Astronomy

The Study of Stars, Galaxies, Planets, and More
Who is an astronomer?

1500s - 1600s
Who is an astronomer?

1900s
Who is an astronomer?

Now
How to become an astronomer

Math and problem solving skills
Curiosity and determination
Writing, speaking, and teamwork skills
Creativity

4 years of college
= Bachelors
(astronomy, physics, math)

3~4 years of graduate school
= Masters
5~6 years of graduate school
= Doctorate
Where are astronomers?

~6,000 in N. America alone!
55% at universities or colleges
teaching and research
  NMSU, UTEP, NM Tech, UNM
30% working at national labs, government agencies
  engineering at observatories, labs
  Goddard, Ames, Jet Propulsion Lab, Los Alamos
  Apache Point, Kitt Peak, Magdalena Ridge
also planetariums, science museums
  Gene Roddenberry, Hayden, Adler
10% work in private industry
  aerospace, instrument sensing, data analysis, programming
What do astronomers do?

Theory
develop new physics, simulations to model reality

Observation
study objects with telescopes, test theory predictions, find new objects

Mission/Instrument
design/operate telescopes & space probes; large teams
Sometimes astronomers travel

- Work with collaborators
- Attend/present at conferences
- Use telescopes
What tools do astronomers use?

- Telescopes
- Probes
- Experiments
What tools do astronomers use?

Our brains

Telescopes
Experiments
Telescopes can be on Earth ... or in space ...
Different telescopes look at different kinds of light.
A typical day
We also work together to create large sky surveys

- Sloan Digital Sky Survey
  - Milky way stars, other galaxies

- Hubble Deep Field galaxy survey
  - Distant galaxies

- COBE and WMAP
  - The early universe
What do astronomers study?

What do astronomers study?

The Sun, planets (formation and history, composition, atmosphere), moons, asteroids and comets, searching for water, solar system formation, interactions in solar system (Sun and planets, planets and moons and rings), planets around other stars, forming stars, stars young/old and large/small, binary stars, clusters of stars, exploding stars, dead stars, dust and gas, how stars change dust and gas, galaxies, galaxies orbiting other galaxies, galaxies colliding, clusters of galaxies, dark matter, shape of the universe, the early universe, etc.
What do astronomers study?

The Sun, planets, formation and history of the Solar System, moons, asteroids, comets, searching for water, solar system formation, interactions in the solar system (Sun and planets, planets and their moons and rings) planets around other stars, forming stars, stars, young and old stars, clusters, collisions, galaxies, orbiting our galaxy, galaxies colliding, clusters of galaxies, dark matter, the shape of the universe, the early universe, etc.
Astronomy-related careers

**Computer Science**
Pattern recognition software to track features on the Sun’s surface

**Spaceflight Industry**
Engineers hired by companies like SpaceX and Blue Origin

**Science Visualization**
Create scientifically accurate artwork and animations for researchers and educators

... and also ...
Astronomy education

Formal Teaching
All grades and ages

Astronomy Education Research

Informal Teaching
Planetariums
Museums
Science Centers
NASA Education/Public Outreach (EPO) Offices
Citizen Science
Help scientists analyze real data!

Galaxy Zoo
classify galaxies, hunt for supernovae

Ice Hunters
search for icy worlds beyond Pluto

Planet Hunters
search for planets around other stars

Solar StormWatch
track storms on surface of the Sun
What are interesting things astronomers are researching right now?
Living With a Star (LWS): SDO

Solar Dynamics Observatory studies Sun’s variability

Connection to spaceweather: flares!
- Damage satellites (GPS and communications)
- Power grid failures
Dust devils on Mars

Mars • Global Dust Storm

June 26, 2001

Hubble Space Telescope • WFPC2
NASA, J. Bell (Cornell), M. Wolff (SSI), and the Hubble Heritage Team (STScI/AURA) • STScI-PRC01-31

September 4, 2001
LCROSS/LRO
Lunar Crater and Object Sensing Satellite/Lunar Reconnaissance Orbiter

Search for water on the Moon

Cratering experiments with the NASA Ames Vertical Gun Range
New Horizons and Pluto

2/3 size of Earth’s Moon

“Frozen world”, rock and ice (nitrogen)

Seasonal changes?
Entire atmosphere “snows” onto surface
Planets around other stars

Previously, ~500 planets detected over 15 years

We managed pictures of 3
Planets around other stars

Since 2009, Kepler looked at 150,000 stars and found 1200 new planet candidates & 61 confirmed planets!
Planets around other stars

We’re hoping to find other planets in the “habitable zone”
Galaxy formation

Simulating the formation of a galaxy like the Milky Way
Bolshoi: universe in a box

- Make a box 250 million light years wide
- Fill with dark matter from CMB
- Use physics to describe particle interactions
- Run on a supercomputer for 18 days
- Compare to observations of galaxies
Where can you learn more?

Organizations and telescopes:
- NASA (www.nasa.gov)
- Hubble telescope (hubblesite.org)
- Chandra telescope (chandra.nasa.gov)
- American Astronomical Society (aas.org)
- ESO (www.eso.org)
- Astronomical Society of the Pacific (www.astrosociety.org)

Citizen Science: (www.zooniverse.org)

News websites:
- www.space.com
- www.universetoday.com
- www.badastronomy.com

Your local astronomers:
- Astronomy Dept. at NMSU (astronomy.nmsu.edu)
- Amateur Astro. Society of Las Cruces (aslc-nm.org)