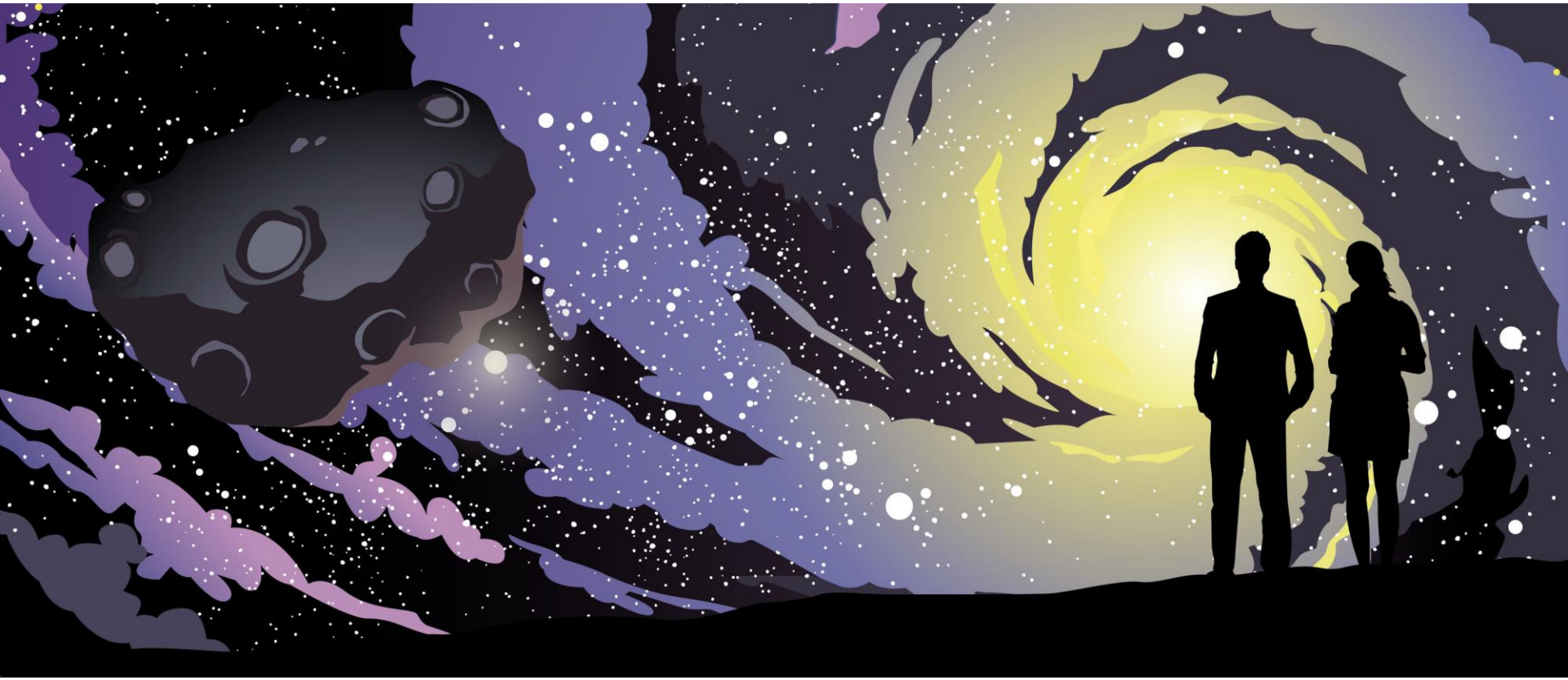
Online Resources for Astronomy Education and Outreach



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)

IAU OFFICE OF ASTRONOMY FOR EDUCATION

OAE

OYA

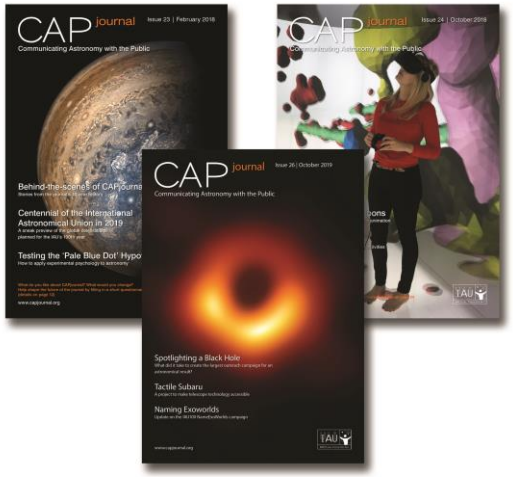
OFFICE FOR YOUNG ASTRONOMERS

ISYA

INTERNATIONAL SCHOOL FOR YOUNG ASTRONOMERS

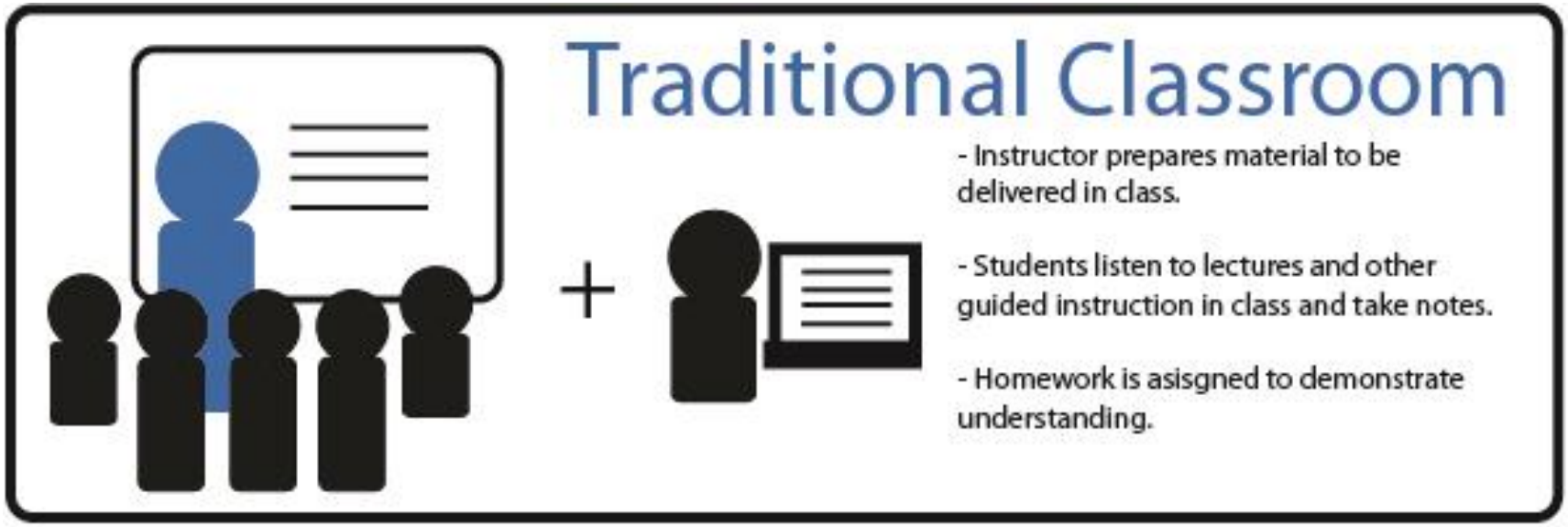
OFFICE FOR ASTRONOMY OUTREACH

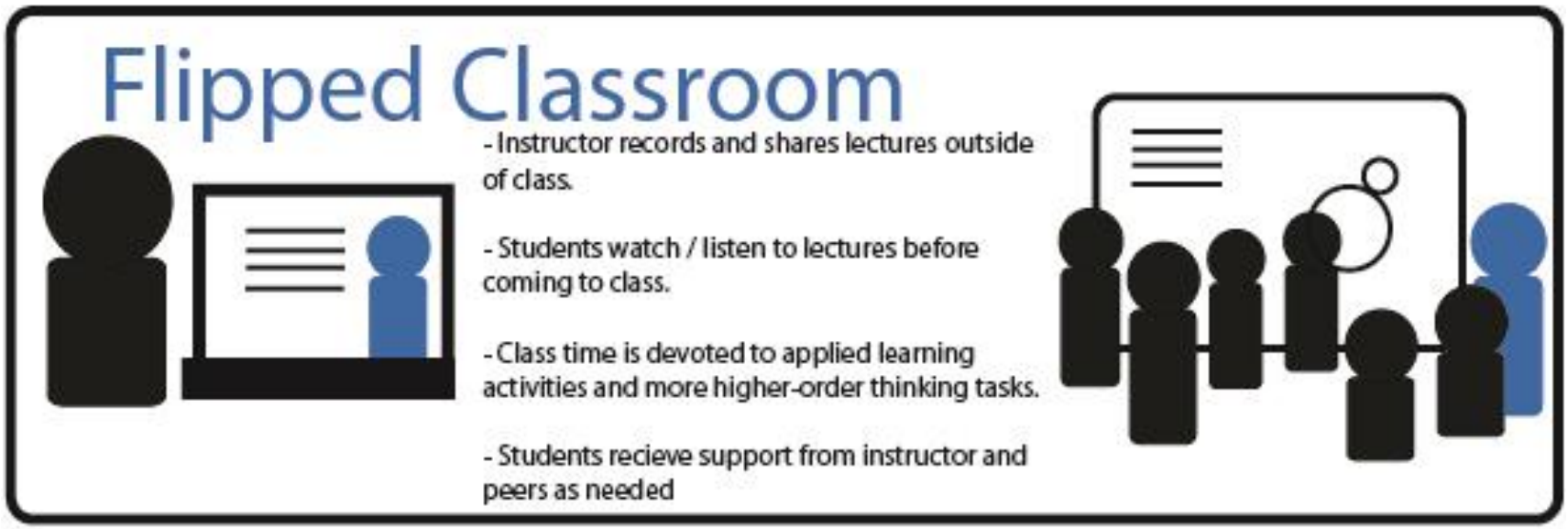
IAU



Fundamentals

Flipped vs Traditional





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.

edublogs

Active Learning

ACTIVE LEARNING

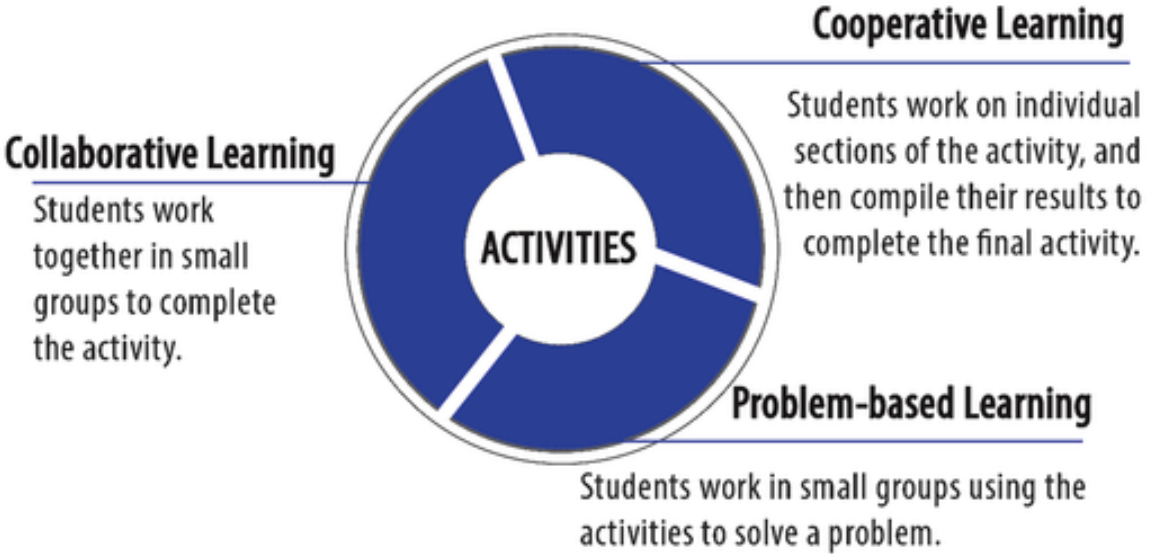
Any method of instruction that allows students to actively participate in the learning process through a variety of individual and group activities.

THE PROCESS

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

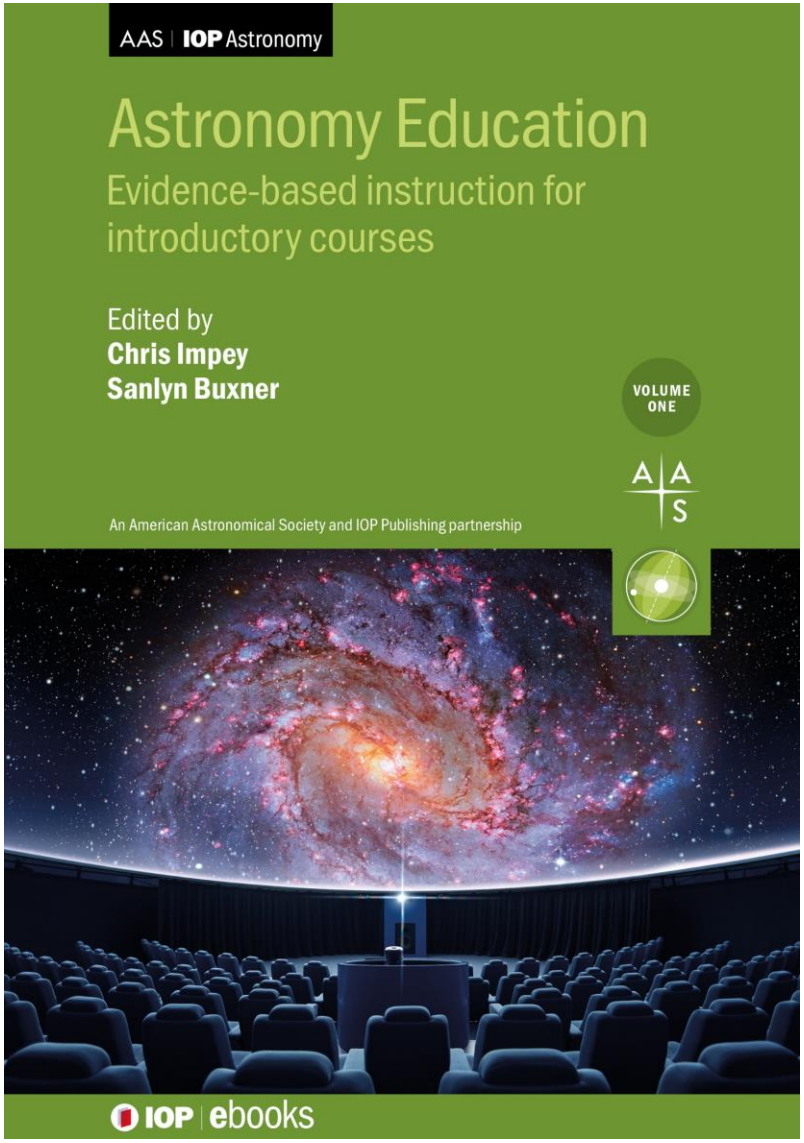
THE ACTIVITIES

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

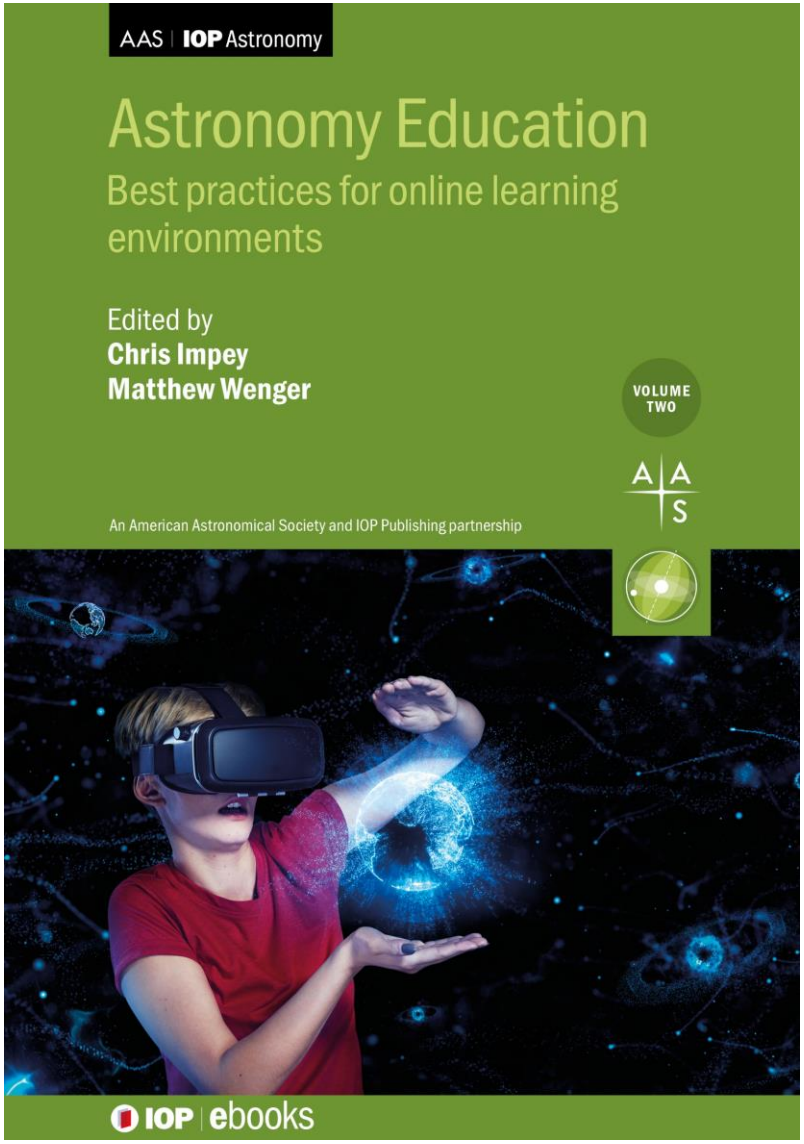


Collections

Volume 1: Table of Contents



Volume 2: Table of Contents



Textbooks

OpenStax Astronomy

openstax™ Log in

‹ Astronomy

Introduction

Table of contents ×

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Chapter Outline

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))

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TEACH ASTRONOMY

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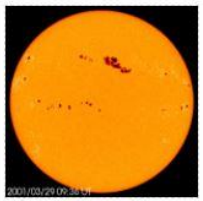
Chapter 11: Our Sun: The Nearest Star

« Previous Page | Next Page »

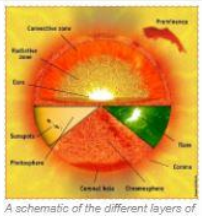
Properties of the Sun

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.



The Sun featuring several large

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 "

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 .

Diagrama de flujo de los pasos del método científico

Hay varios pasos esenciales en el método científico. El primer paso es reunir pruebas, generalmente en forma de observaciones o datos. La evidencia puede ser lecturas de instrumentos, como medidas de lu 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 .

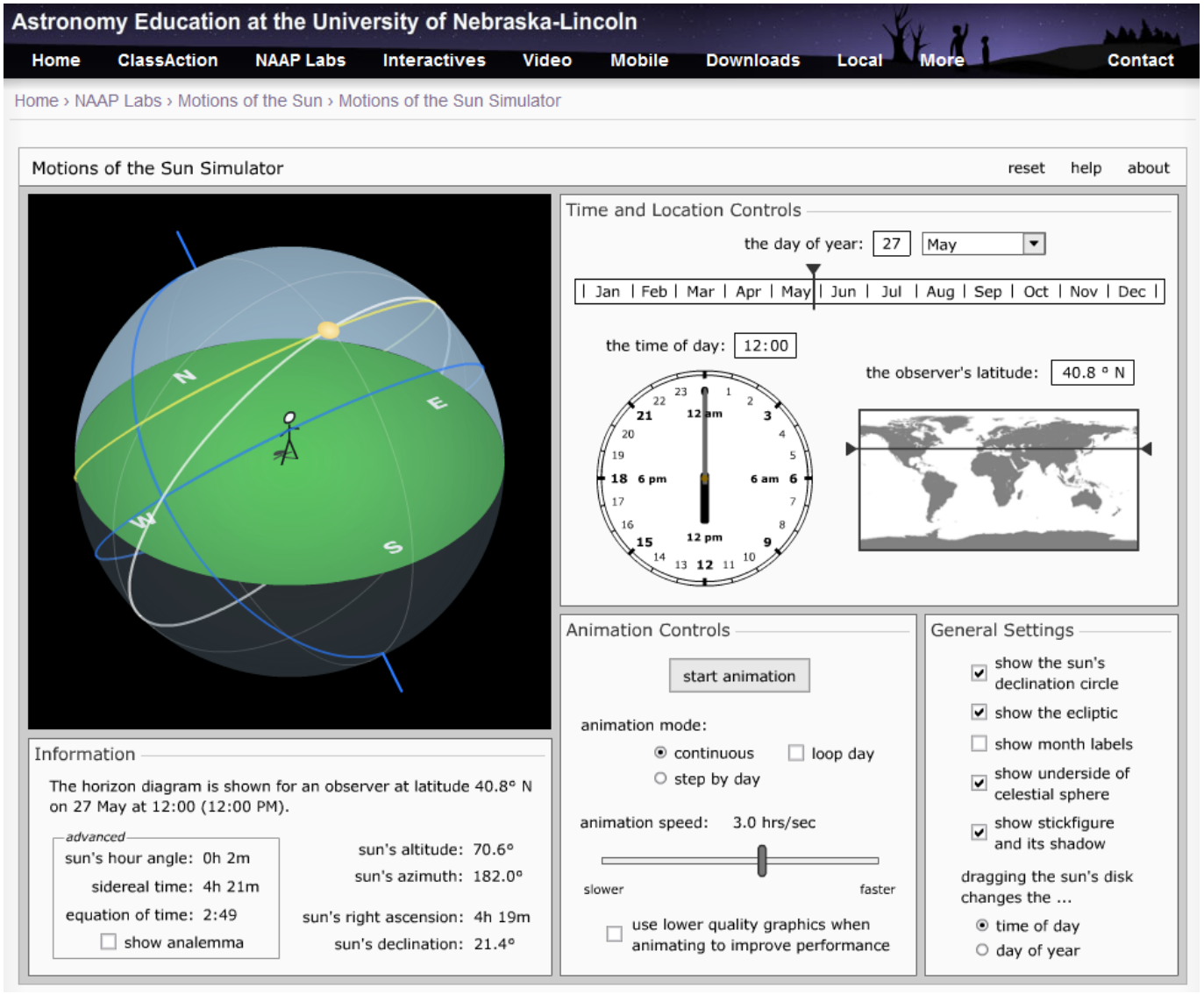
Un instrumento para recolectar radiación electromagnética y producir imágenes ampliadas de objetos distantes.

Interactives

WorldWide Telescope

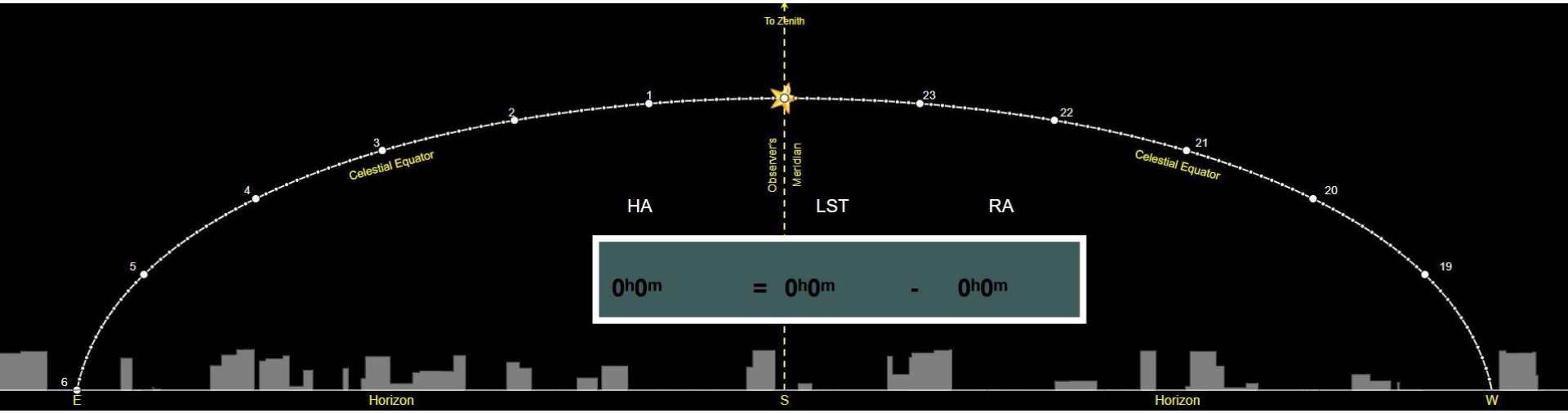
Patricia Udompresert

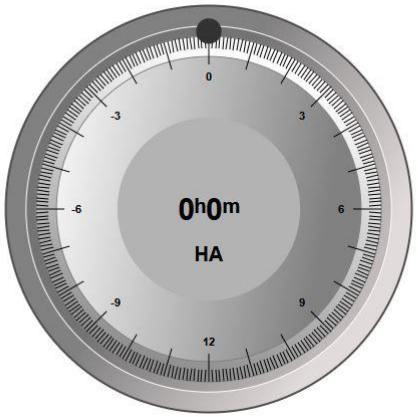
NAAP Labs

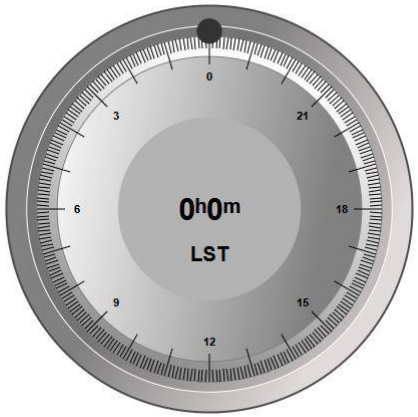


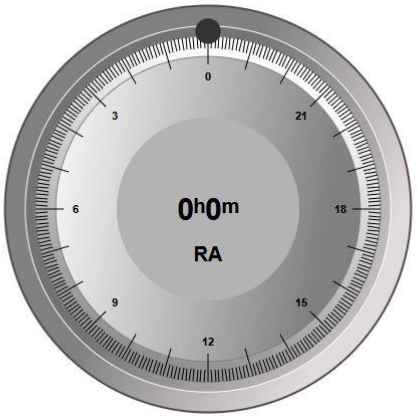
Kevin Lee

ClassAction



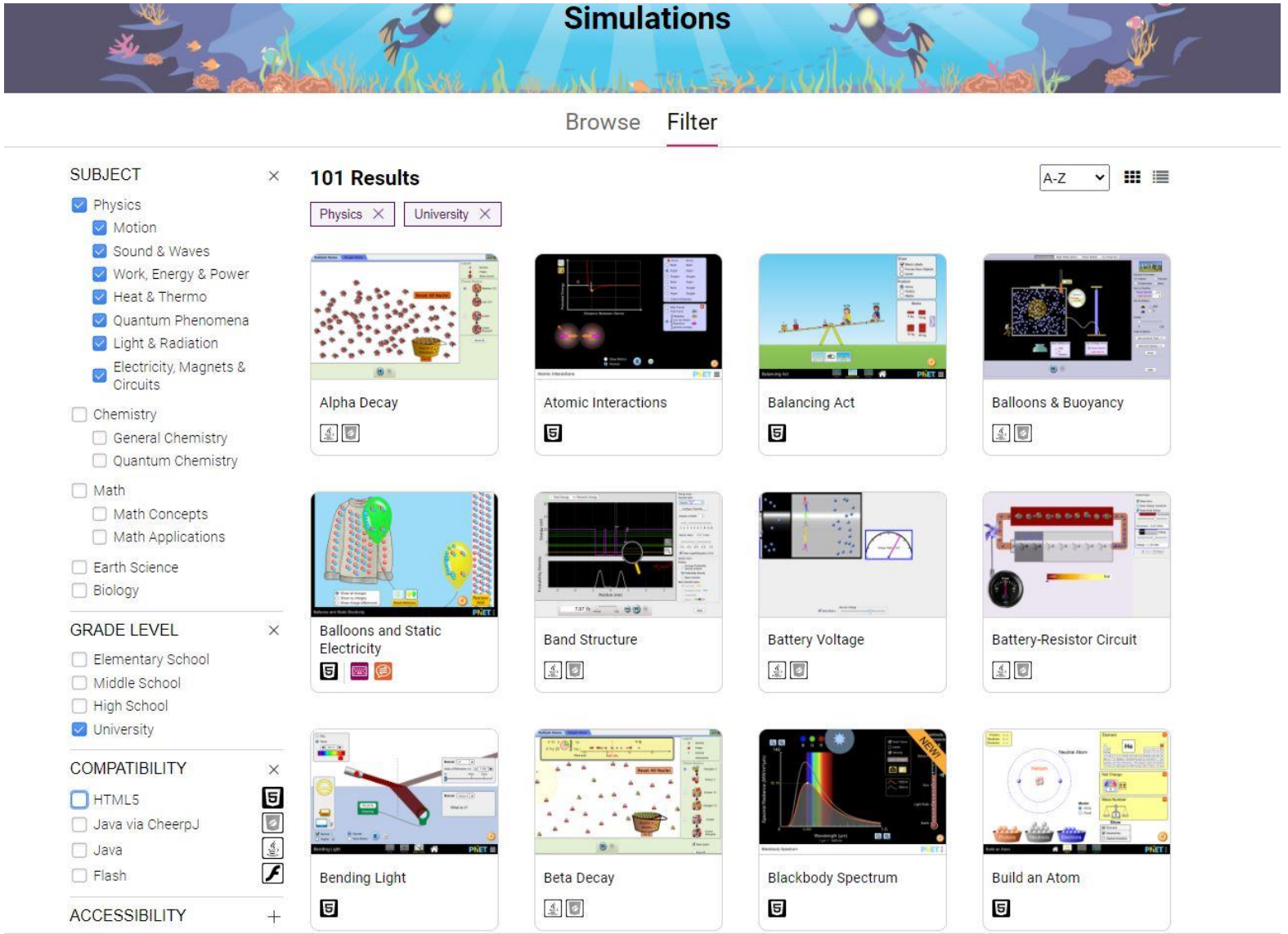






Kevin Lee

PHET Simulations



Carl Weiman

Polling

Poll Everywhere

Participating from any web enabled browser

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

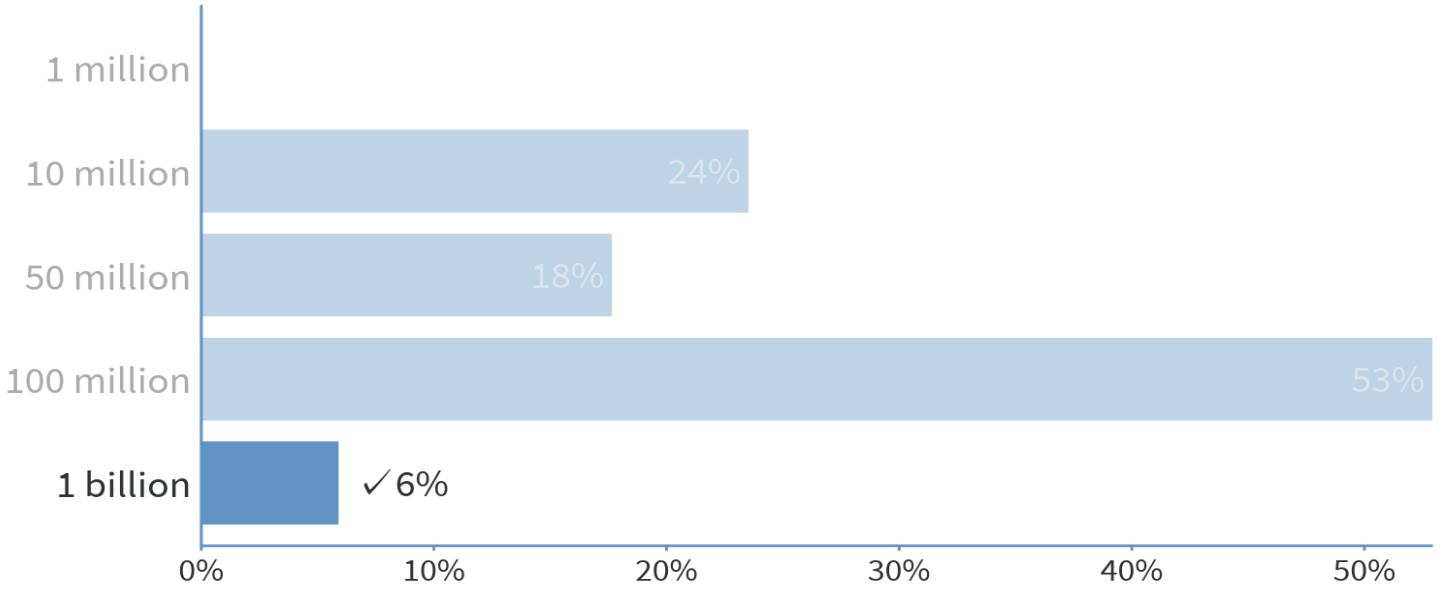
Participating through SMS text messaging

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

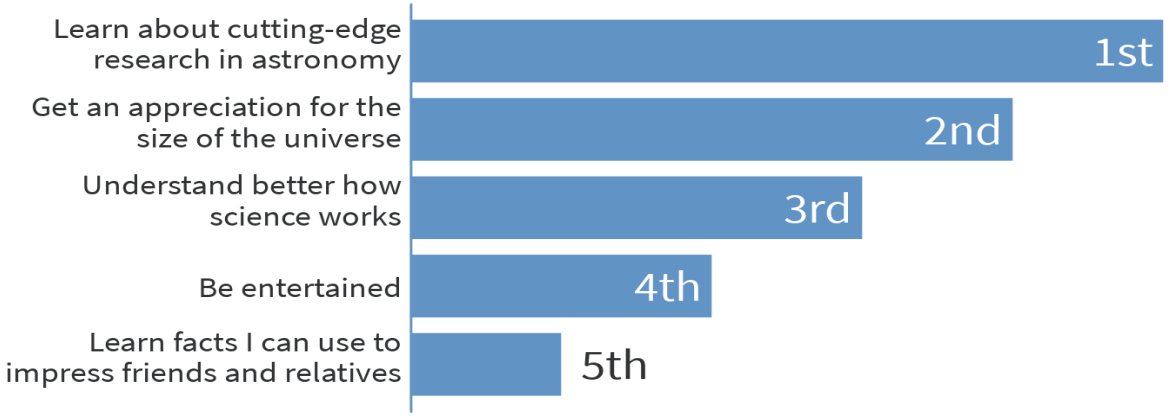
How many bad or fake science web pages are there?

When poll is active, respond at **PollEv.com/chrisimpey829** 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



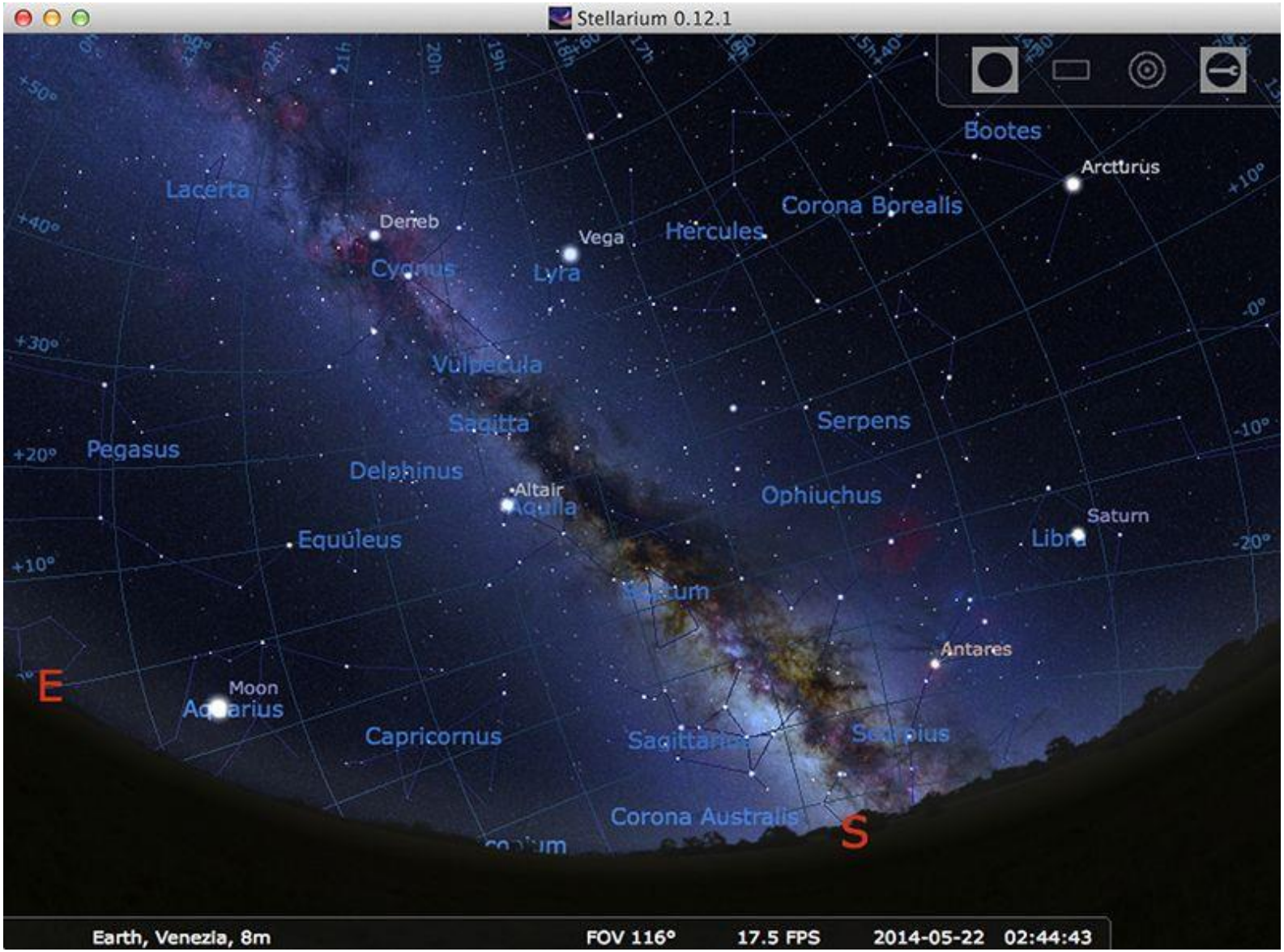
What words come to mind in thinking about black holes?

Where were you born (click the location on the map)?

Planetaria

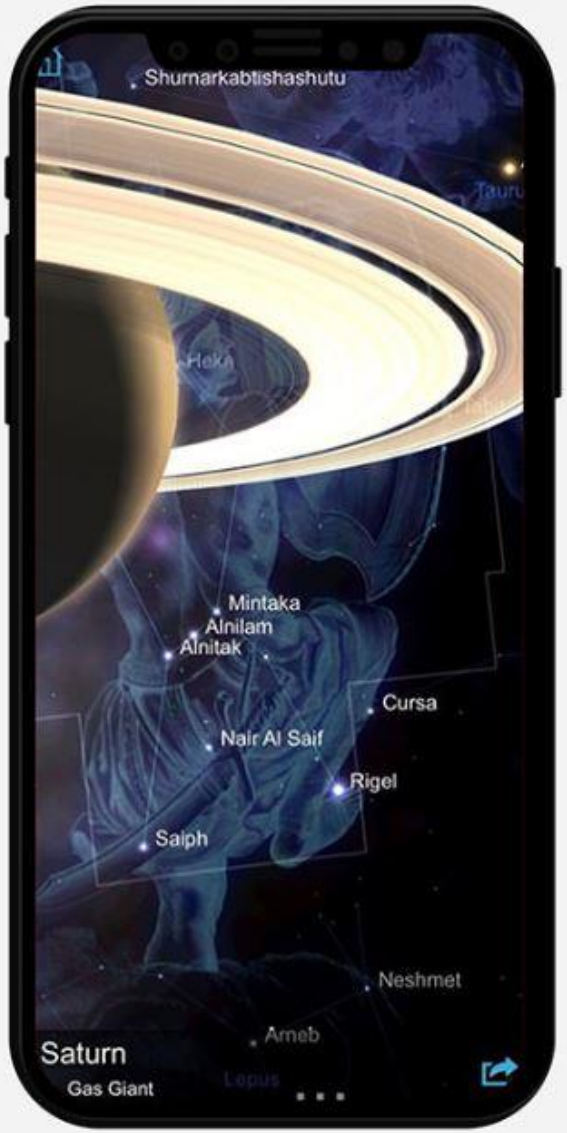
Starry Night

Stellarium


Stellarium 0.12.1
Bootes
Arcturus
Lacerta
Corona Borealis
Hercules
Vega
Deneb
Cygnus
Lyra
Vulpecula
Sagitta
Serpens
Pegasus
Delphinus
Altair
Aquila
Ophiuchus
Saturn
Libra
Equuleus
Antares
Moon
Capricornus
Sagittarius
Scorpius
Corona Australis
E
S
Earth, Venezia, 8m
FOV 116°
17.5 FPS
2014-05-22 02:44:43

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?

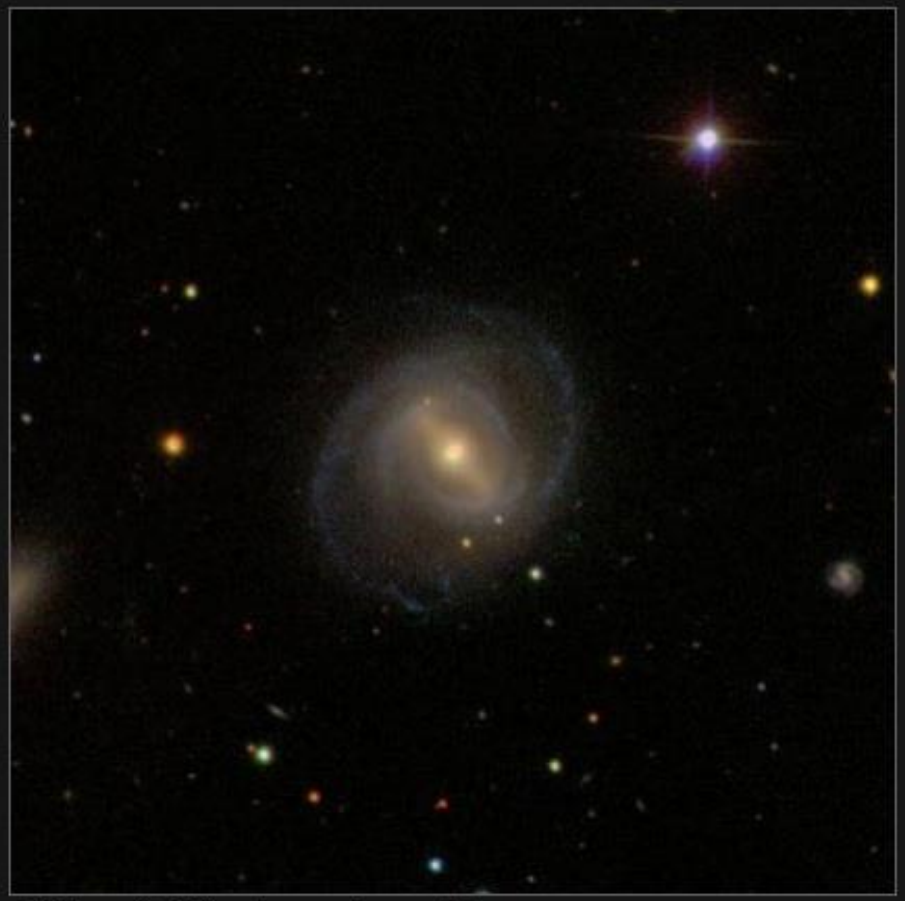
- Volunteers **classify** (assess data) independently
- Between 3 and 80 classifications per image/video file aka **subject**
- Responses are aggregated for **consensus**
- Volunteers interact with researchers on Talk boards
- Zooniverse.org/publications - **projects have led to 300+ publications**
-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

Laura Trouille

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

CLOCK | ANTI | EDGE ON/ UNCLEAR
SPIRAL GALAXY

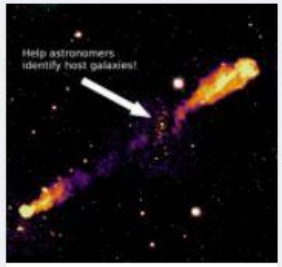
ELLIPTICAL GALAXY

STAR / DON'T KNOW | MERGERS

DISK DETECTIVE

SPIRAL GRAPH

AURORA ZOO



RADIO GALAXY ZOO: LOFAR

STAR NOTES

MAPPING HISTORIC SKIES

GALAXY ZOO: CLUMP SCOUT

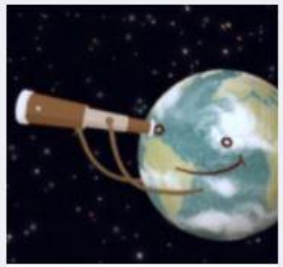
GALAXY ZOO MOBILE

PLANET HUNTERS TESS

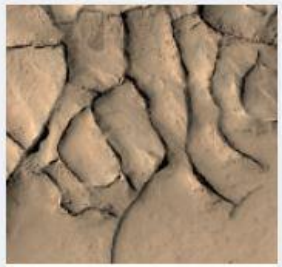
SUPERWASP VARIABLE STARS

GALAXY ZOO

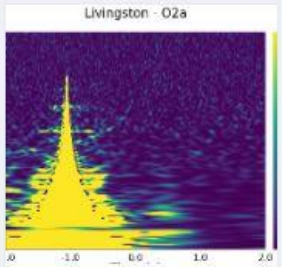
ASTRONOMY REWIND



BACKYARD WORLDS: PLANET 9



PLANET FOUR: RIDGES



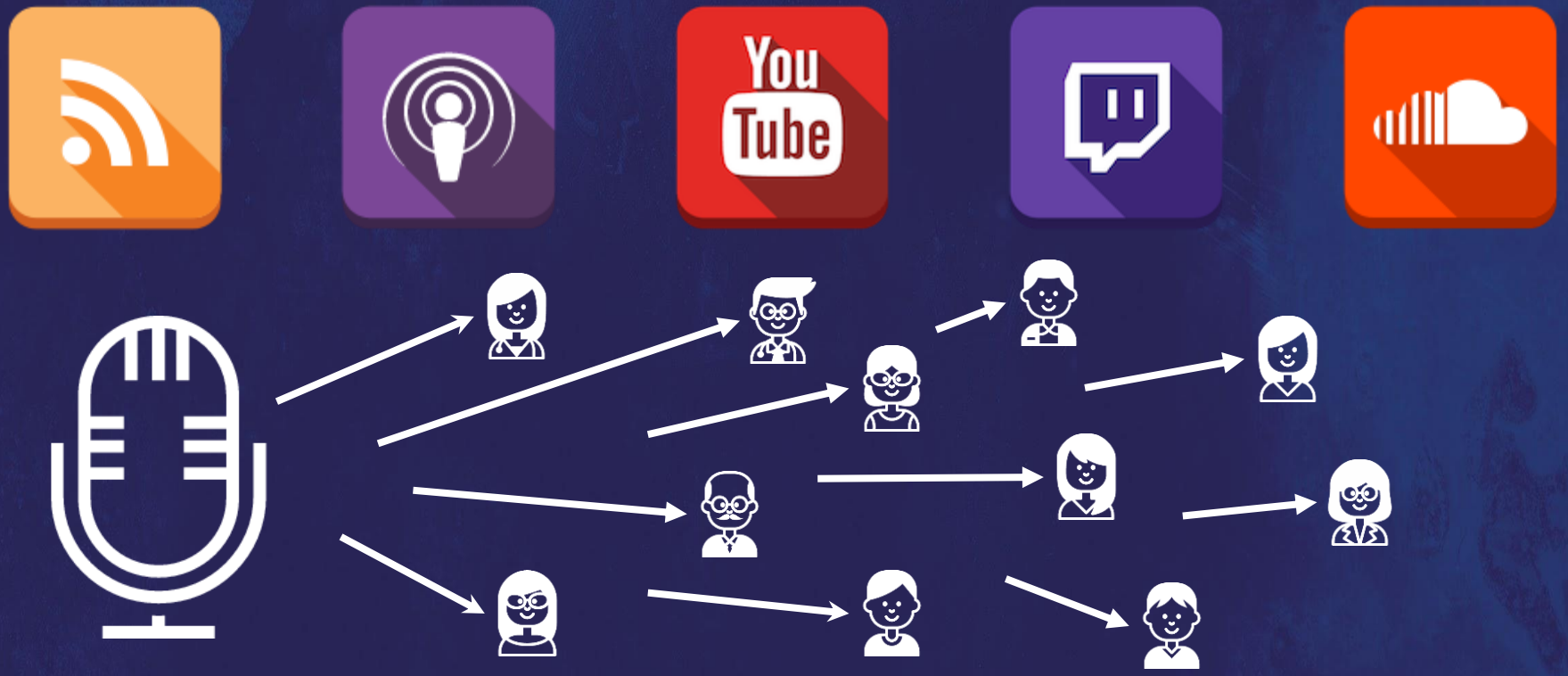
GRAVITY SPY

RADIO METEOR ZOO

SUPERNOVA HUNTERS

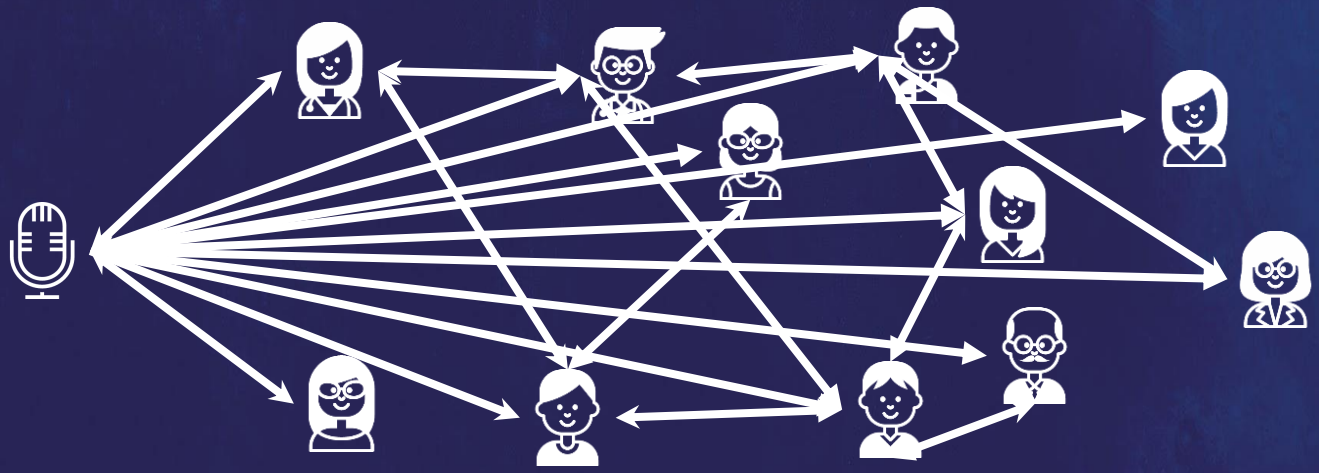
Social Media

New Media



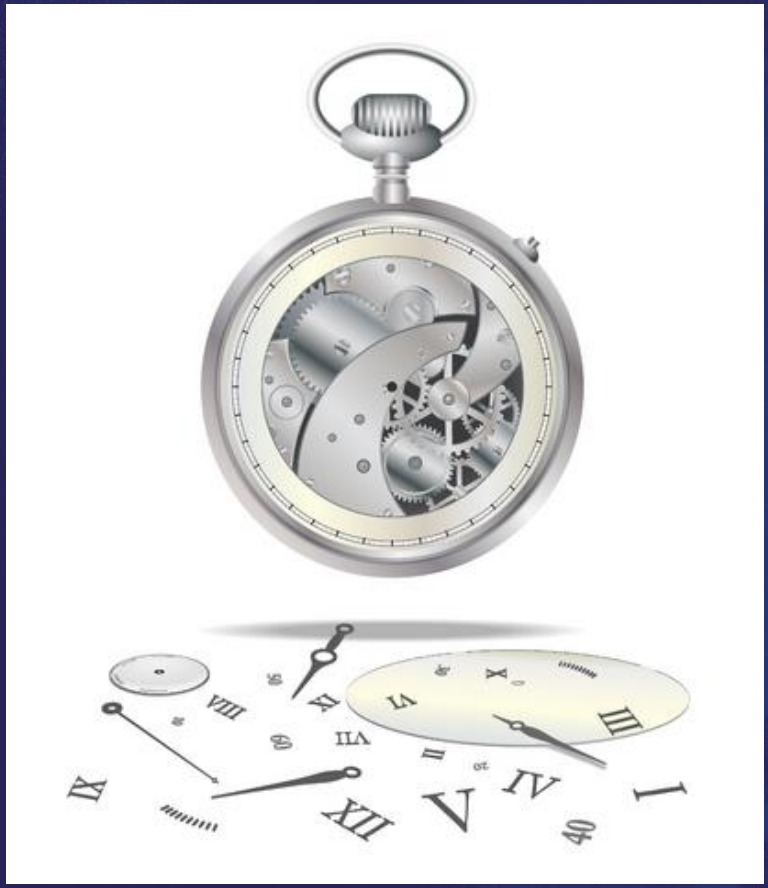
Pamela Gay

Social Media

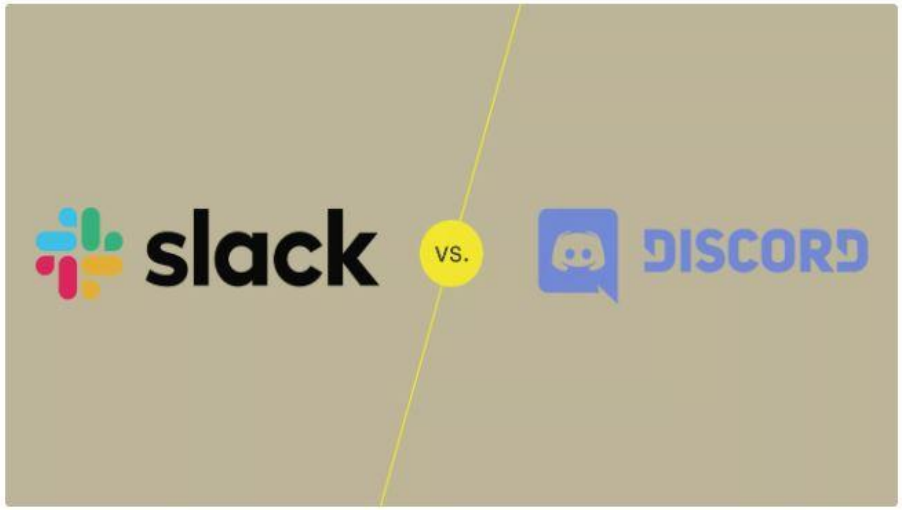


Long term storytelling:
Essays, long-form articles, YouTube videos, lists
(archival media)

Punctuation:
Twitter, Twitch
[anything] Live
(ephemerial media)



Chat and Messaging



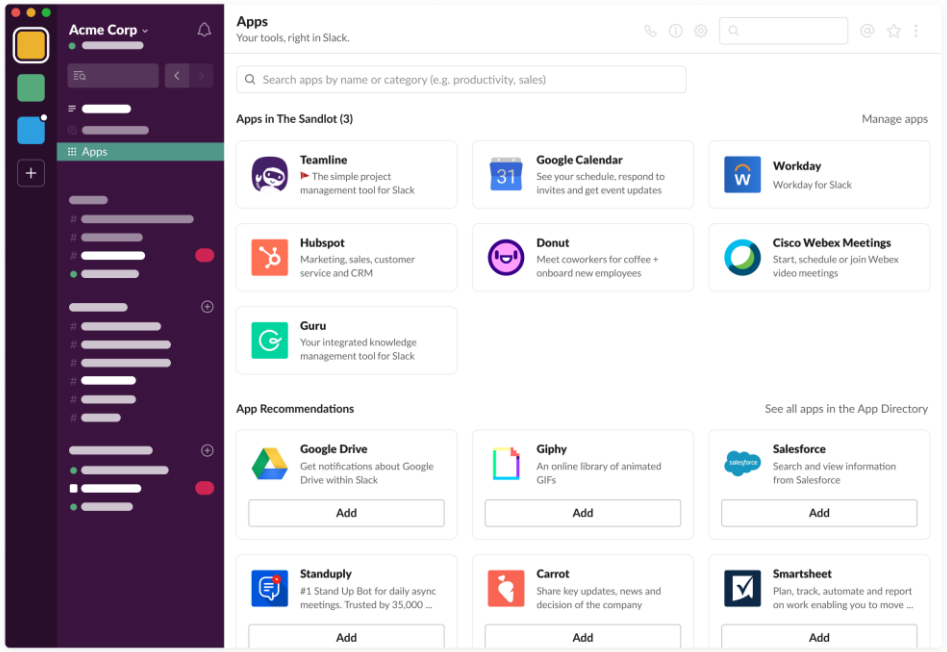
Overall Findings

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

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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

Authors & editors: Robert Nemiroff (MTU) & Jerry Bonnell (USRA)
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A service of: LHEA at NASA/ GSFC

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 ; @NOAONorth; 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 SUBSCRIBE

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Introduction to Astronomy: Crash Course Astronomy #1
CrashCourse

3 

Naked Eye Observations: Crash Course Astronomy #2
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4 

Cycles in the Sky: Crash Course Astronomy #3
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5 

Moon Phases: Crash Course Astronomy #4
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6 

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7 

Telescopes: Crash Course Astronomy #6
CrashCourse

8 

The Gravity of the Situation: Crash Course Astronomy #7
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9 

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

1 

Minute Physics: What is Gravity?
minutephysics

2 

Minute Physics: What is Dark Matter?
minutephysics

3 

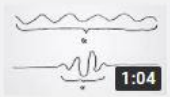
What is the Wave/Particle Duality? Part 1
minutephysics

4 

The Wave/Particle Duality - Part 2
minutephysics

5 

How the Sun works: Fusion and Quantum Tunneling
minutephysics

6 

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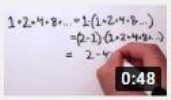
9 

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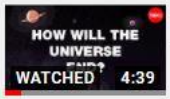
6. 

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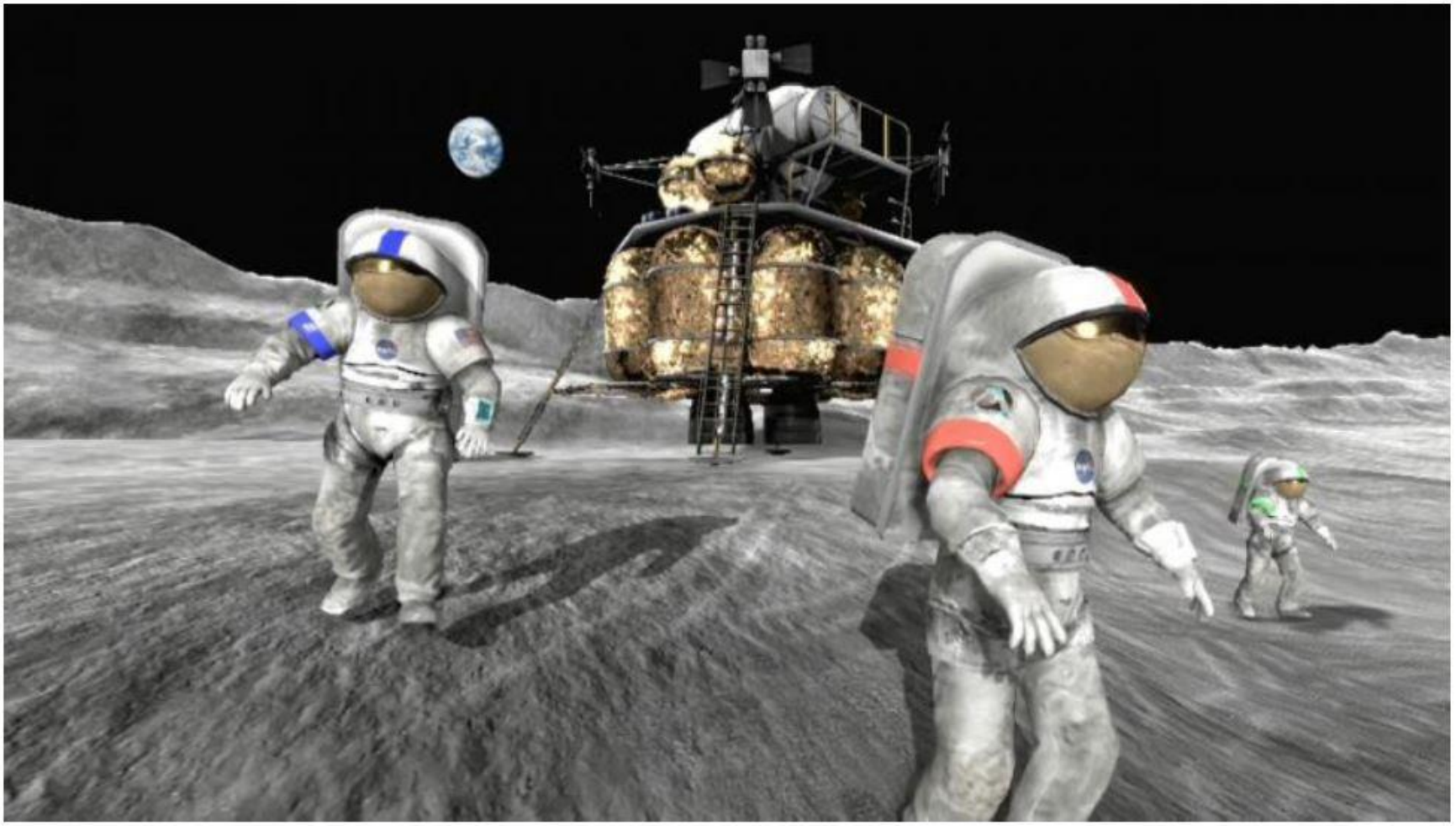
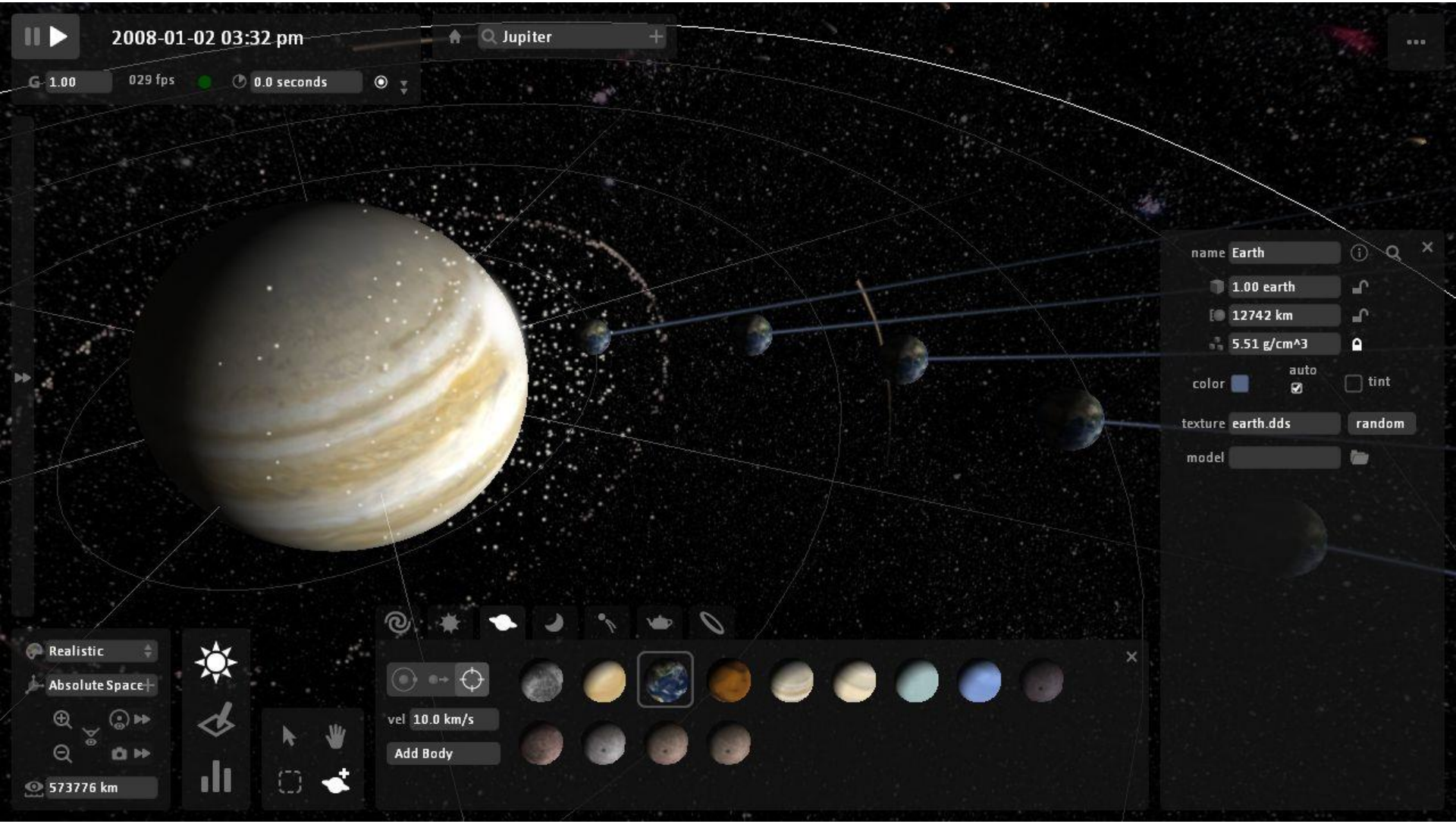


NASA's Moonbase Alpha game.

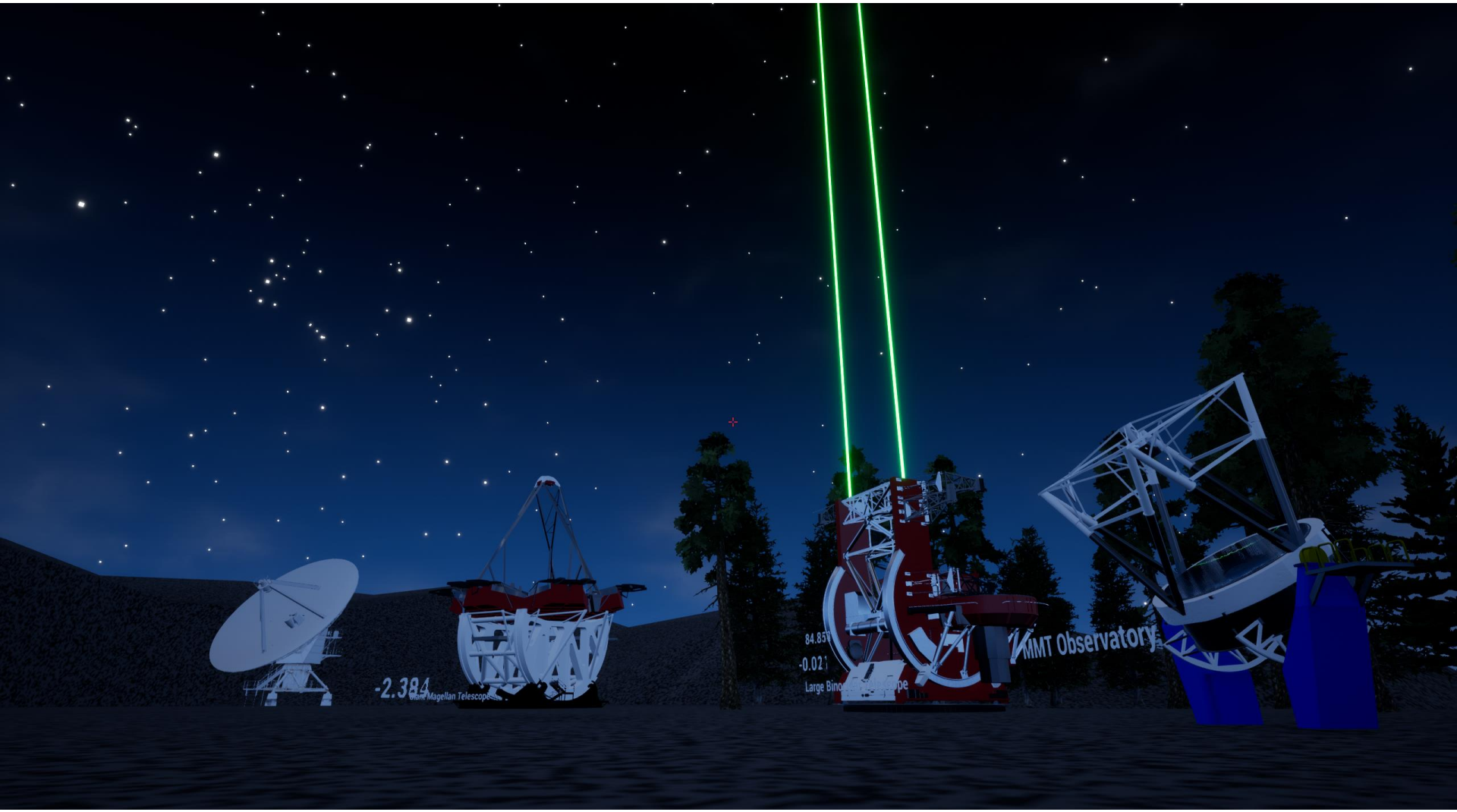
Universe Sandbox



Hogwarts Mystery

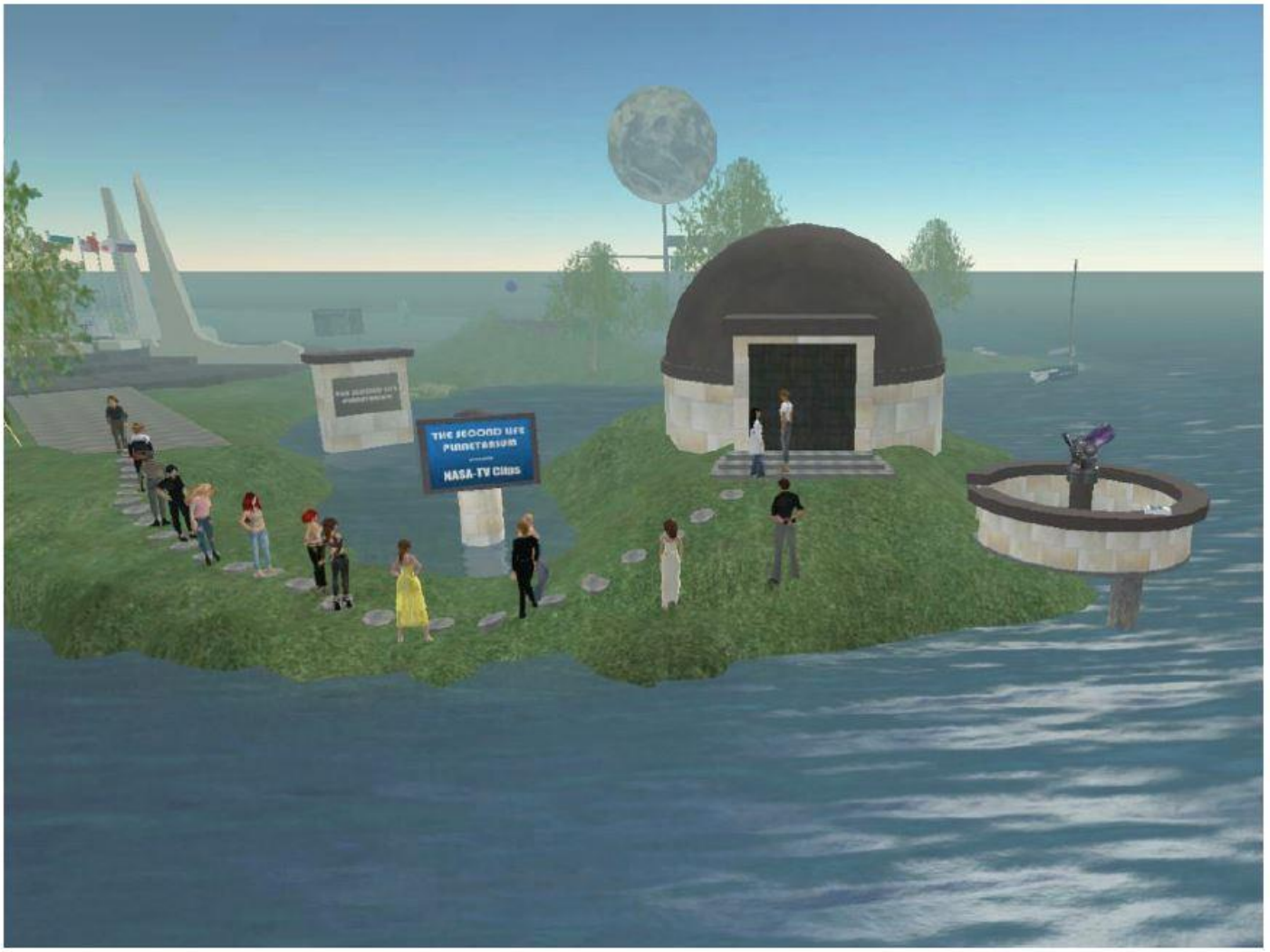
Virtual

VR Telescopes



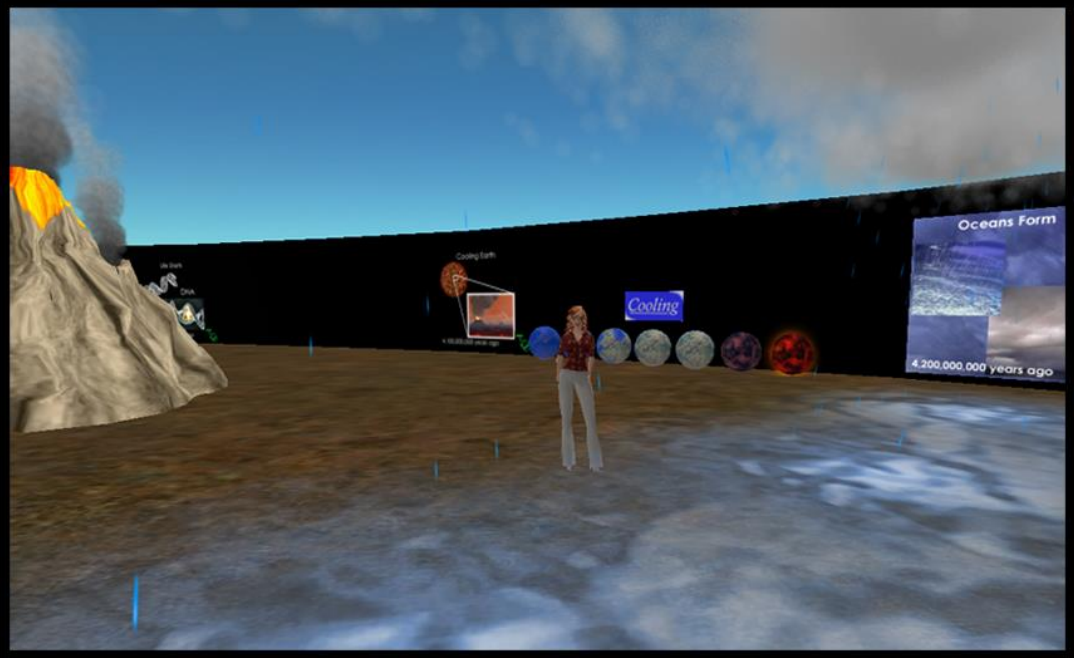
Alexander Danehy

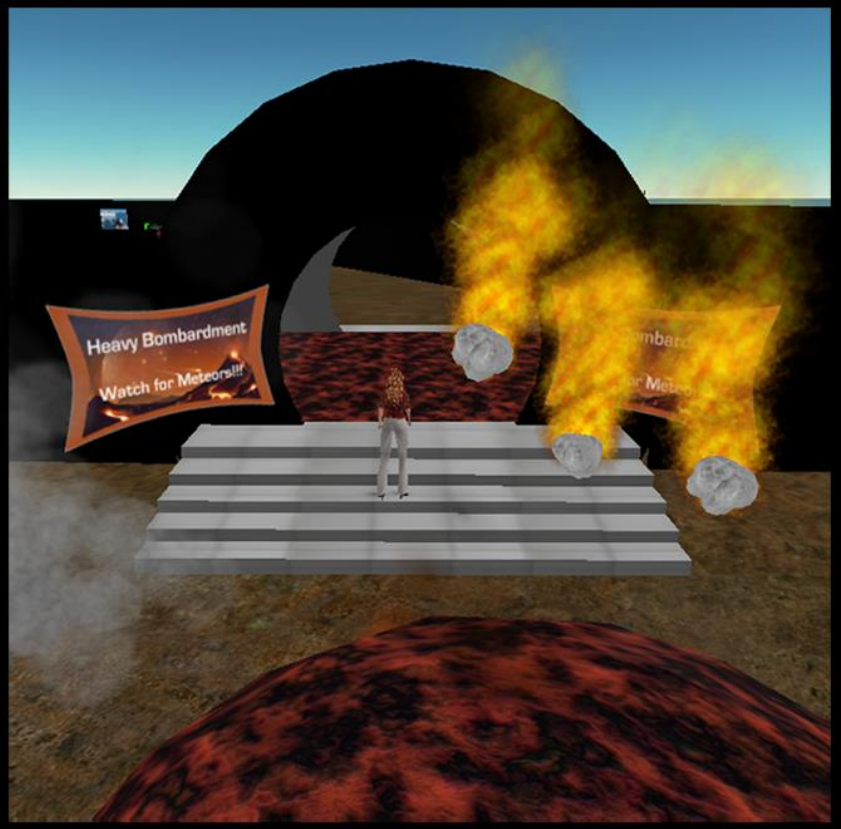
Second Life



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

Tony Crider





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

Adrienne Gauthier

History of Earth & Life on Earth SL Exhibit

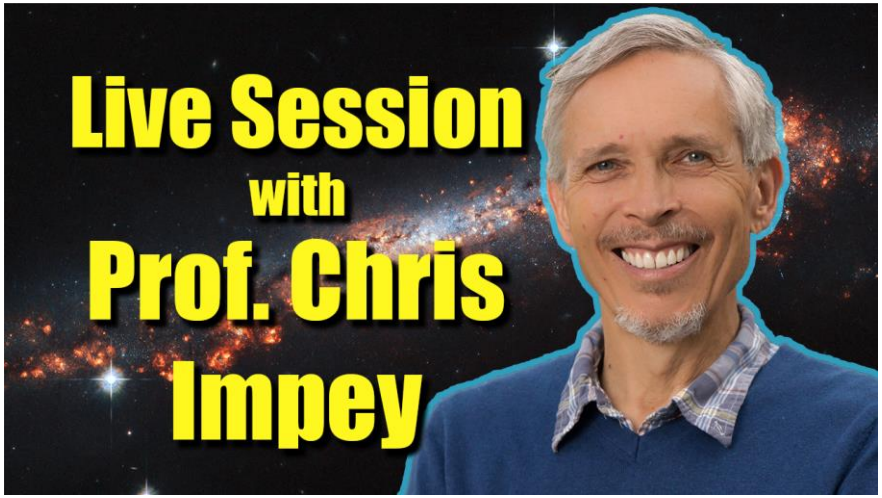
4.6 billion years ago to the present


Teleport to
Central
Teleport Hub


Intro to Astronomy
JACK
CYCLE
NEXT
RESET
To use this
space for lectures
IM:
Cosmo
Priestman

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?”