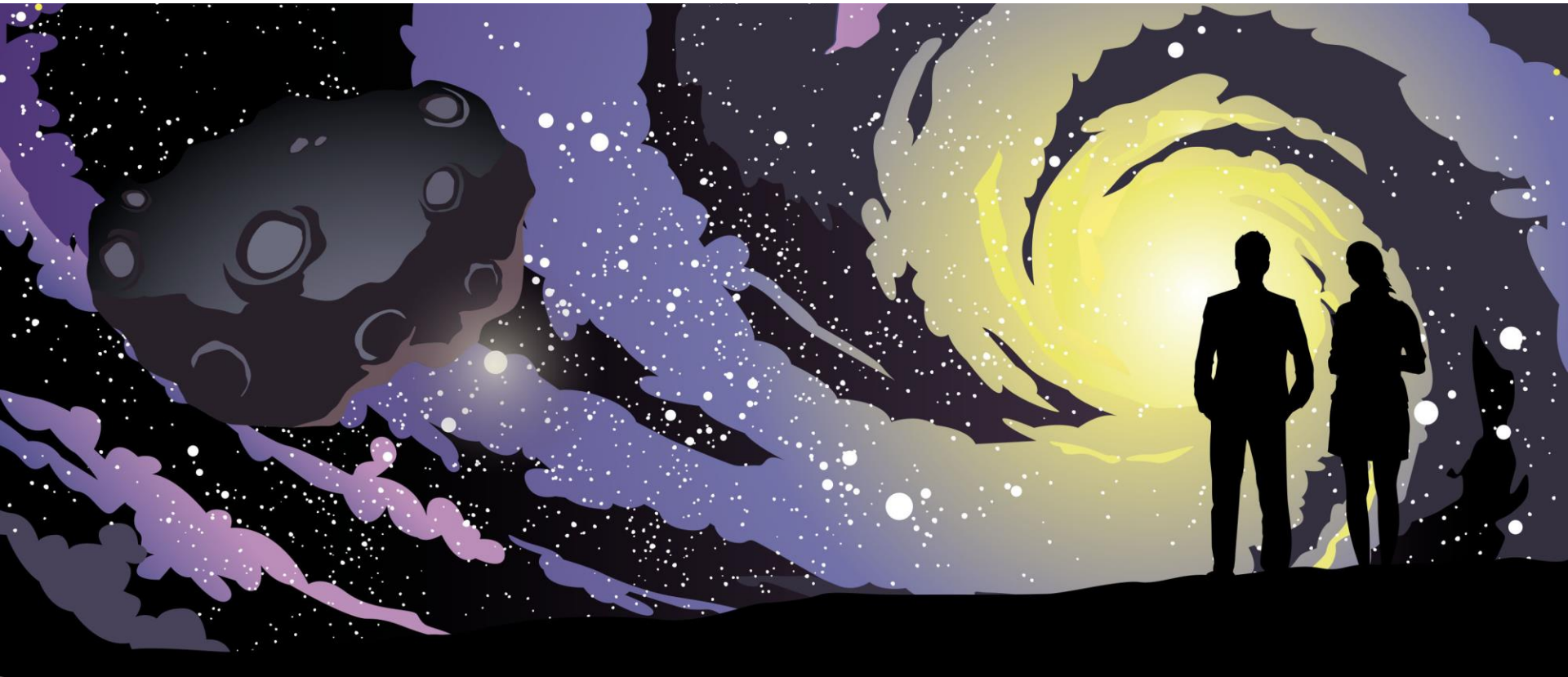


# Online Resources for Astronomy Education and Outreach

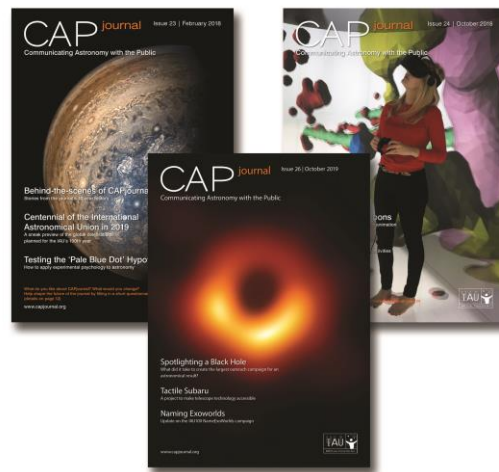


Chris Impey  
University Distinguished Professor  
Department of Astronomy, The University of Arizona

# Overview

# IAU Initiatives


**Division C Education, Heritage, and Outreach**  
(~2400 active members, 1 in 5 of IAU members)




# Fundamentals

# Flipped vs Traditional


## Traditional Classroom




+ 

- Instructor prepares material to be delivered in class.
- Students listen to lectures and other guided instruction in class and take notes.
- Homework is assigned to demonstrate understanding.

## Flipped Classroom



- Instructor records and shares lectures outside of class.
- Students watch / listen to lectures before coming to class.
- Class time is devoted to applied learning activities and more higher-order thinking tasks.
- Students receive support from instructor and peers as needed



# Synchronous vs Asynchronous

## Synchronous



**Students learn at the same time.**

Communication happens in real time.

Possibly more engaging and effective.

Allows for instant feedback and clarification.



### Examples

Video conferencing, live chat, live streamed videos.

## Asynchronous



**Students learn at different times.**

Communication is not live.

Possibly more convenient and flexible.

Allows students to work at their own pace.



### Examples

Email, screencasts, Flipgrid videos, blog posts/comments.



# Active Learning

## ACTIVE LEARNING

Any method of instruction that allows students to actively participate in the learning process through a variety of individual and group activities.

### THE PROCESS

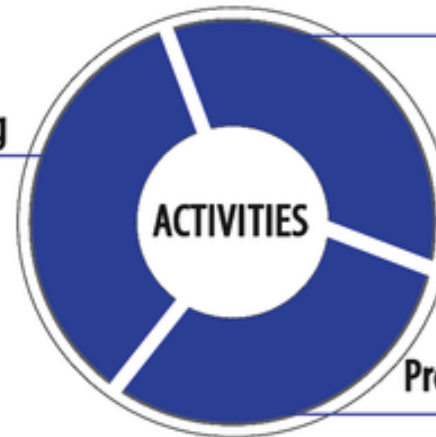
Students are given a variety of ways to interact with each other and complete the activities.

### THE ACTIVITIES

- Discussions
- Presentations
- Games
- Worksheets
- Short Readings
- Short Writings
- Case Studies/Senarios
- Surveys

#### Collaborative Learning

Students work together in small groups to complete the activity.



#### Cooperative Learning

Students work on individual sections of the activity, and then compile their results to complete the final activity.

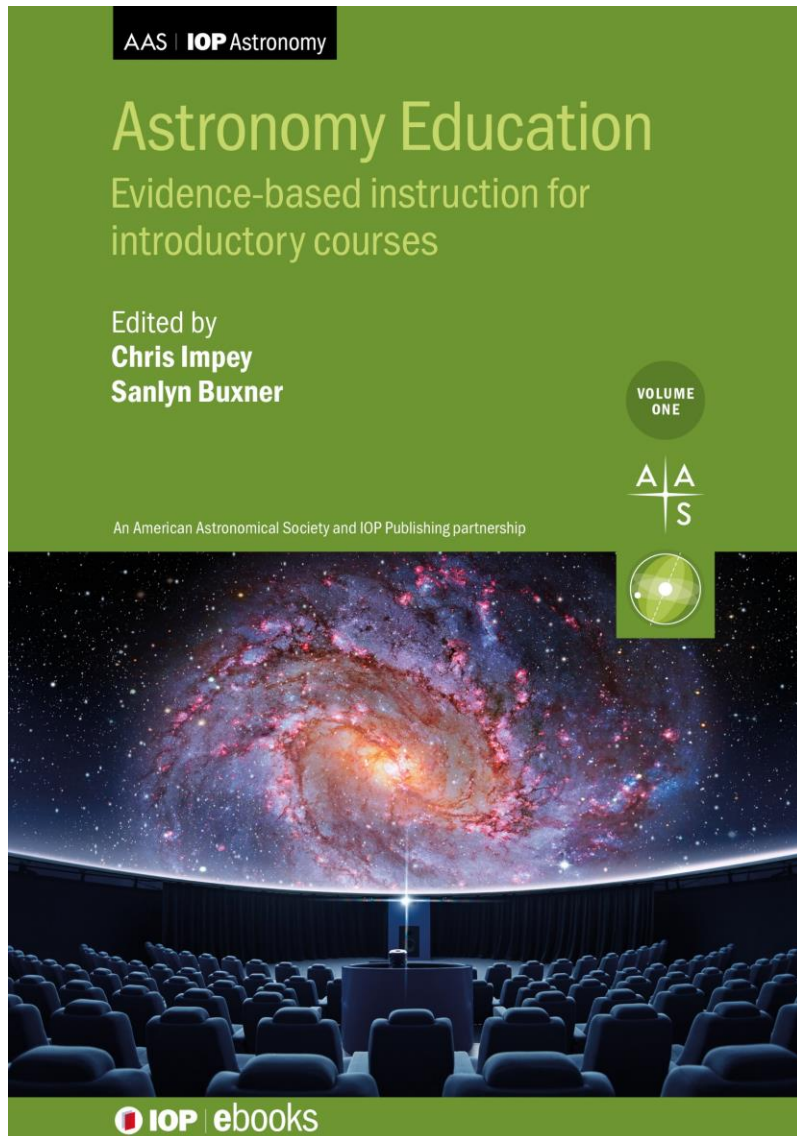
#### Problem-based Learning

Students work in small groups using the activities to solve a problem.

# Collections

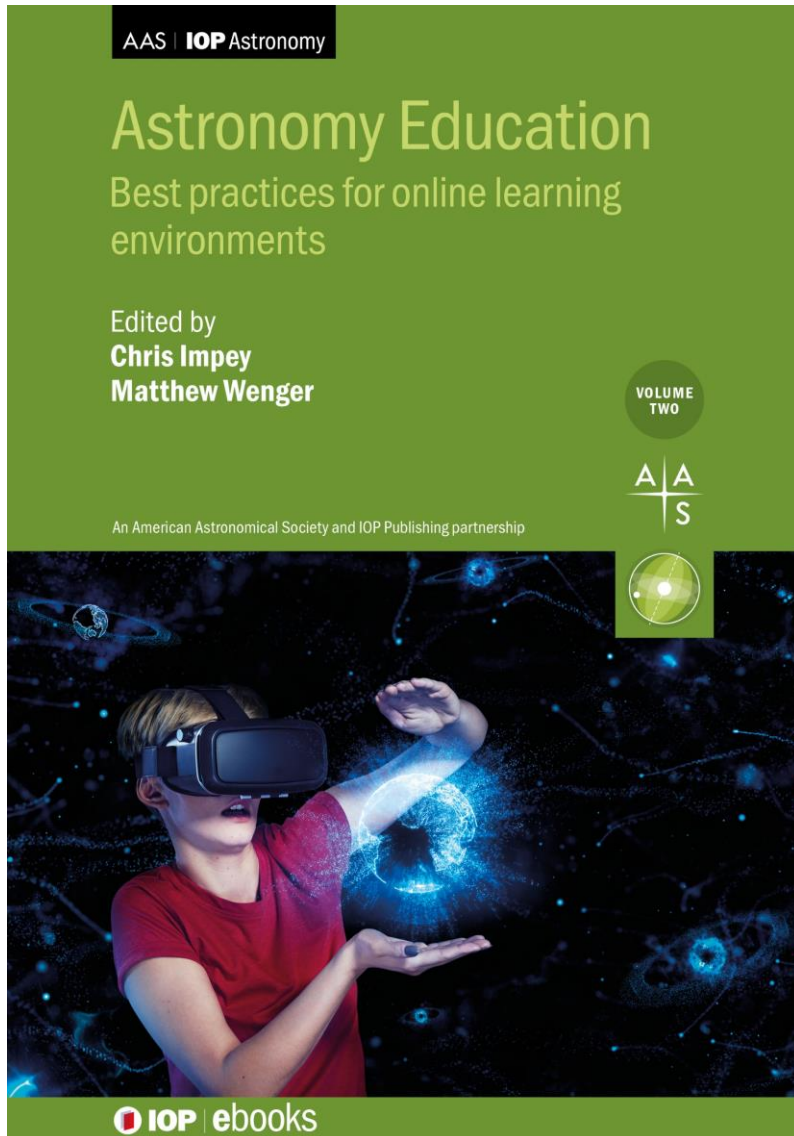


# Volume 1: Table of Contents



- 1 Learner-centered Teaching in Astronomy
- 2 Effective Course Design
- 3 Lecture-tutorials in Introductory Astronomy
- 4 Technology and Engagement in the University Classroom
- 5 Using Simulations Interactively in the Introductory Astronomy Classroom
- 6 Practical Considerations for Using a Planetarium for Astronomy Instruction
- 7 Authentic Research Experiences in Astronomy to Teach the Process of Science
- 8 Citizen Science in Astronomy Education
- 9 WorldWide Telescope in Education
- 10 Measuring Students' Understanding in Astronomy with Research-based Assessment Tools
- 11 Everyone's Universe: Teaching Astronomy in Community Colleges
- 12 Making Your Astronomy Class More Inclusive

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- Prologue: We All Are Online Astronomy Instructors
- 1 Guidelines for Teaching Astronomy Online
- 2 Who Are We Teaching Online, and Why?
- 3 Effective Course Design
- 4 Astronomy Education in Virtual Worlds and Virtual Reality
- 5 Massive Open Online Astronomy Courses
- 6 Using New Media and Social Media for Online Learning
- 7 Education Through Exploration: A Model for Using Adaptive Learning to Teach Laboratory Science Online
- 8 Key Online Resources for Teaching Astronomy
- 9 Epilogue: Lessons Learned from Transitioning to Online Learning During Spring 2020 During COVID

**Textbooks**

# OpenStax Astronomy

< Astronomy

## Introduction

☰ Table of contents



Preface

▼ 1 Science and the Universe: A Brief Tour

**Introduction**

- 1.1 The Nature of Astronomy
  - 1.2 The Nature of Science
  - 1.3 The Laws of Nature
  - 1.4 Numbers in Astronomy
  - 1.5 Consequences of Light Travel Time
  - 1.6 A Tour of the Universe
  - 1.7 The Universe on the Large Scale
  - 1.8 The Universe of the Very Small
  - 1.9 A Conclusion and a Beginning
- For Further Exploration

- ▶ 2 Observing the Sky: The Birth of Astronomy
- ▶ 3 Orbits and Gravity
- ▶ 4 Earth, Moon, and Sky
- ▶ 5 Radiation and Spectra
- ▶ 6 Astronomical Instruments
- ▶ 7 Other Worlds: An Introduction to the Solar System
- ▶ 8 Earth as a Planet
- ▶ 9 Cratered Worlds
- ▶ 10 Earthlike Planets: Venus and Mars

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### Chapter Outline

- [1.1 The Nature of Astronomy](#)
- [1.2 The Nature of Science](#)
- [1.3 The Laws of Nature](#)
- [1.4 Numbers in Astronomy](#)
- [1.5 Consequences of Light Travel Time](#)
- [1.6 A Tour of the Universe](#)
- [1.7 The Universe on the Large Scale](#)
- [1.8 The Universe of the Very Small](#)
- [1.9 A Conclusion and a Beginning](#)




**Figure 1.1 Distant Galaxies.** These two interacting islands of stars (galaxies) are so far away that their light takes hundreds of millions of years to reach us on Earth (photographed with the Hubble Space Telescope). (credit: modification of work by NASA, ESA, the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration, and K. Noll (STScI))





# Teach Astronomy

**TEACH ASTRONOMY** Educator Forums

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**Chapter 11: Our Sun: The Nearest Star** « Previous Page Next Page »  

Early Astronomy

Chapter 3  
The Copernican Revolution

Chapter 4  
Matter and Energy in the Universe

Chapter 5  
The Earth-Moon System

Chapter 6  
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Chapter 7  
The Giant Planets and Their Moons

Chapter 8  
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Chapter 9  
How Planetary Systems Form

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Chapter 11  
Our Sun: The Nearest Star

Chapter 12  
Properties of Stars

Chapter 13  
Star Birth and Death

Chapter 14  
The Milky Way

Chapter 15  
Galaxies

Chapter 16  
The Expanding Universe

Chapter 17  
Cosmology

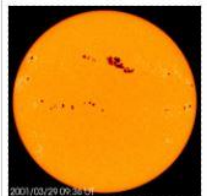
Chapter 18  
Life On Earth

Chapter 19  
Life in the Universe

---

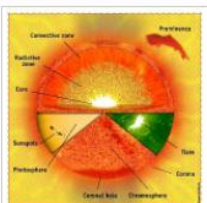
## Properties of the Sun

No space vehicle has ever probed the Sun's atmosphere, as we have begun to do for the planets. To study the Sun or stars astronomers must for the present rely on indirect evidence: interpreting their light gathered by telescopes. Imagine you had to deduce as much as you could about a person from the contents of their house or apartment. Their clothes, their books and music, and the food in their kitchen would give you valuable clues. You could learn a lot without ever meeting the person. Deduction from indirect evidence is one of the standard methods of astronomy. Most of that indirect evidence is electromagnetic radiation from various regions of the Sun. We interpret that evidence in terms of the laws of physics as they apply to extremely hot gas. Although our evidence is indirect, powerful techniques of analysis help us create models that fill in gaps in our observations.



2003/03/29 09:35:51  
The Sun featuring several large sunspots.

In ancient times, astronomers in China and India noticed and recorded dark spots on the Sun, called sunspots. In the 1600s, when the first telescopes were pointed at the Sun, astronomers were able to closely track the sunspots. Galileo saw these blemishes as evidence that the Sun was not a smooth and perfect sphere. He used this evidence to argue against the ideas of Aristotle, who had thought that the celestial objects were perfect and unchanging. Although it seems like a simple insight, Galileo's observation marked a decisive break with the ancient Greek conception of the universe. Unfortunately, direct observation of the Sun is extremely dangerous. Galileo spent his last years almost totally blind from his years of observation of the Sun.



A schematic of the different layers of

# Google Translation

## Capítulo 1: Cómo funciona la ciencia

" Pagina anterior "

Siguiente página "



Capítulo 1  
Cómo funciona la ciencia

El método científico

Evidencia

Mediciones

Unidades y el sistema métrico

Errores de medición

Estimación

Dimensiones

Masa, duración y tiempo

Observaciones e incertidumbre

Precisión y cifras significativas

Errores y estadísticas

Notación científica

Formas de representar datos

Lógica

Matemáticas

Geometría

Álgebra

Logaritmos

Probando una hipótesis

## El método científico

Desde la época de los antiguos griegos, las personas que estudian el mundo natural han desarrollado un sistema para establecer el conocimiento, llamado **método científico**. El método científico requiere, como mínimo, lo siguiente: terminología definida con precisión, mediciones cuantitativas y repetibles y afirmaciones respaldadas por **evidencia**.



Hay varios pasos esenciales en el método científico. El primer paso es identificar un problema, generalmente en forma de observaciones o datos. La evidencia puede ser de muchos tipos, como mediciones de luz o imágenes ampliadas de objetos distantes, o pueden ser lecturas de instrumentos, como medidas de luz o imágenes ampliadas de objetos distantes, realizadas sin pruebas que las respalden se denominan especulaciones; pueden ser verdad o no. Sin evidencia de apoyo, no hay forma de probarlos o refutarlos. En algunos **campos** científicos como la química, la física y la **biología**, la evidencia a menudo proviene de experimentos en un laboratorio. En **astronomía**, donde muchos objetos son muy remotos, la mayor parte de la evidencia se presenta en forma de luz y otros tipos de radiación electromagnética.

Un instrumento para recolectar radiación electromagnética y producir imágenes ampliadas de objetos distantes.



**Interactives**

# WorldWide Telescope

The screenshot shows the WorldWide Telescope interface with several callouts:

- Seamlessly explore imagery from the best ground and space-based telescopes in the world**: Points to the 'More Surveys' button.
- Expert led Tours of the Universe**: Points to the 'Digitized Sky Survey' button.
- Much more than "just" the sky at night! 3D features can take you to other planets, stars, & galaxies**: Points to the 'Look At' dropdown menu.
- Finder Scope links to Wikipedia, publications, and data, so you can learn more**: Points to the 'Finder Scope' window.
- View and compare imagery from across the electromagnetic spectrum**: Points to the 'View' button.
- Control time to study how the night sky changes**: Points to the 'Image Cross' slider.
- Context bar shows items of interest in current field of view**: Points to the 'Context Search For' bar.
- Context globe shows where you're looking**: Points to the 'Context Search For' globe.

The interface includes a top navigation bar with 'Explore', 'Guided Tours', 'Search', 'Community', 'Telescope', 'View', and 'Settings'. Below this is a 'Collections' section with 'All-Sky Surveys' and a row of survey thumbnails: 'More Surveys', 'Digitized Sky Survey', 'VLSS: VLA Low-fr...', 'WMAP ILC 5-Yea...', 'SFD Dust Map (In...', 'IRIS: Improved P...', '2MASS: Two Micr...', 'Hydrogen Alpha...', and 'SDSS: Sloan Digit...'. The main view shows a large image of M81 (Bode's Galaxy) with a 'Finder Scope' window overlaid. The 'Finder Scope' window displays the following information:

Finder Scope

Classification: Galaxy in Ursa Major

Names: M81; NGC 3031; Bode's Galaxy

RA: 09h55m33s	Magnitude: n/a
Dec: 69:03:58	Distance: n/a
Alt: 41:30:08	Rise: Circumpolar
Az: 331:42:35	Transit: Circumpolar
	Set: Circumpolar

Image Credits:  
Spitzer data: NASA/JPL/Caltech/S. Willner  
(Harvard-Smithsonian CfA); Hubble data: NASA, ...  
<http://gallery.spitzer.caltech.edu/Imagegall...>

The bottom of the interface features a 'Look At' dropdown set to 'Sky', an 'Imagery' section with 'Digitized Sky Survey (Optical...)', and a 'Context Search For' bar. Below these are several image thumbnails: 'Astronomy for Everyone', 'Interesting Objects', 'M82 Cigar Galaxy', 'Seventop galaxies', 'Dust & Us', 'M81', and 'M82'. On the right, there is a 'Context Search For' globe and a 'Context Search For' map of Ursa Major with coordinates RA: 09h55m55s and Dec: +69:17:49.

# NAAP Labs

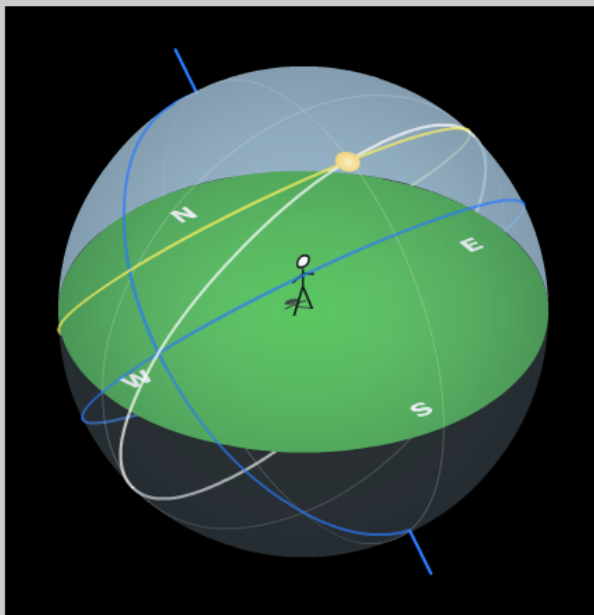
Astronomy Education at the University of Nebraska-Lincoln

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[Home](#) > [NAAP Labs](#) > [Motions of the Sun](#) > [Motions of the Sun Simulator](#)

Motions of the Sun Simulator

[reset](#) [help](#) [about](#)



## Information

The horizon diagram is shown for an observer at latitude  $40.8^\circ$  N on 27 May at 12:00 (12:00 PM).

*advanced*

sun's hour angle: 0h 2m

sidereal time: 4h 21m

equation of time: 2:49

show analemma

sun's altitude:  $70.6^\circ$

sun's azimuth:  $182.0^\circ$

sun's right ascension: 4h 19m

sun's declination:  $21.4^\circ$

## Time and Location Controls

the day of year:

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |

the time of day:



the observer's latitude:



## Animation Controls

animation mode:

continuous  loop day

step by day

animation speed: 3.0 hrs/sec



use lower quality graphics when animating to improve performance

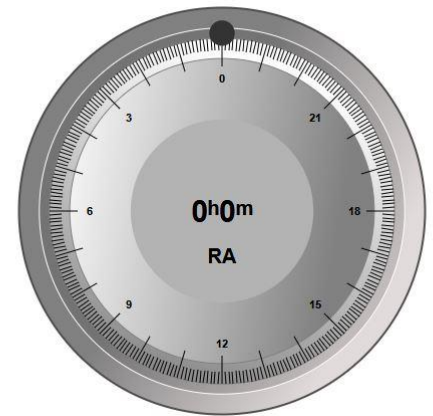
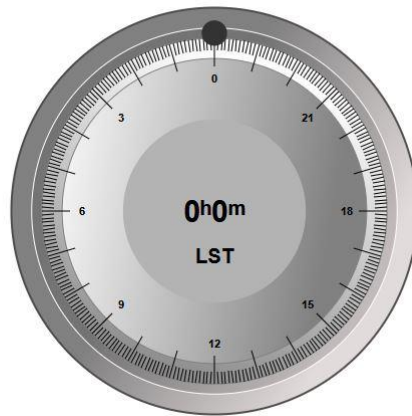
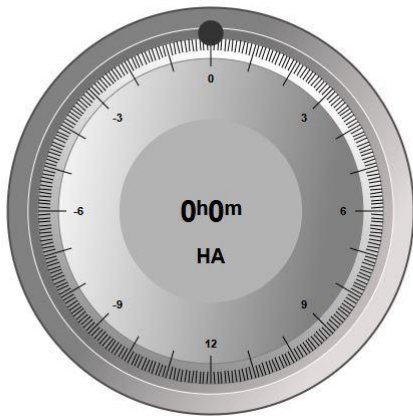
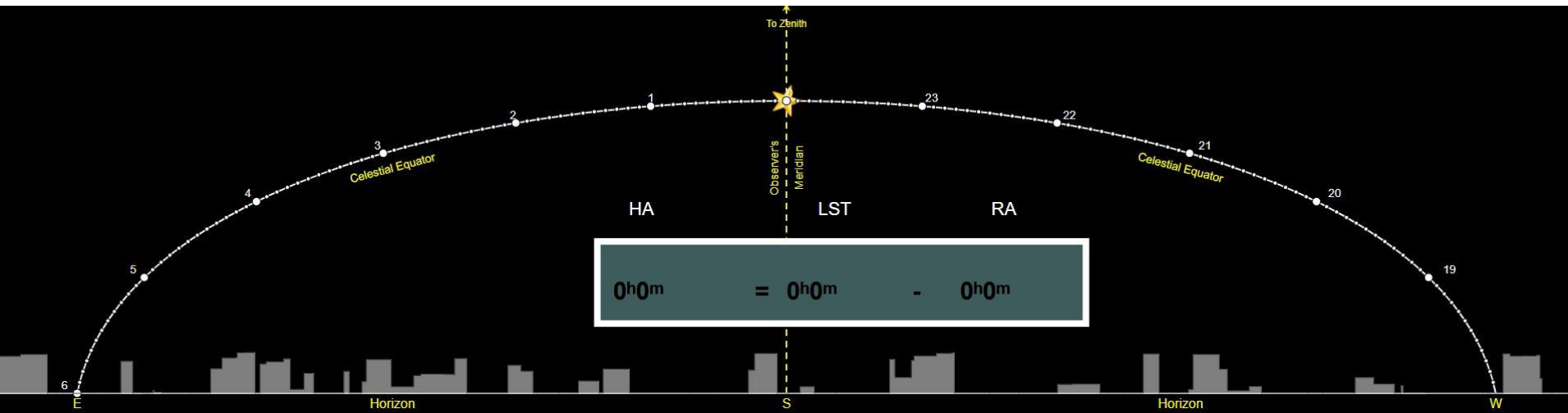
## General Settings

- show the sun's declination circle
- show the ecliptic
- show month labels
- show underside of celestial sphere
- show stickfigure and its shadow

dragging the sun's disk changes the ...

- time of day
- day of year

# ClassAction



# PHET Simulations



Browse Filter

SUBJECT

×

101 Results

A-Z



- Physics
  - Motion
  - Sound & Waves
  - Work, Energy & Power
  - Heat & Thermo
  - Quantum Phenomena
  - Light & Radiation
  - Electricity, Magnets & Circuits

- Chemistry
  - General Chemistry
  - Quantum Chemistry

- Math
  - Math Concepts
  - Math Applications

- Earth Science
- Biology

GRADE LEVEL

×

- Elementary School
- Middle School
- High School
- University

COMPATIBILITY

×

- HTML5
- Java via CheerpJ
- Java
- Flash



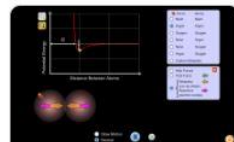
ACCESSIBILITY

+

Physics X University X



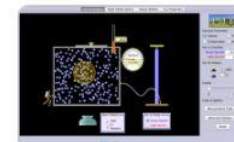
Alpha Decay



Atomic Interactions



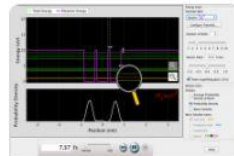
Balancing Act



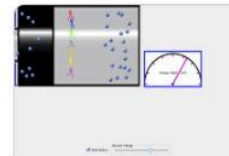
Balloons & Buoyancy



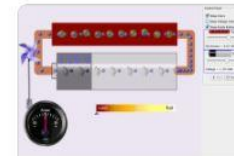
Balloons and Static Electricity



Band Structure



Battery Voltage



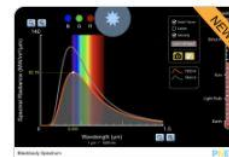
Battery-Resistor Circuit



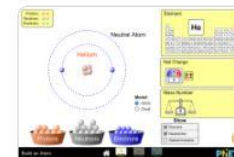
Bending Light



Beta Decay



Blackbody Spectrum



Build an Atom



# Polling



# Poll Everywhere

## Participating from any web enabled browser



Remember to update these visuals with the specific instructions for your own poll.

## Participating through SMS text messaging

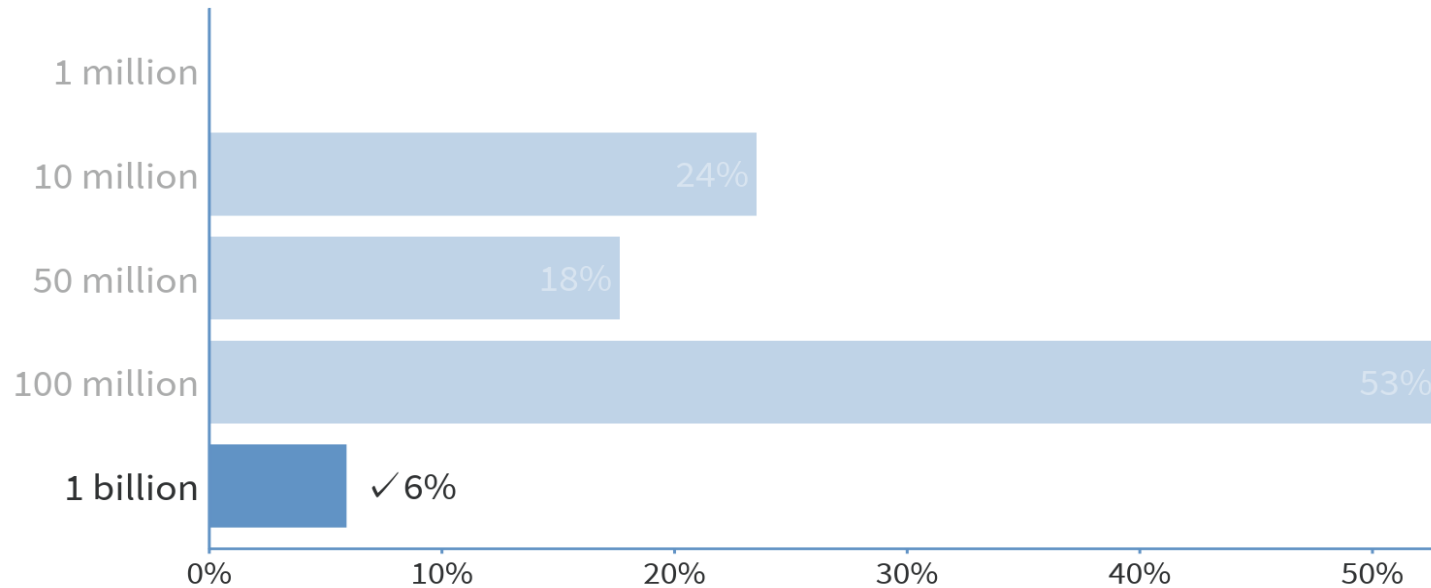


Remember to update these visuals with the specific instructions for your own poll.

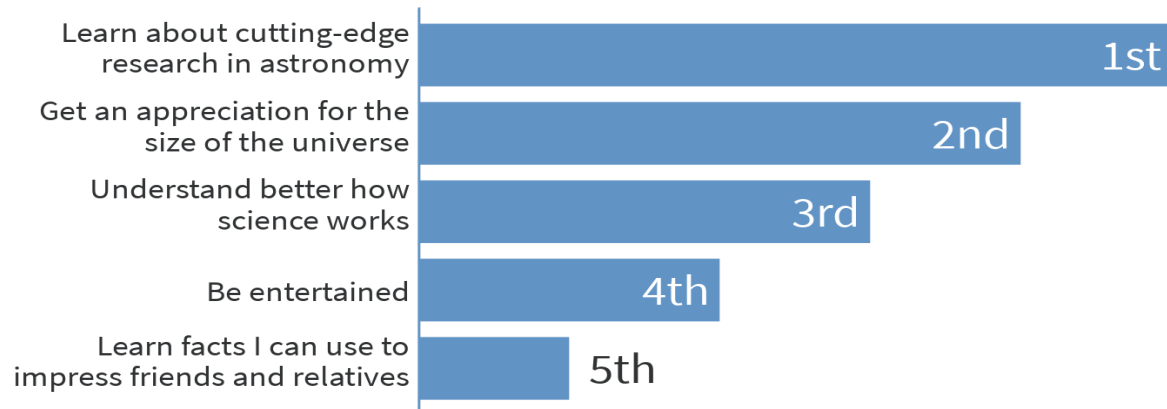
## How many bad or fake science web pages are there?

🗳️ When poll is active, respond at [PollEv.com/chrisimpey829](https://www.poll-ev.com/chrisimpey829) 📱 Text **CHRISIMPEY829** to **37607** once to join

🔒 Answers to this poll are anonymous



## Rank the following in order of what you want to get out of the class





Planetaria

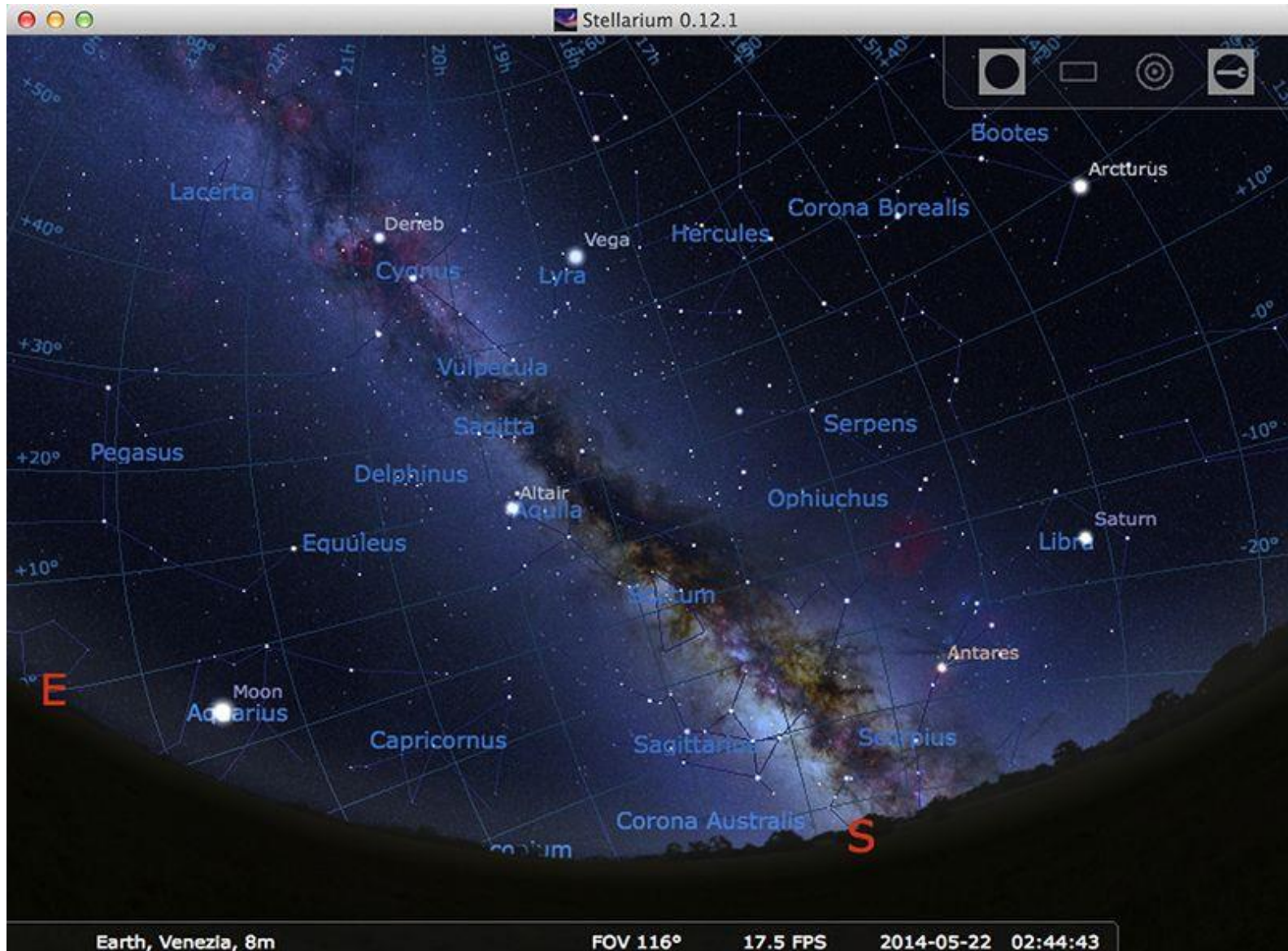


# Starry Night





# Stellarium

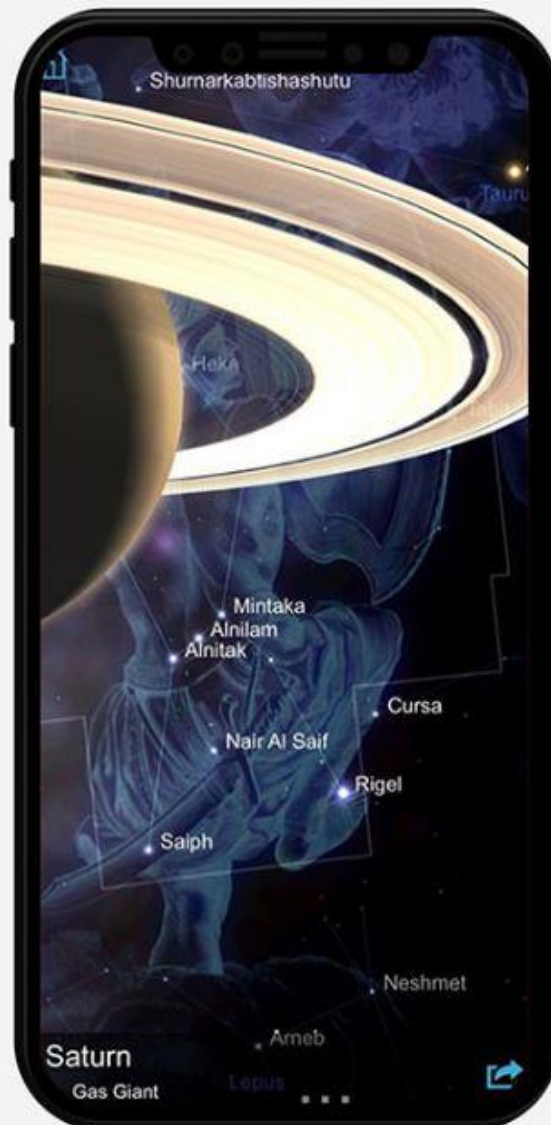




# Smartphone Apps



Night Sky



Star Chart



NASA

# Citizen Science

# Zooniverse

## People-powered research

Scientists in fields from astronomy to zoology can post their collections of hundreds of thousands of images and anyone – regardless of background, age, or location – can answer a series of short questions to help classify and process the data.

It's amazingly effective: with many people looking at each image, researchers can synthesize and study their data much faster than if they were working alone.

## How does Zooniverse work?

- Volunteers **classify** (assess data) independently
- Between 3 and 80 classifications per image/video file aka **subject**
- Responses are aggregated for **consensus**
- Volunteers interact with researchers on Talk boards
- Zooniverse.org/publications - **projects have led to 300+ publications**
- Galaxy Zoo has had **60,000 volunteers make 1,700,000 classifications**

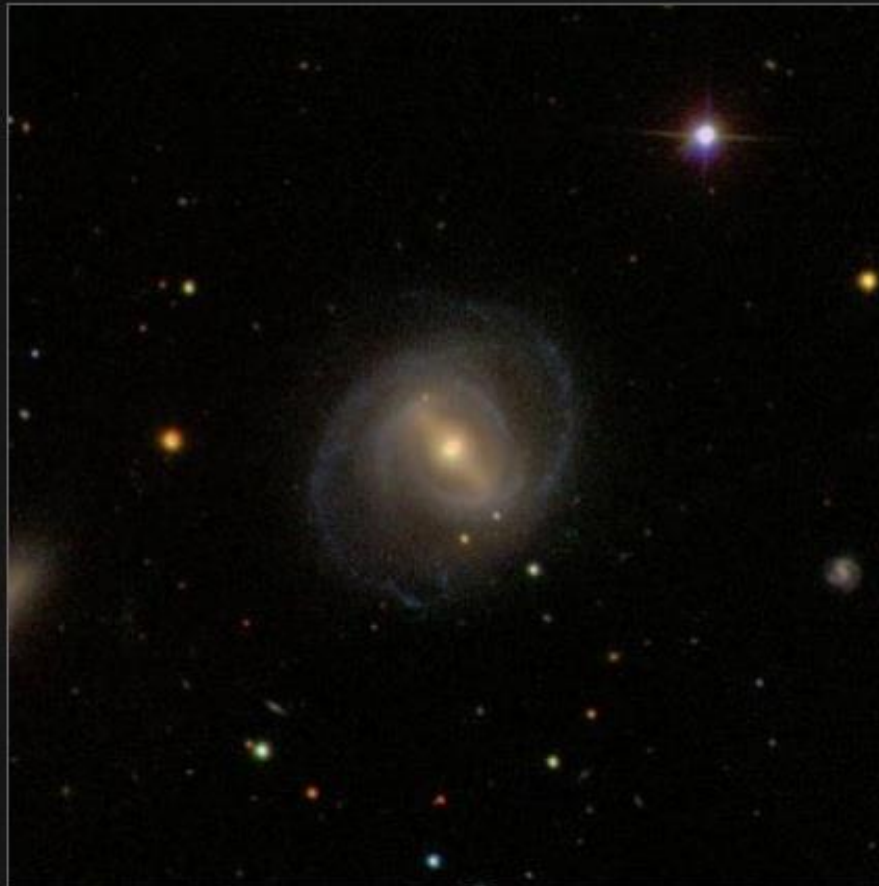
# GALAXY ZOO.org

Hi starstryder

[Home](#)[The Science](#)[How to Take Part](#)[Galaxy Analysis](#)[Forum](#)[Press](#)[Blog](#)[FAQ](#)[Links](#)[Contact Us](#)[Logout](#)[Profile](#)[Galaxy Tutorial](#)[Galaxy Analysis](#)[Galaxy Zoo - Thank You](#)[Show My Galaxies](#)

## Galaxy Analysis

Welcome to Galaxy Zoo's view of the Universe. If you're here you should already have seen the [Tutorial](#), but feel free to go and remind yourself. There's no need to agonise for too long over any one image, just make your best guess in each case.


 Show Grid Overlay on the next Image

Galaxy Ref:  
**587729387677679742**

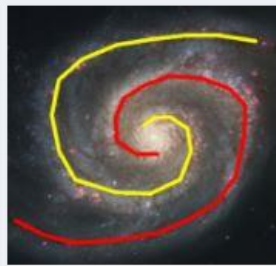
Choose the Galaxy Profile  
by clicking the buttons  
below







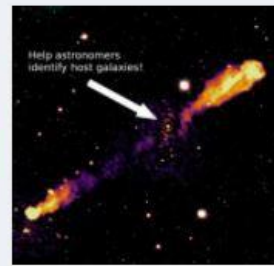
DISK DETECTIVE



SPIRAL GRAPH



AURORA ZOO



RADIO GALAXY ZOO: LOFAR



STAR NOTES



MAPPING HISTORIC SKIES



GALAXY ZOO: CLUMP SCOUT



GALAXY ZOO MOBILE



PLANET HUNTERS TESS



SUPERWASP VARIABLE STARS



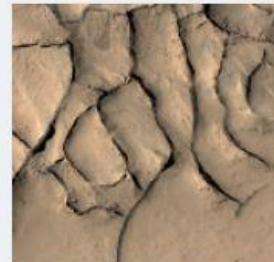
GALAXY ZOO



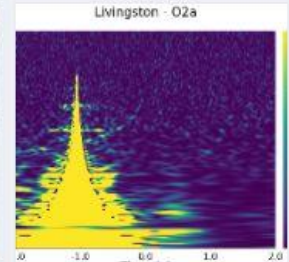
ASTRONOMY REWIND



BACKYARD WORLDS: PLANET 9



PLANET FOUR: RIDGES



GRAVITY SPY



RADIO METEOR ZOO

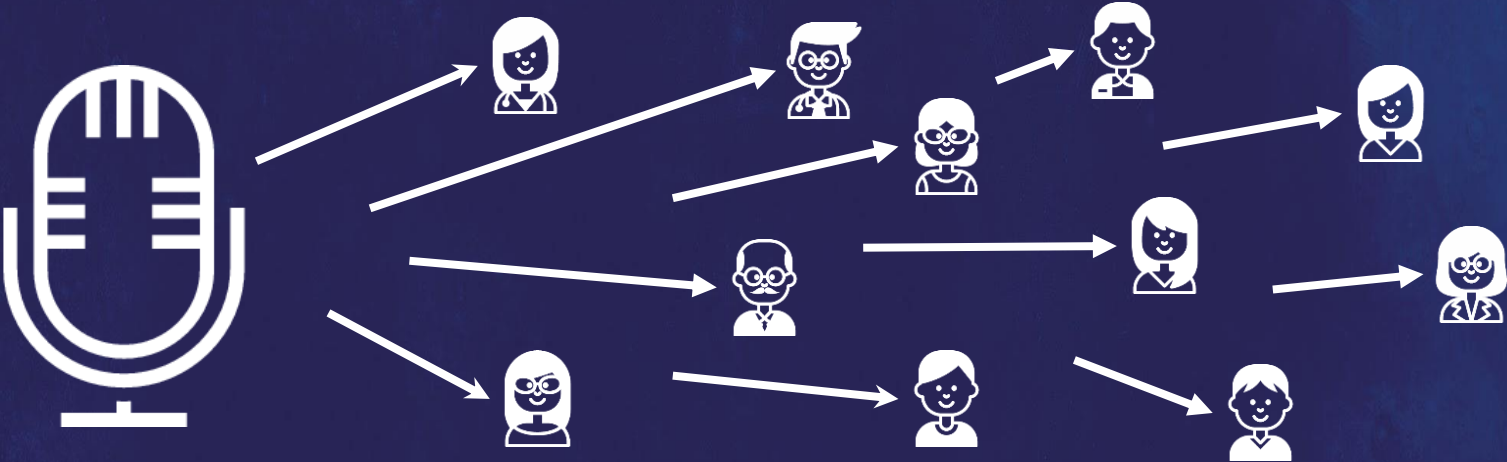


SUPERNOVA HUNTERS

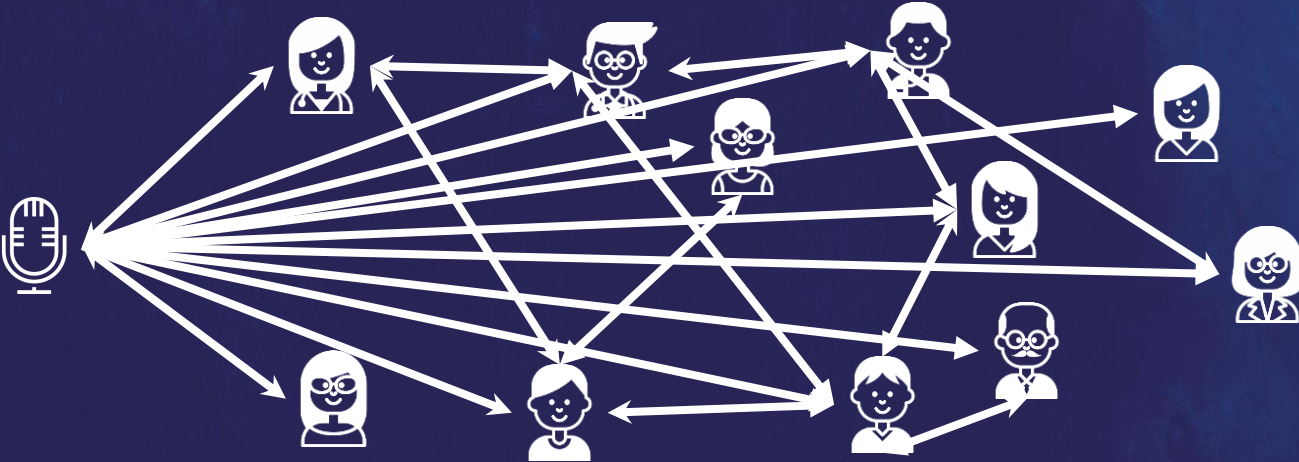
**Social Media**



# New Media



# Social Media

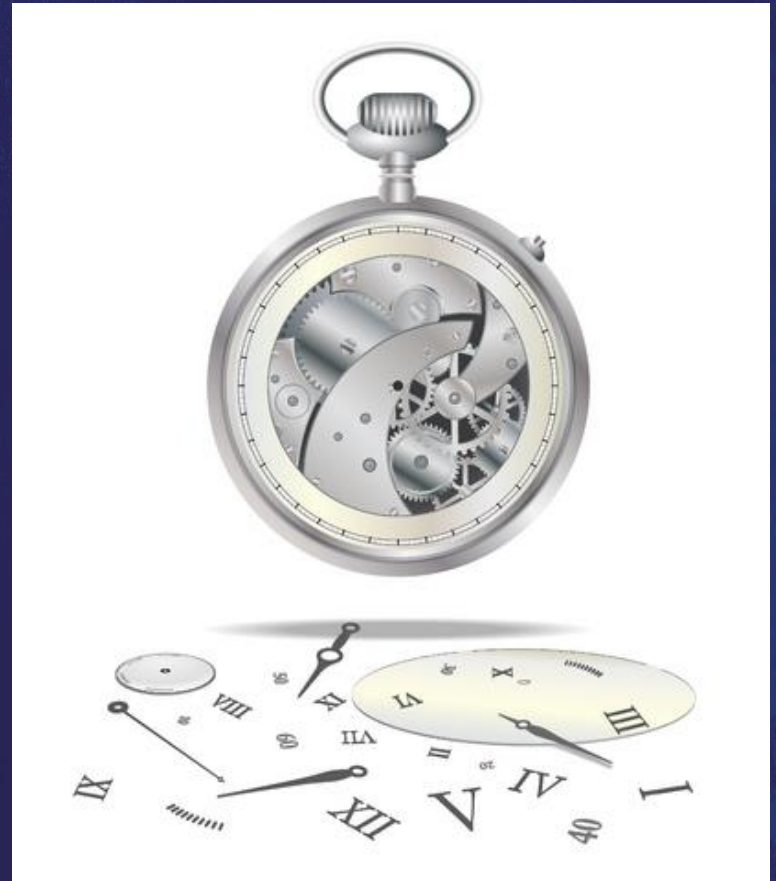


## Long term storytelling:

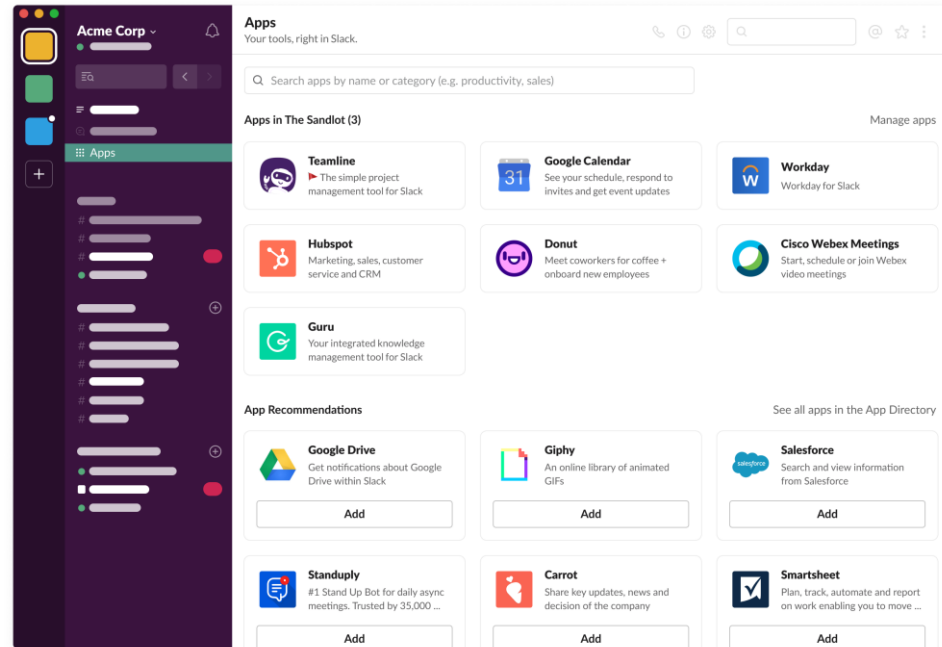
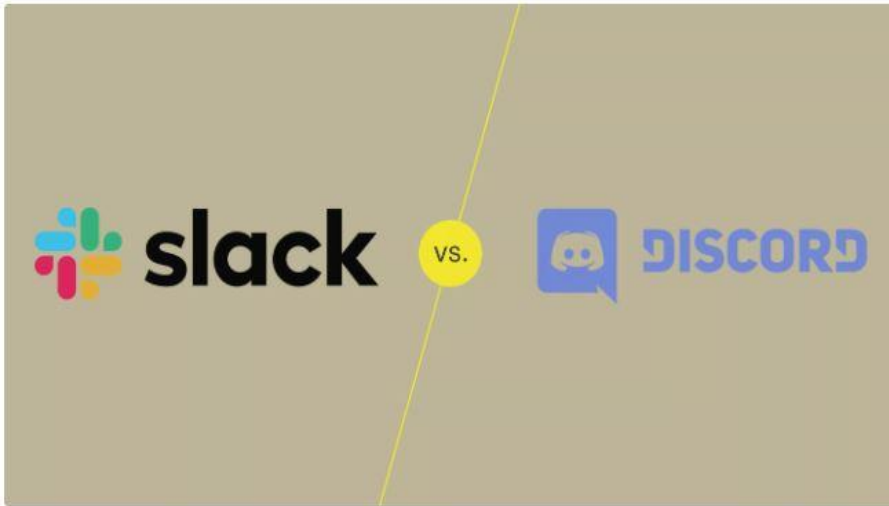
Essays, long-form articles,  
YouTube videos, lists  
(*archival media*)

## Punctuation:

Twitter, Twitch  
[anything] Live  
(*ephemeral media*)



# Chat and Messaging



## Overall Findings

### Slack

- ✔ Business and productivity focused.
- ✔ Basic service is free but extremely limited, most teams will have to pay a per-seat fee for each team member.
- ✔ Large file uploads.
- ✔ Great app integration.

### Discord

- ⊖ Gaming and community focused.
- ⊖ Service is entirely free with an optional add-on Nitro plan that provides some bonuses.
- ⊖ Features like video conferencing and screen sharing are free.
- ⊖ No app integration.



# Resources



# Images

Hosted by  
NASA & MTU



Astronomy Picture of the Day  
Index - Main Page

Since 1995:  
~10,000 images

[| Today's Picture](#) | [| Archive](#) | [| Search](#) | [| Calendar](#) |



## Cosmos

Stars : [Binary Stars](#) \* [Black Holes](#) \* [Globular Clusters](#) \* [Individual Stars](#) \* [Neutron Stars](#) \* [Nurseries](#) \* [Open Clusters](#) \* [Sun](#) \* [White Dwarfs](#)

Galaxies : [Clusters of Galaxies](#) \* [Colliding Galaxies](#) \* [Elliptical Galaxies](#) \* [Local Group](#) \* [Milky Way](#) \* [Spiral Galaxies](#)

Nebulae : [Dark Nebulae](#) \* [Emission Nebulae](#) \* [Planetary Nebulae](#) \* [Reflection Nebulae](#) \* [Supernova Remnants](#)



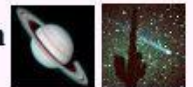
Miscellaneous : [Quasars/Active Galactic Nuclei](#) \* [Dark Matter](#)

[Sun](#) \* [Mercury](#) \* [Venus](#) \* [Earth](#) \* [Earth's Moon](#) \* [Mars](#) \* [Jupiter](#) \* [Jupiter's Moons](#) \* [Saturn](#) \* [Saturn's Moons](#) \* [Uranus](#) \* [Neptune](#) \* [Pluto](#)

Comets --- [Hyakutake](#) \* [Hale-Bopp](#) \* [Halley](#)

[Asteroids](#)

Solar System



## Space Technology

[Rockets/Launch Vehicles](#) \* [Orbiting Observatories](#) \* [Space Stations](#) \* [Earth Observatories](#)

[Scientists](#) \* [Astronauts](#)

## People



## Sky

[Messier Objects](#) \* [Sky Views](#)

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# Podcasts

365 DAYS OF  
ASTRONOMY



A project of CosmoQuest



## Nov 16th: Stellar Populations

by Astronomy Cast | Nov 16, 2020 | Astronomy Cast

Podcaster: Fraser Cain & Dr. Pamela Gay Title: Astronomy Cast Episode Ep. 75: Stellar Populations Organization: Astronomy Cast Link: <http://www.astronomycast.com> Description: After the big bang, all we had was hydrogen, a little bit of helium, and a few other...



## Nov 15th: Phantom Meteor Shower & Target Asteroids

by Al Grauer | Nov 15, 2020 | Travelers in the Night

Podcaster: Dr. Al Grauer Title: Travelers in the Night Eps. 83E & 84E: Phantom Meteor Shower & Target Asteroids Organization: Travelers in the Night Link : Travelers in the Night ; @Nmcanopus Description:

Today's 2 topics: Comet Blanpain...



## Nov 14th: Big Astronomy

by Rob Sparks | Nov 14, 2020 | NOIRLab

Podcaster: Rob Sparks. Guest: Peter Michaud, Camila Ibarlucea, Leonor Opazo, Manuel Paredes Title: Big Astronomy Organization: NOIRLab (NSF's National Optical-Infrared Astronomy Research Laboratory) Links:

[www.noao.edu](http://www.noao.edu) ; @NOAONorth; [http://www.lsst.org/...](http://www.lsst.org/)



## Nov 13th: Amy Ross, NASA Spacesuit Designer

by WSH team | Nov 13, 2020 | Weekly Space Hangout

Podcaster: Host : Dr. Pamela Gay ; Guest: Amy Ross, Dr. Brian Koberlein, Pam Hoffman, Molly Wakeling Title: Weekly Space Hangout – Amy Ross, NASA Spacesuit Designer Link: Cosmoquest: <http://cosmoquest.org>

## About Our Podcast

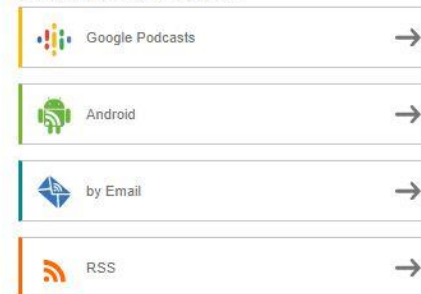
The 365 Days of Astronomy podcast launched in 2009 as part of the International Year of Astronomy. This community podcast continues to bring you day after day of content across the years. In 2013, we evolved to add video, and in 2015 we joined the International Year of Light.

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# Blogs



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(Cached)



Below is a list of blogs written by professional astronomers on astronomy content. Please feel free to edit this page to add or remove your blog. Or leave a comment. And maybe help with the organization into categories.

## Resources

- [GradHacker](#)
- [Jobs for Astronomers](#)
- [Professor Hacker](#)
- [Women in Astronomy](#)
- [Women in Planetary Science](#)

## News, views and personal blogs:

- [13.7: Cosmos and Culture](#) - including Adam Frank
- [A Curious Mind](#) - Mario Livio
- [Alice in Galaxyland](#)
- [Amy's Next Adventure](#)
- [Angry Astronomer](#) - Jon Voisey

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## Latest Changes

Videos



# Crash Course



## Astronomy

48 videos • 16,514,786 views • Last updated on Aug 21, 2020



In 46 episodes, Phil Plait (aka The Bad Astronomer) teaches you astronomy! This course starts with the astronomical observations we can make with the naked eye and expands out to cover the solar system, stars, galaxies, and the universe itself. The content is loosely based on an introductory university-level curriculum. By the end of this course, you will be able to:

- \* Define the components of the universe, from the planets in the Solar System to dark energy and gamma rays
- \* Understand how astronomers collect and analyze data to study the past and current state of the universe
- \* Explain the difference between asteroids, comets, and meteors
- \* Contextualize observed phenomena within scientific theories about the history and physics of space, such as the Big Bang theory



CrashCourse

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### Crash Course Astronomy Preview

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### Introduction to Astronomy: Crash Course Astronomy #1

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### Naked Eye Observations: Crash Course Astronomy #2

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### Cycles in the Sky: Crash Course Astronomy #3

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### Moon Phases: Crash Course Astronomy #4

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### Eclipses: Crash Course Astronomy #5

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### Telescopes: Crash Course Astronomy #6

CrashCourse



### The Gravity of the Situation: Crash Course Astronomy #7

CrashCourse



### Tides: Crash Course Astronomy #8

CrashCourse

**Phil Plait**



# Minute Physics



## MinutePhysics (chronological order)

181 videos • 9,730,240 views • Last updated on Sep 4, 2020








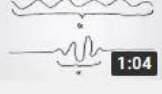



Watch every MinutePhysics video in the order they were created



minutephysics

SUBSCRIBE

Henry Reich

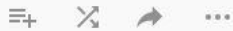
-  Gravity: ? ? ? ? ?  
minutephysics  
WATCHED 1:26
-  Minute Physics: What is Dark Matter?  
minutephysics  
1:09
-  What is the Wave/Particle Duality? Part 1  
minutephysics  
1:07
-  The Wave/Particle Duality - Part 2  
minutephysics  
1:04
-  How the Sun works: Fusion and Quantum Tunneling  
minutephysics  
WATCHED 1:07
-  What is the Uncertainty Principle?  
minutephysics  
1:04
-  The Sound of Hydrogen  
minutephysics  
1:17
-  What is Quantum Tunneling?  
minutephysics  
1:05
-  Adding Past Infinity (WARNING: Math Ahead)  
minutephysics  
0:48

# Kurzgesacht



## The Universe and Space stuff

28 videos • 4,207,014 views • Last updated on Oct 9, 2020












All our space related videos.



Kurzgesagt - In a Nutshell

SUBSCRIBE

Philipp Dettmer

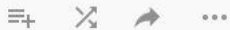
-  **LARGEST STAR** The Largest Star in the Universe – Size Comparison  
Kurzgesagt – In a Nutshell 11:59
-  **ASTEROID MINING** Unlimited Resources From Space – Asteroid Mining  
Kurzgesagt – In a Nutshell 7:56
-  **ALIEN SCALE** What Do Alien Civilizations Look Like? The Kardashev Scale  
Kurzgesagt – In a Nutshell 11:41
-  **SOLAR STORMS** Could Solar Storms Destroy Civilization? Solar Flares & Coronal Mass Ejections  
Kurzgesagt – In a Nutshell 9:43
-  **STELLAR ENGINE** How to Move the Sun: Stellar Engines  
Kurzgesagt – In a Nutshell 9:00
-  **SKYHOOK** 1,000km Cable to the Stars - The Skyhook  
Kurzgesagt – In a Nutshell 8:15
-  **NEUTRON STARS** Neutron Stars – The Most Extreme Things that are not Black Holes  
Kurzgesagt – In a Nutshell 8:41
-  **STRANGE STARS** The Most Dangerous Stuff in the Universe - Strange Stars Explained  
Kurzgesagt – In a Nutshell 8:28
-  **MARS BASE** Building a Marsbase is a Horrible Idea: Let's do it!  
Kurzgesagt – In a Nutshell 9:22

# TED-Ed



## Out of This World






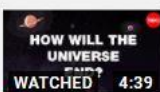



43 videos • 1,156,056 views • Last updated on Oct 19, 2020



TED-Ed

SUBSCRIBE

Various

-  **1** Could we actually live on Mars? - Mari Foroutan  
TED-Ed 4:30
-  **2** Where does gold come from? - David Lunney  
TED-Ed 4:35
-  **3** The journey to Pluto, the farthest world ever explored - Alan Stern  
TED-Ed 6:10
-  **4** Light seconds, light years, light centuries: How to measure extreme distances - Yuan-Sen Ting  
TED-Ed 5:30
-  **5** How fast are you moving right now? - Tucker Hiatt  
TED-Ed 6:10
-  **6** The death of the universe - Renée Hlozek  
TED-Ed 4:39
-  **7** Who won the space race? - Jeff Steers  
TED-Ed 4:47
-  **8** The beginning of the universe, for beginners - Tom Whyntie  
TED-Ed 3:42
-  **9** How small are we in the scale of the universe? - Alex Hofeldt  
TED-Ed 4:08

# Sci Show



▶ PLAY ALL

## Astronomy/Astrophysics/Space

64 videos • 555,541 views • Last updated on Feb 26, 2020












SciShow episodes covering topics in astronomy, astrophysics, and space in general.



SUBSCRIBE

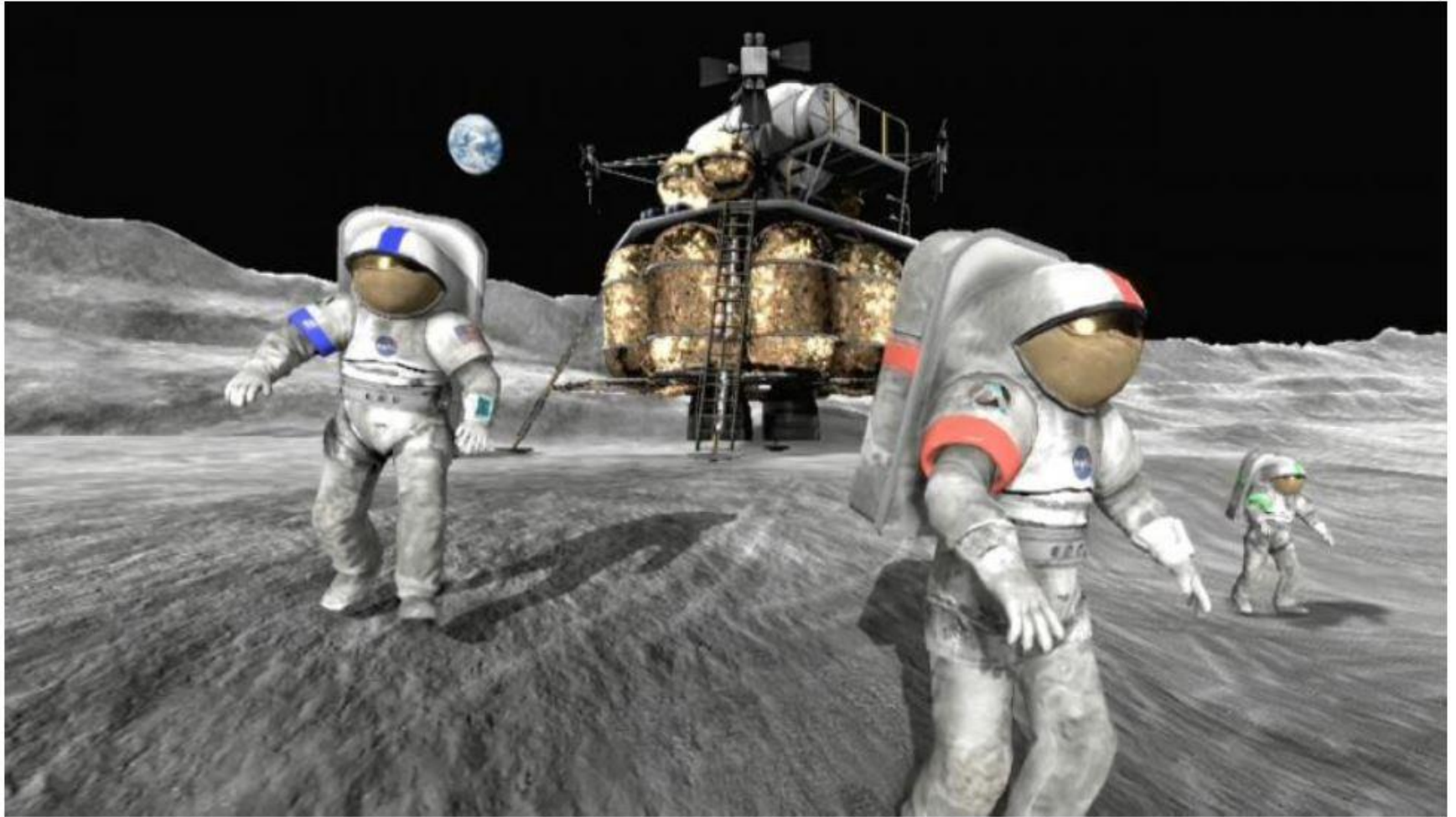
**Hank Green**

-  **Tardigrades: Adorable Extremophiles**  
SciShow  
WATCHED 4:20
-  **Tatooine Discovered?**  
SciShow  
3:24
-  **Solar Storms**  
SciShow  
4:15
-  **Curiosity: Mars' Next Visitor**  
SciShow  
4:38
-  **Football Disease, Moon Base Dreams, and the Deepest Vents Ever!**  
SciShow  
10:12
-  **Wheezy Waiter on Movie Science, Mutant Flu Facts, and 2 Sounds You've Never Heard!**  
SciShow  
10:35
-  **Europa**  
SciShow  
4:11
-  **Sun VS. Atomic Bomb**  
SciShow  
3:45
-  **Life on Mars?**  
SciShow  
2:58

Games

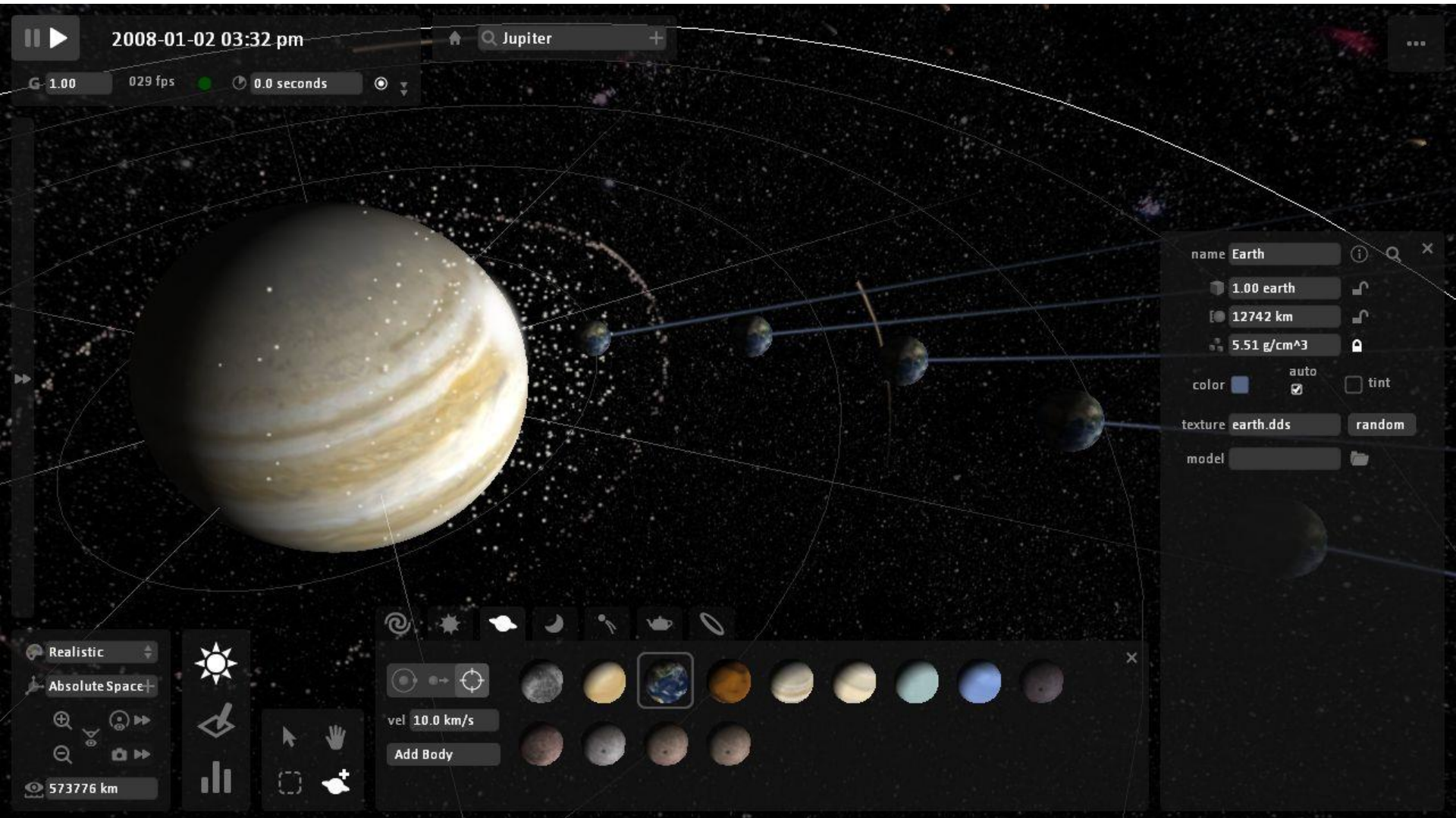


# NASA Moonbase



*NASA's Moonbase Alpha game.*

# Universe Sandbox





# Hogwarts Mystery



26  
26  
26

Making Star Charts

1h 23m 8s



Bonus stars!

0:48 +  
25,308 +  
459 +

**SPECIAL**  
2d 20h



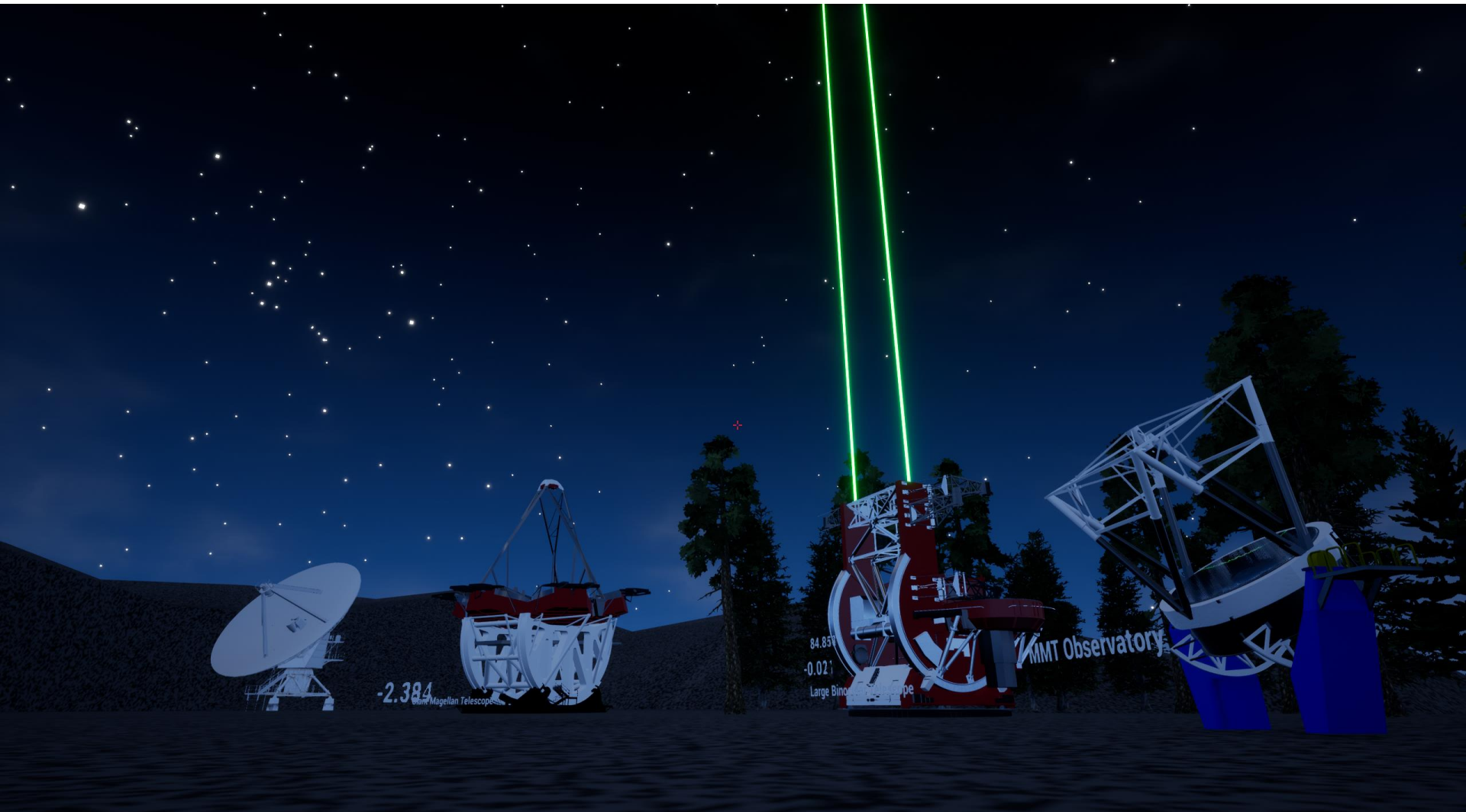
Observe

6d 19h

2d 19h

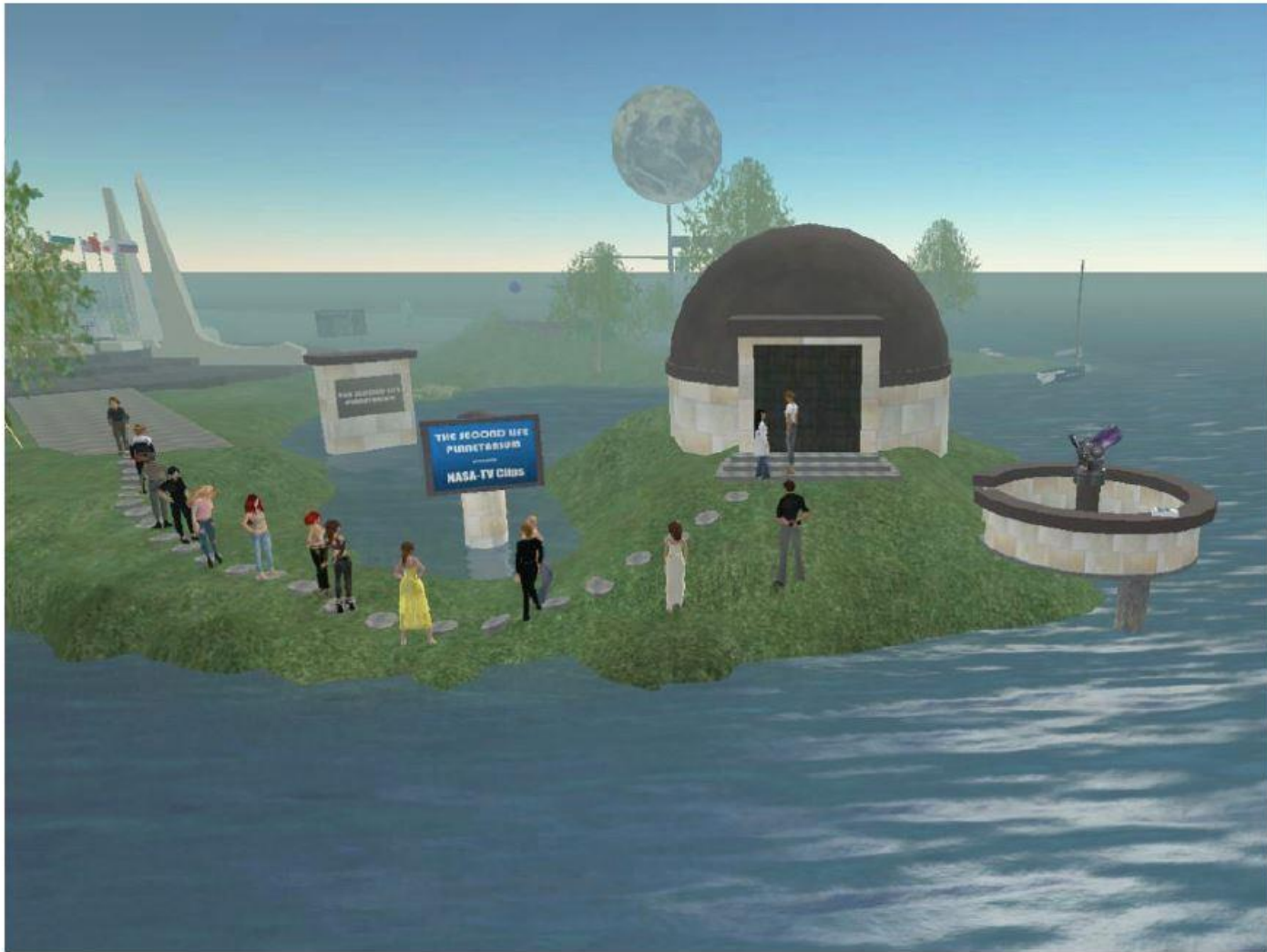
**Virtual**

# VR Telescopes

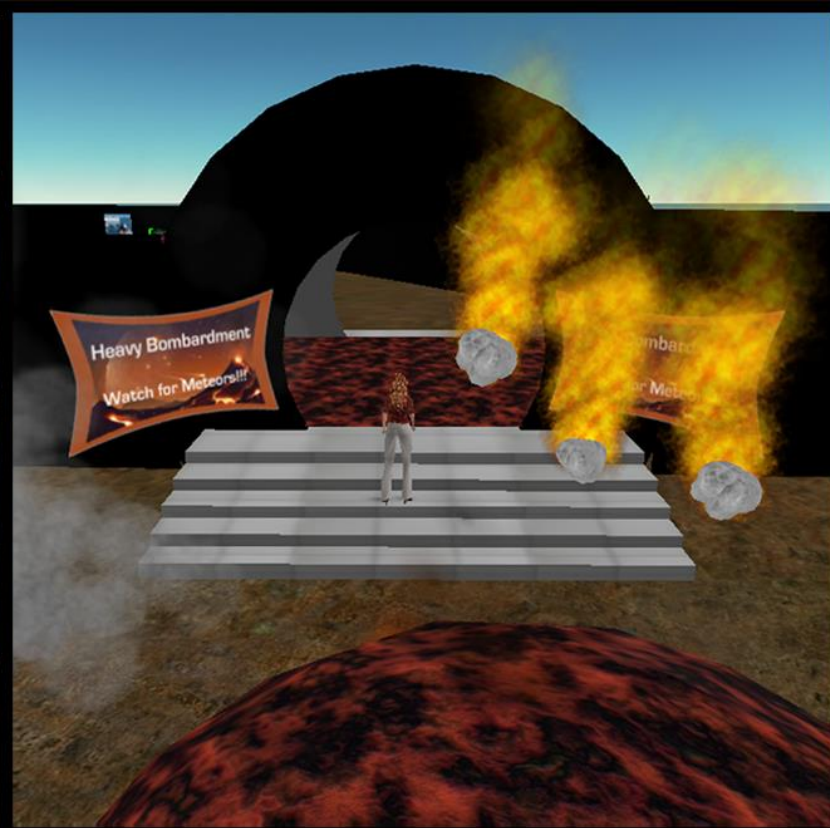
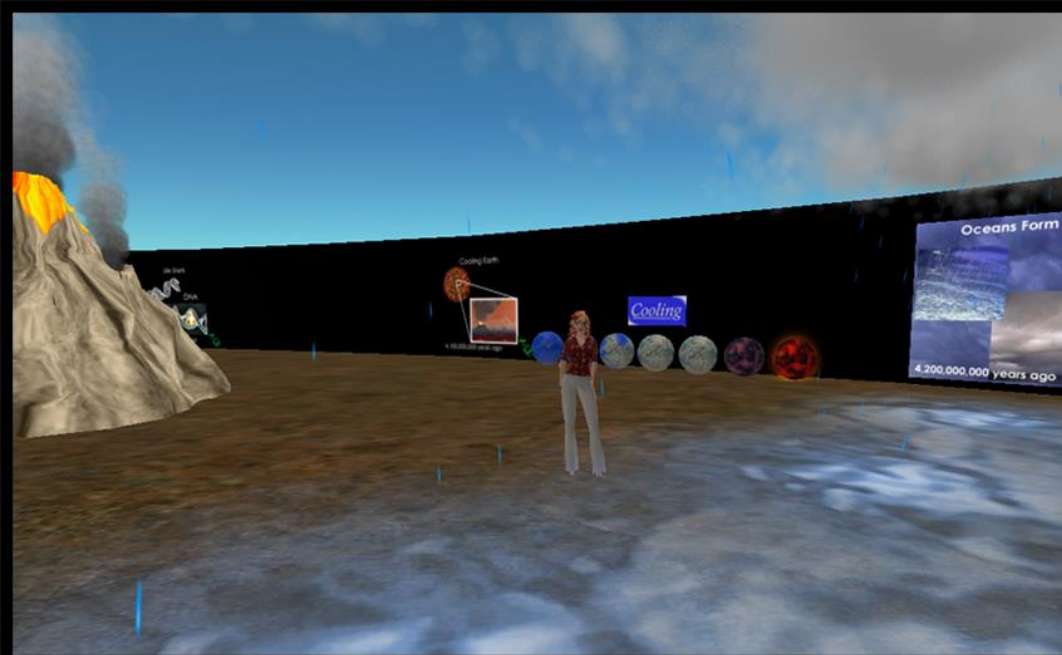




# Second Life



*Residents of Second Life form a line to enter The Second Life Planetarium.*



Built by "Exploring Life in the Universe" students from the University of Arizona



Adrienne Gauthier



**HISTORY OF EARTH & LIFE ON EARTH SL EXHIBIT**  
4.6 billion years ago to the present





# Astronomy Expert

**Raw Material:** 200 hours of video Q&A for 3 astronomy MOOCs. A total of over 5000 questions answered on all topics.



**Processed Material:** Video is chopped into single Q&As, with transcripts. AI is used to match questions with answers. Users can type question into text box in browser, or install an astronomy skill for Google Home or Amazon Alexa and get answers in response to a voice query.



“OK Google, what happens when a star dies?”



“Hey Alexa, how fast is the universe expanding?”