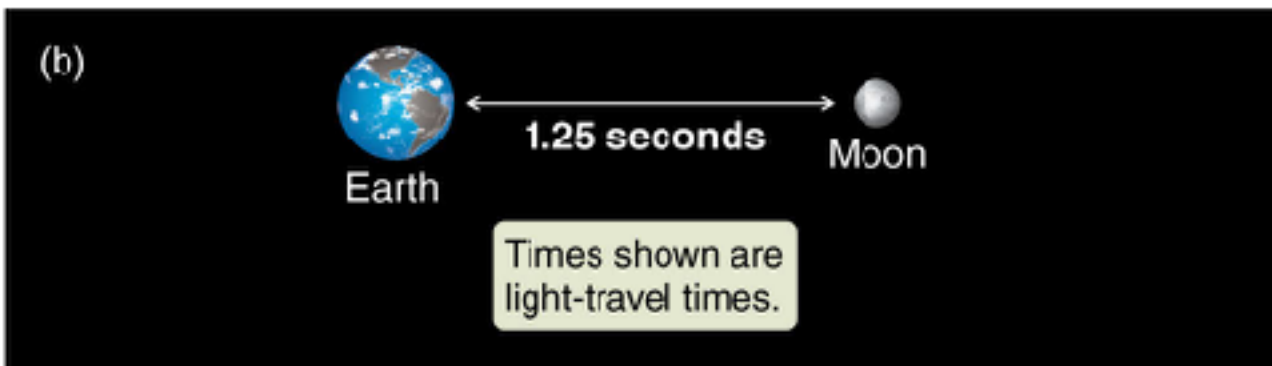
How far away is the nearest star, if the Sun is a softball?



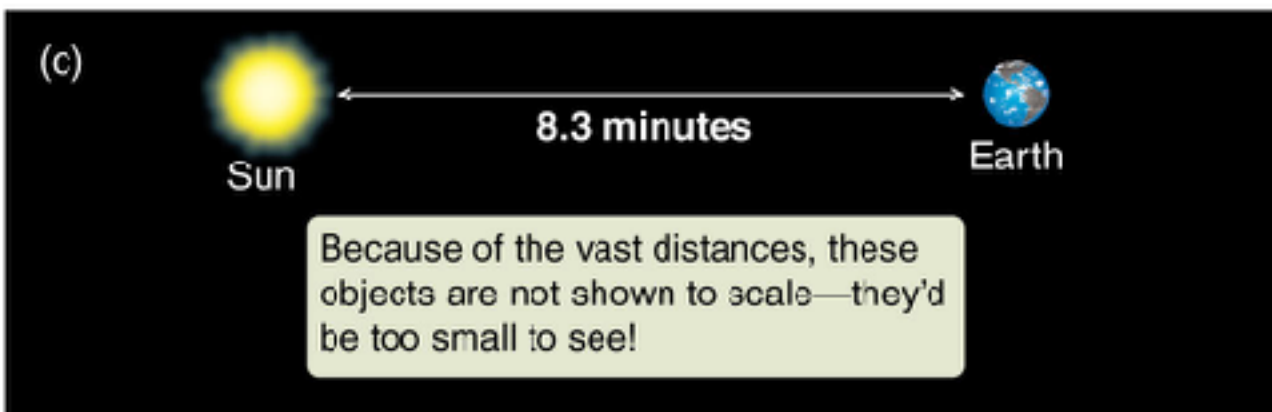
Scale by light-speed



Moving outward through the universe at the speed of light, going around Earth is like a snap of your fingers.



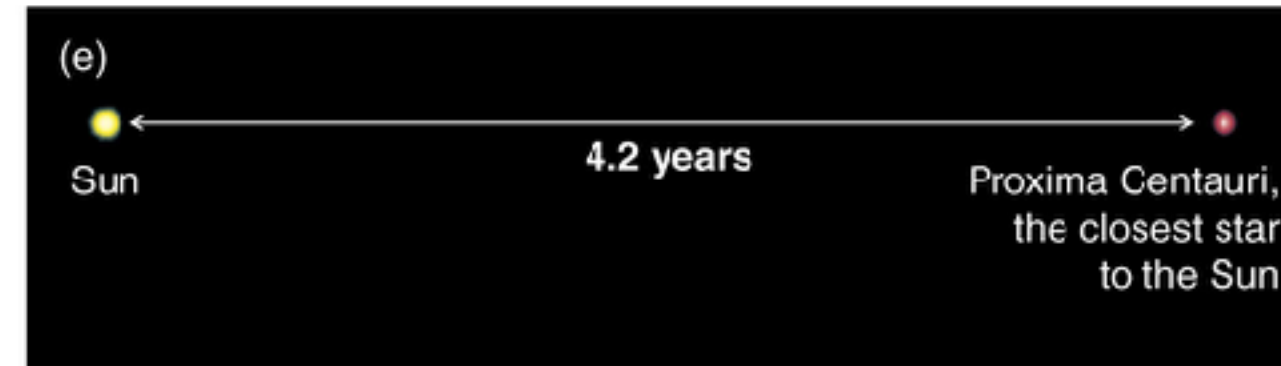
The Moon is a little more than a second away.



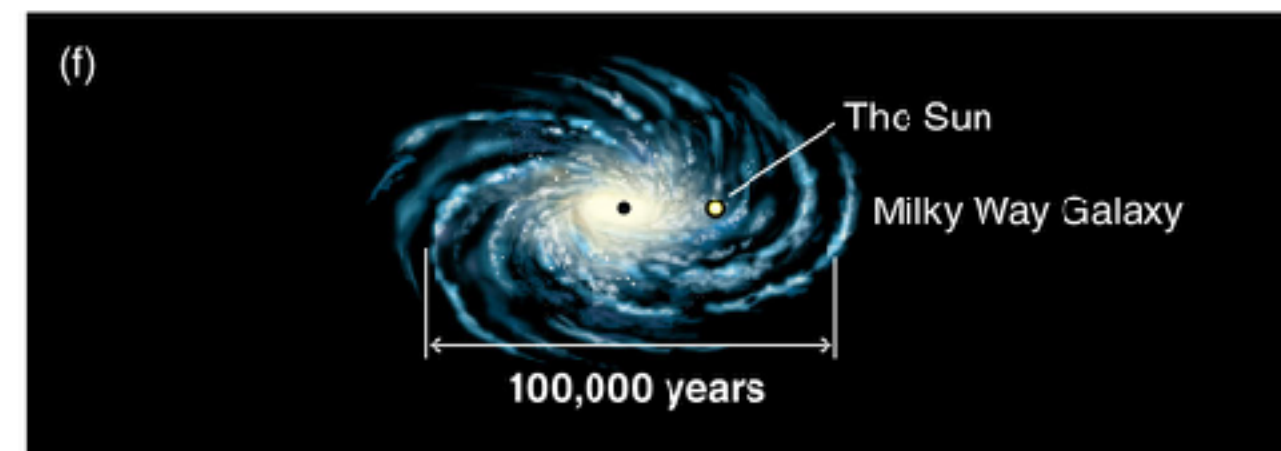
The Sun's distance is like a quick meal.



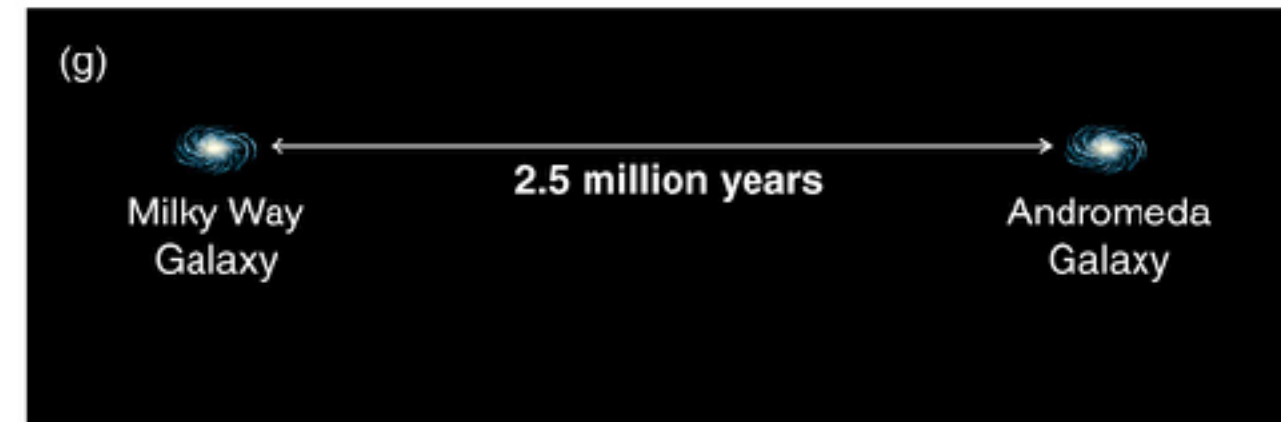
The diameter of Neptune orbit is a night's sleep.



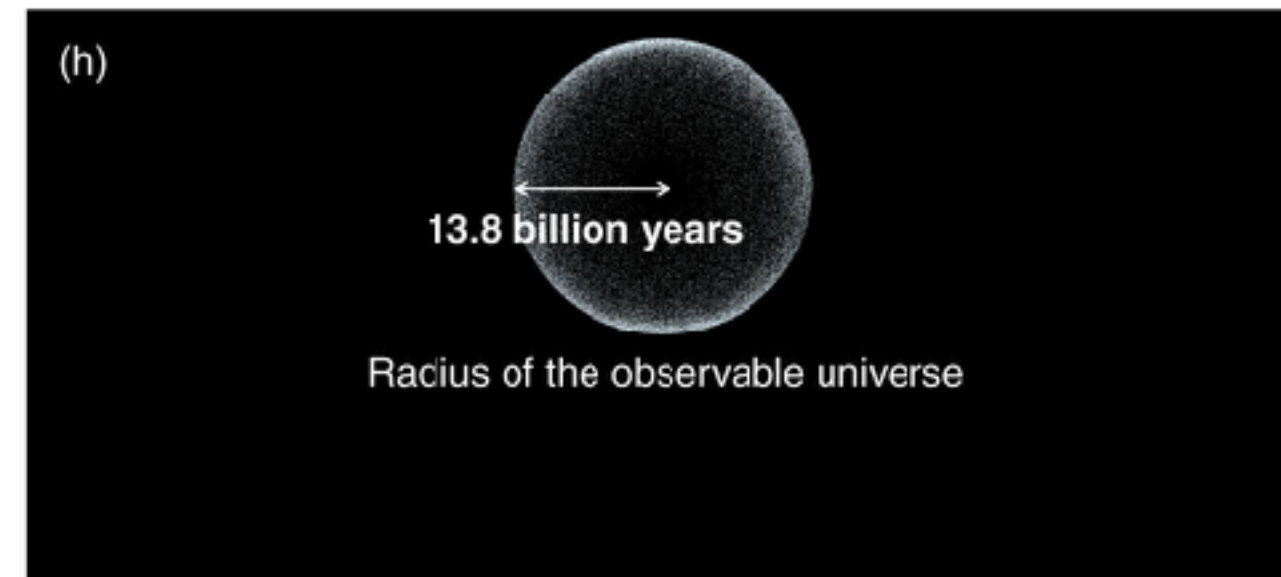
Leaving the Solar System, the distance to the nearest star is like the time you spend in high school.



The diameter of the galaxy is like the age of our species.



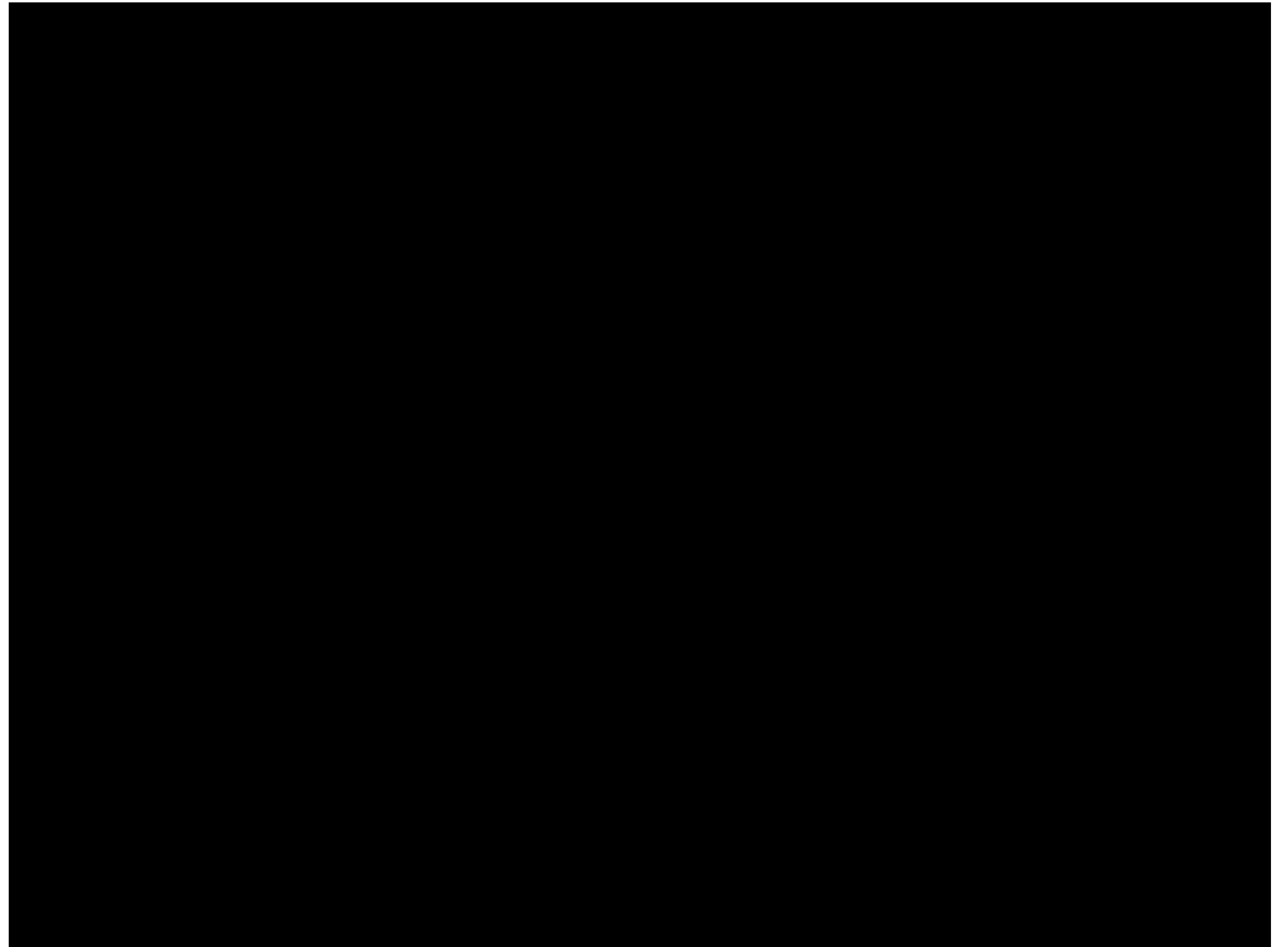
The distance between galaxies is like the time since our earliest human ancestors walked on Earth.



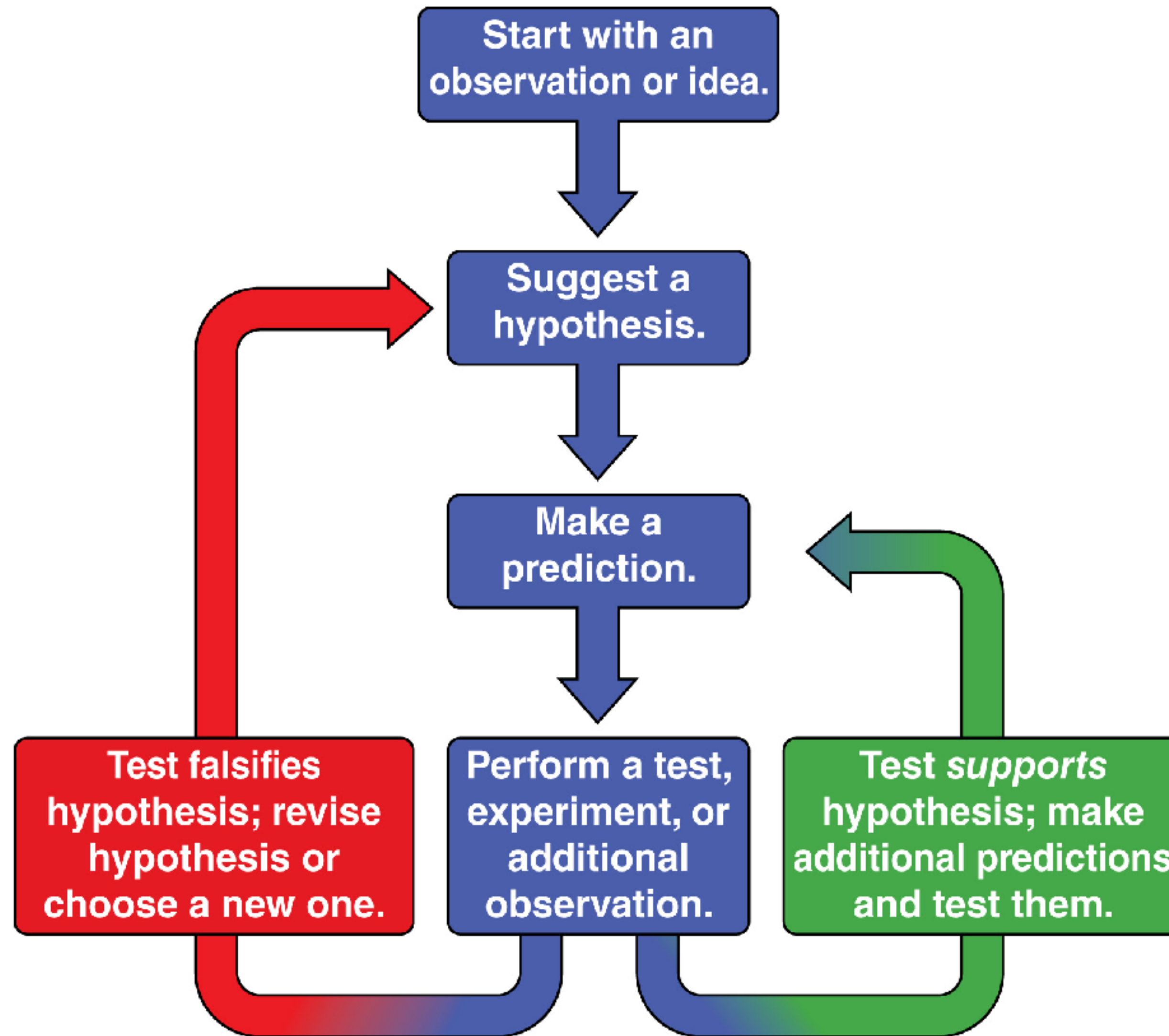
The size of the observable universe is like three times the age of Earth.

Powers of Ten:

[https://www.youtube.com/
watch?v=0fKBhvDjuy0](https://www.youtube.com/watch?v=0fKBhvDjuy0)



Scientific Method



Scientific Notation

$$10^6 = 1,000,000 = \text{one million}$$

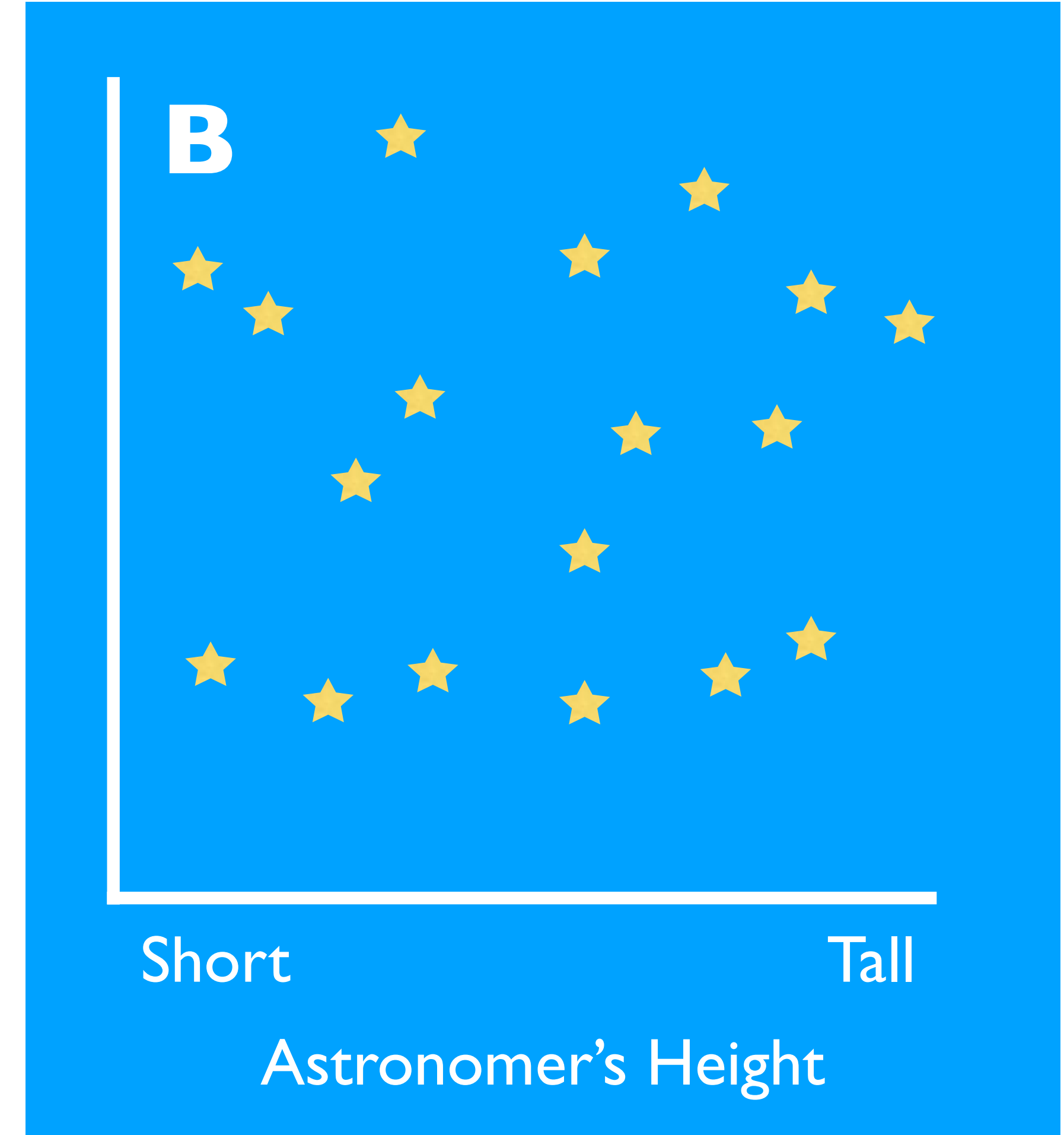
$$5 \times 10^9 = 5,000,000,000 = \text{five billion}$$

$$2 \times 10^2 \times 3 \times 10^3 = 6 \times 10^5 = 600,000 = \text{six hundred thousand}$$

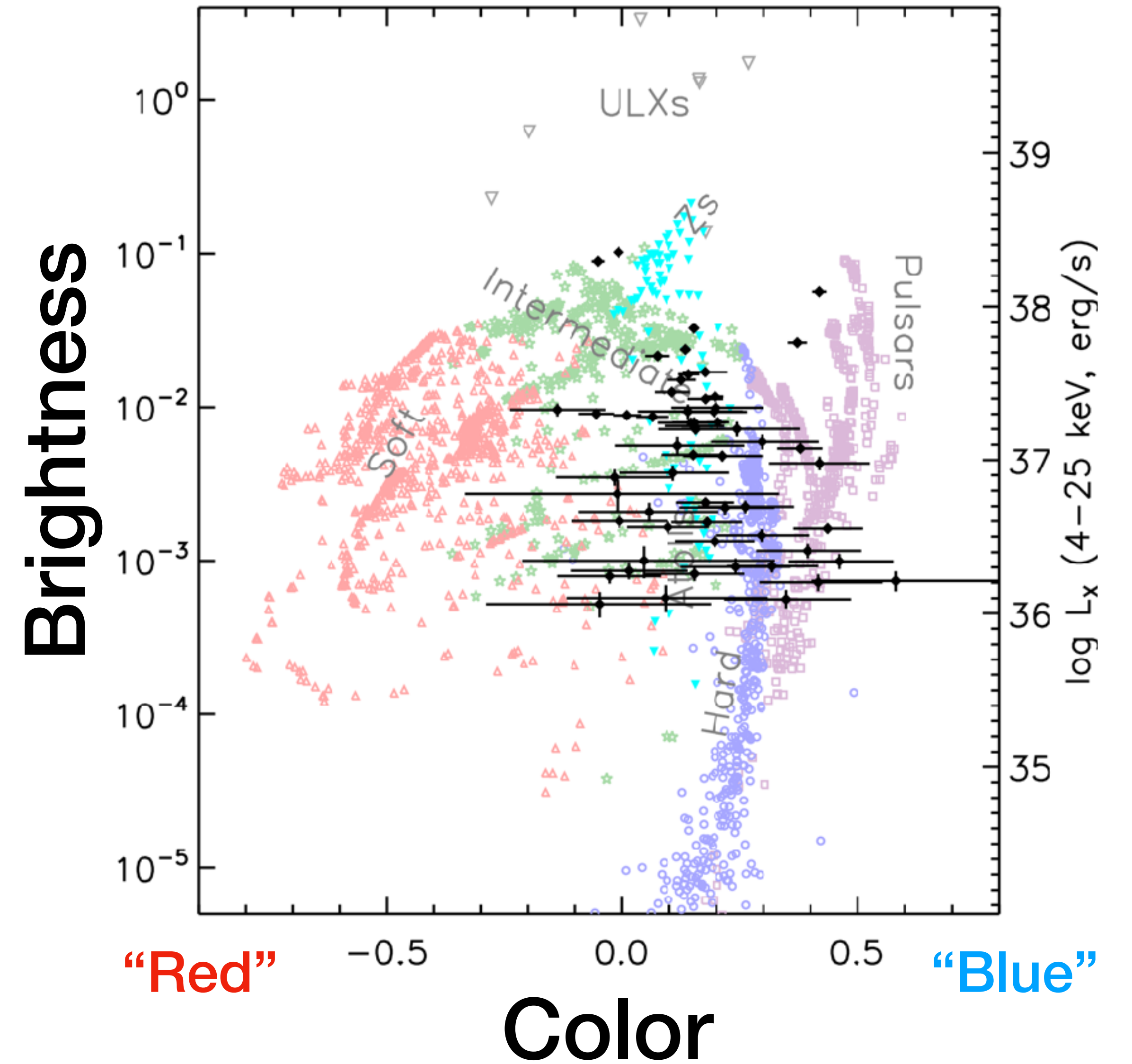
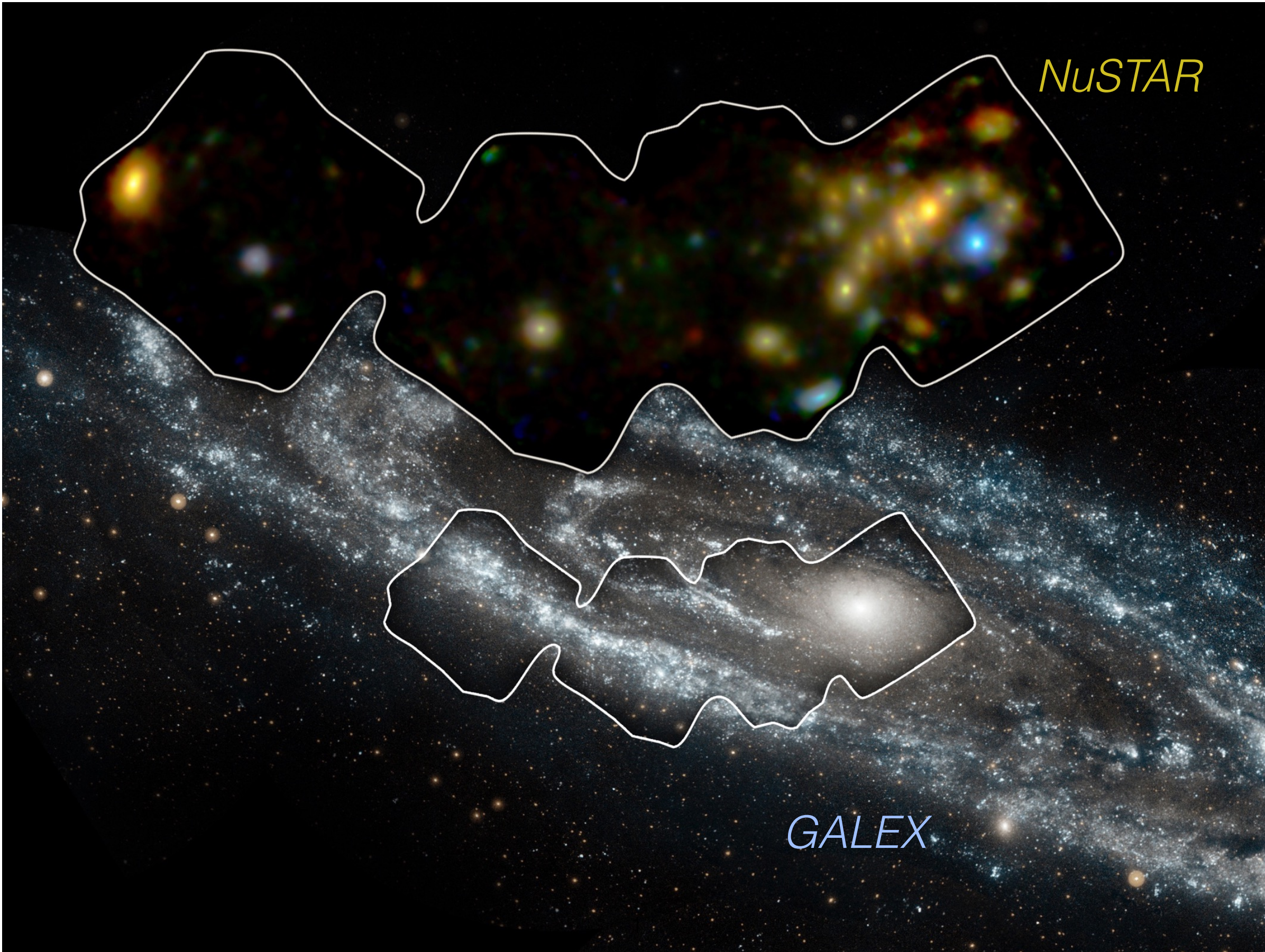
Calculator / Computer shorthand: $2e-7 = 2 \times 10^{-7} = 0.0000002$
(on exams and assignments, use the correct notation, not this shorthand)

Reading a Graph

Which y-axis is IQ and which is weight?



Real Life Example



To conclude (or really, begin):

Because light travels at a finite speed,
looking far away is looking into the past

There are ~100 billion stars in our Galaxy,
the Milky Way

There are ~100 billion galaxies in the visible
universe

Most stars host planets (although mostly
uninhabitable by our standards)

We are made of stardust

