Common Misconception about the Universe

From Everyday Life to the Big Bang

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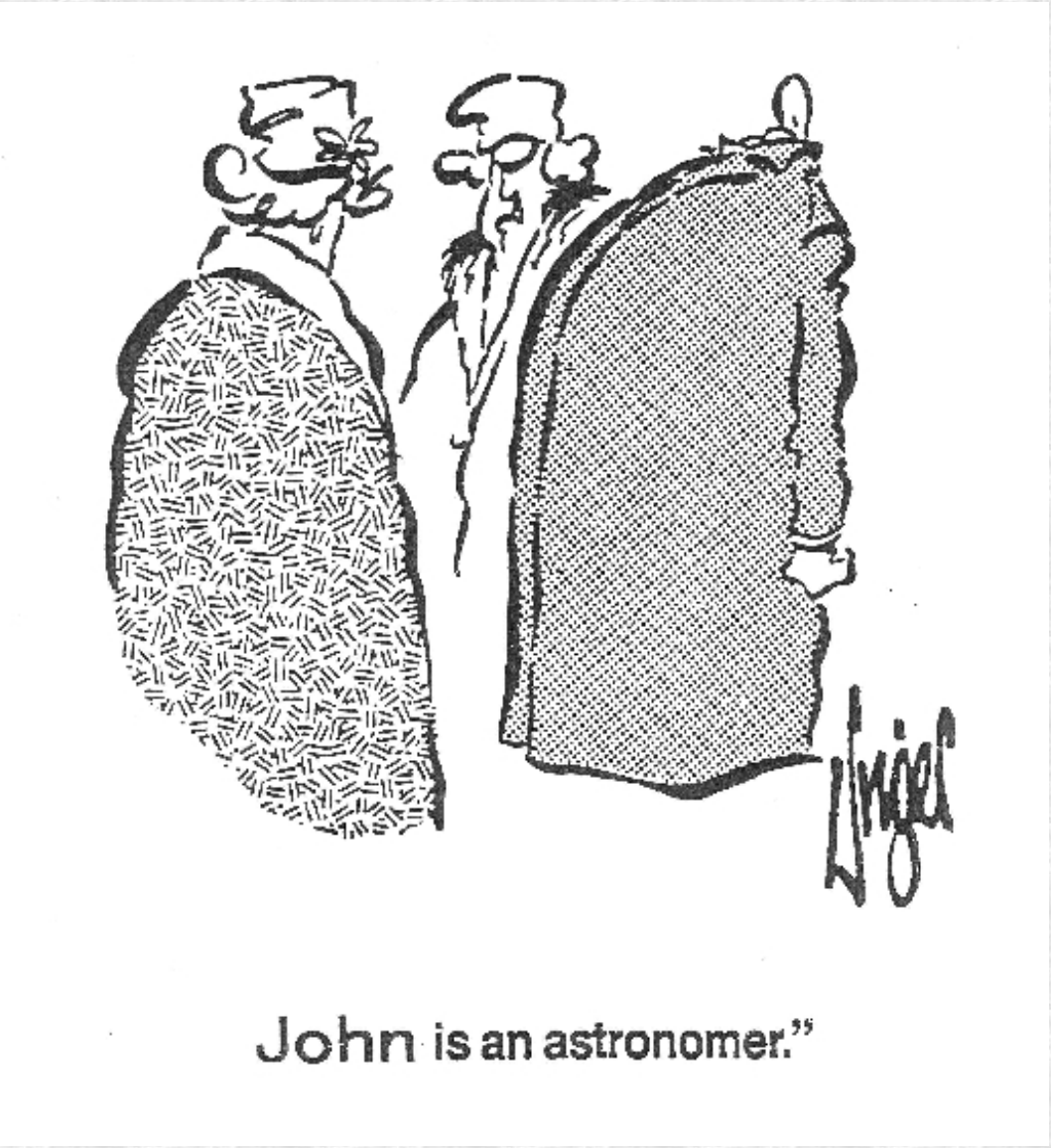
Summary: This presentation will be a gentle introduction to astronomy, from everyday life to exotic black holes and the Big Bang. We will do this by highlighting common misconceptions or “heavenly errors”, and by doing simple demonstrations, to address some of these.

What Is an astronomical misconception?

Something that people “know” about the universe that is not correct.

There are many kinds of misconceptions, depending on their nature and cause.

Misconceptions about Astronomers



- Who they are: old white males: not any more!
- What they look like; how they dress
- What they do

Google

Some of Our Young(er) Astronomers: Dunlap Institute of Astronomy

The grandaddy of astronomical misconceptions

Why is it warm in summer?

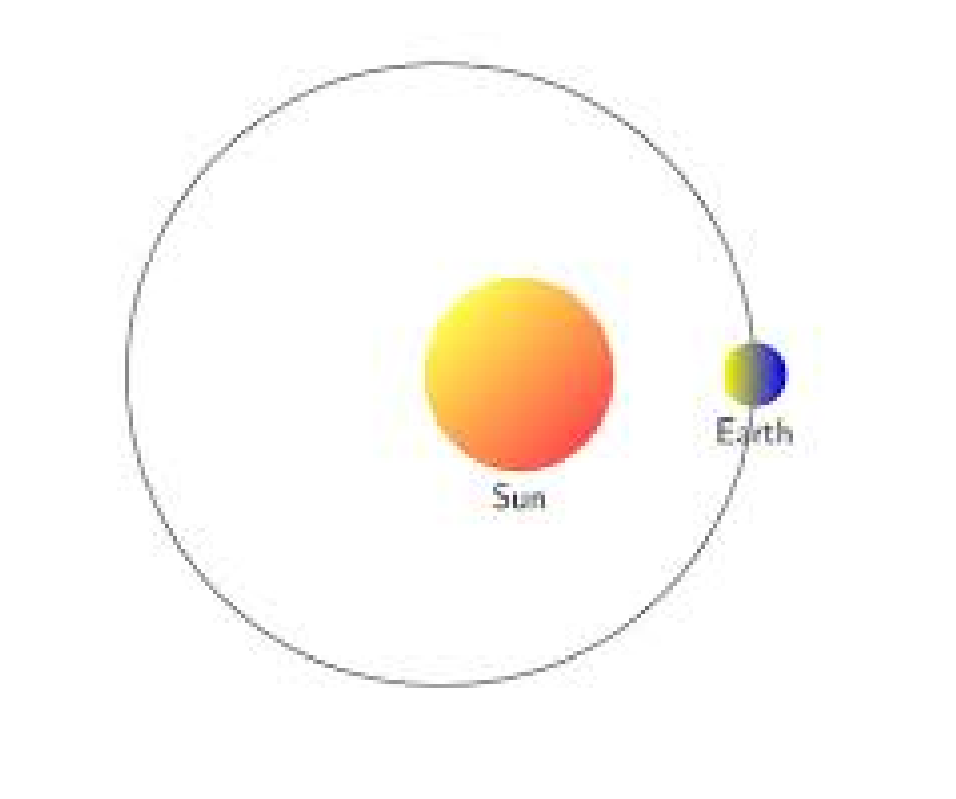
Misconception: What Causes the Seasonal Increase in Temperature in the Summer?

- The Earth is closer to the sun
- The sun is higher in the sky
- The distance between the northern hemisphere and the sun decreases
- Ocean currents carry warm water north
- An increase in “greenhouse gases”

Misconception: What Causes the Seasonal Increase in Temperature in the Summer?

- The Earth is closer to the sun
- The sun is higher in the sky (and the days are longer)
- The distance between the northern hemisphere and the sun decreases
- Ocean currents carry warm water north
- An increase in “greenhouse gases”

Why This Misconception?



- Misleading diagrams like this one; the Earth's orbit is almost circular
- And this diagram is not to scale
- But: simplest and most common explanation is “nearer is warmer”

Why does the moon show phases?

Fred Espenak

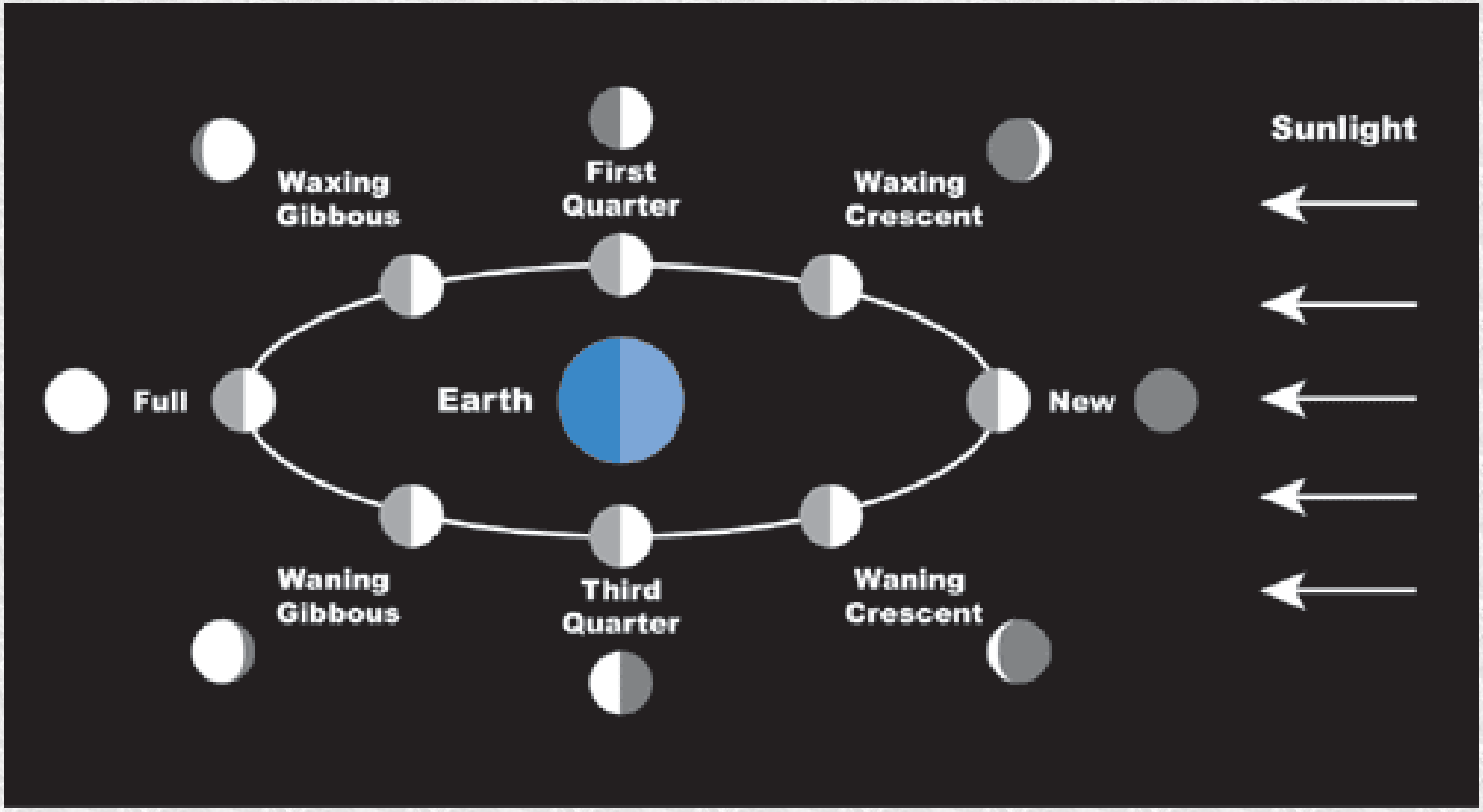
Misconception: The phases of the moon are due to Earth's shadow

NASA

Fred Espenak

- No!! The phases occur because of the relative positions of the sun, Earth, and moon
- The sun shines on the moon from different directions as the moon revolves around the Earth

How Do We Teach Moon Phases?



What colour is the moon – white or black?

Misconception: The Moon is White

NASA

No!! Actually, the moon is as black as tar. It reflects only about 5% of the light that falls on it...

- ... and absorbs the other 95%
- Why does it look white?

Misconception: the full moon is twice as bright as the first or last quarter moon

Full moon

Quarter moon

NASA

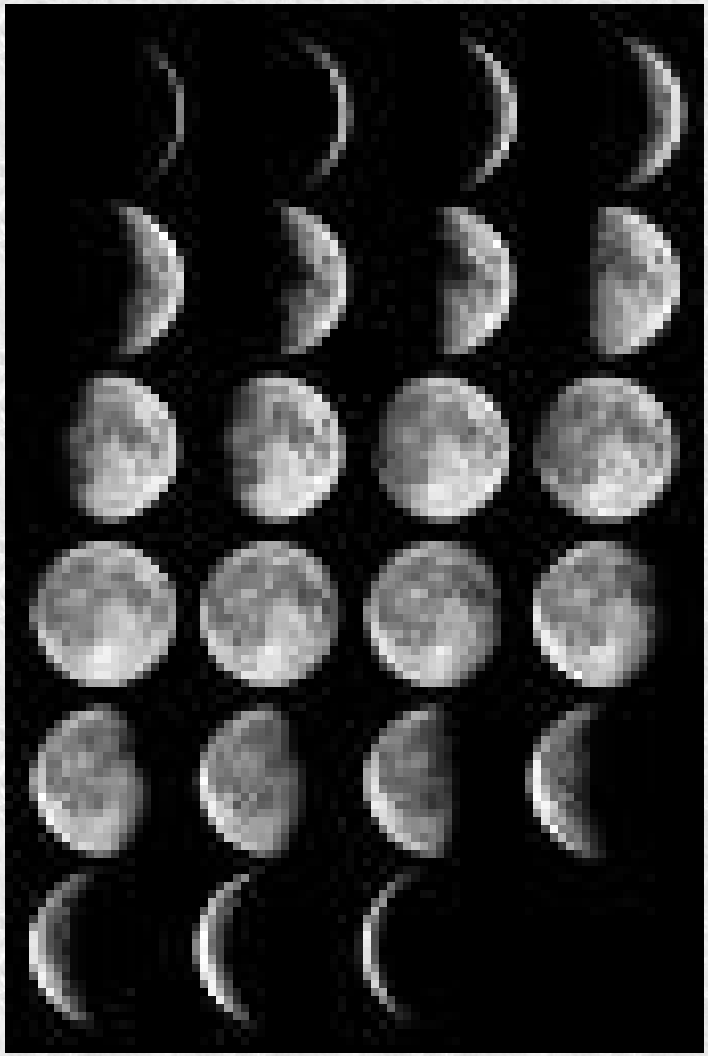
Misconception: the full moon is twice as bright as the first or last quarter moon

NASA

- No!! The full moon is 13 times brighter than the first or last quarter (“half”) moon.
- This is because of shadowing when the sun shines on the moon from the side

The moon always keeps the same face towards Earth. Does the moon rotate?

Misconception: The moon keeps the same face toward Earth; therefore the moon does not rotate



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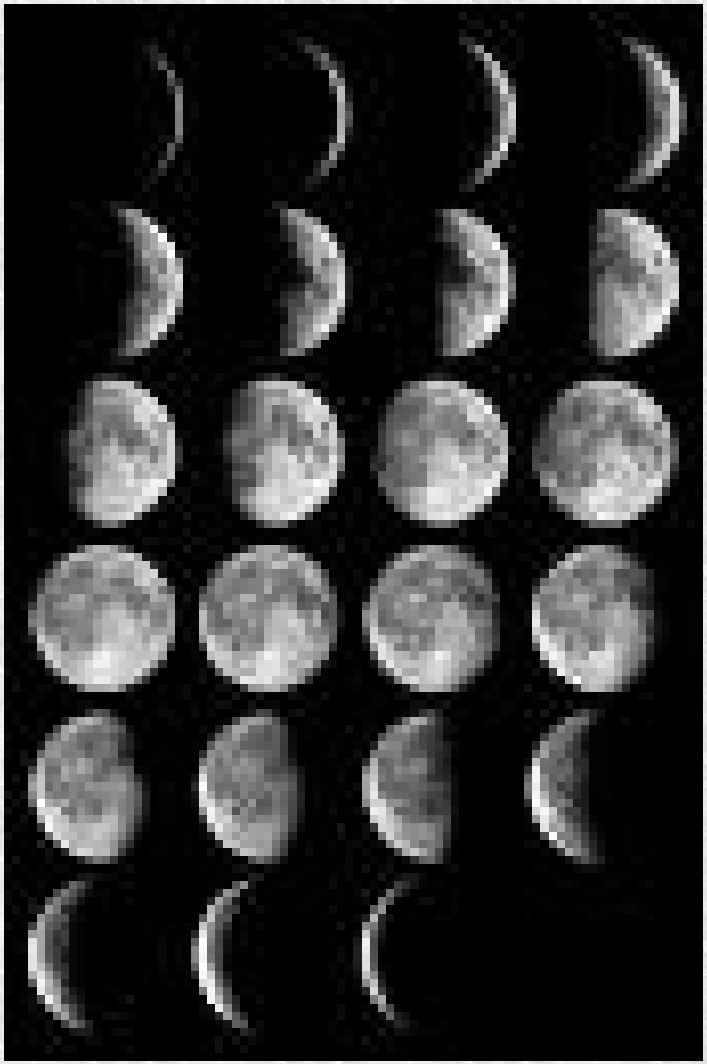
- The moon rotates in the same period of time as it revolves around Earth, thus keeping the same face toward Earth

Misconception:
Far side of moon = “dark side” of moon



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- We don't see the far side (back side) of the moon
- But it's fully lit at new moon, dark at full moon, and partially lit at other times

Misconception: the moon is only visible at night

Robert Servranckx, www.art.com

- No!! The moon is visible in the afternoon around first quarter, and in the morning around third quarter

Misconception: “Supermoons”

So-called “supermoons” are insignificant

Thousands Gather to Watch an Eclipse of the “Supermoon”

Misconception :The moon is larger when it is near the horizon: “the moon illusion”

National Geographic

- It *looks* larger, but this is an optical illusion
- You can test this by holding an Aspirin at arm's length; it exactly covers the moon, whether the moon is near the horizon or high in the sky

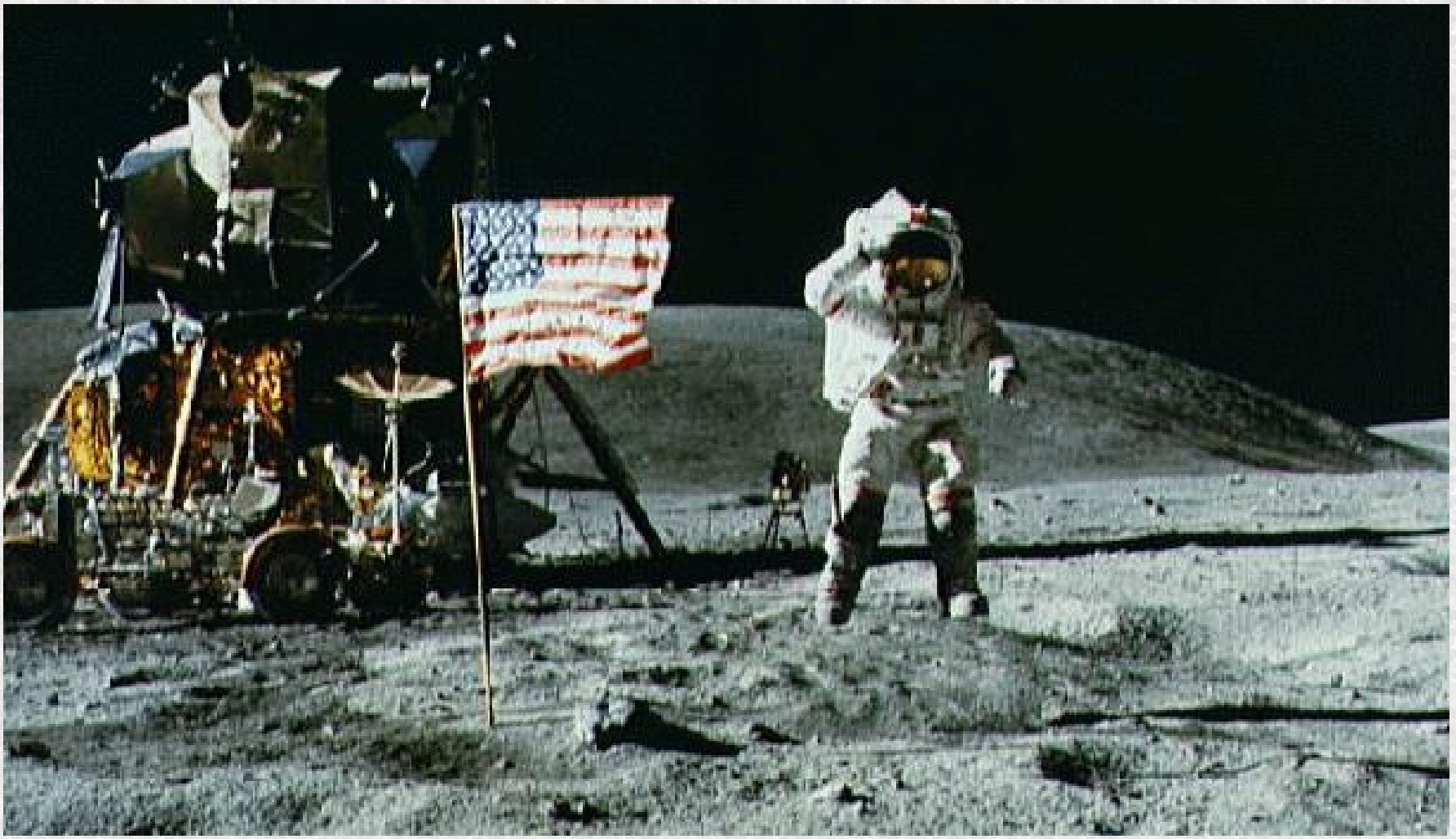
Why do astronauts feel "weightless"?

Misconception: astronauts feel weightless because there is no gravity in space

Canadian Space Agency

- Yes there is! The astronaut and the spacecraft are both falling to Earth at the same rate
- But the Space Station is moving sideways so as to follow the curvature of Earth, and not to fall to Earth

Misconception (or conspiracy theory)
The Apollo moon landings never happened



NASA

Misconception: The planets are close together and in a line

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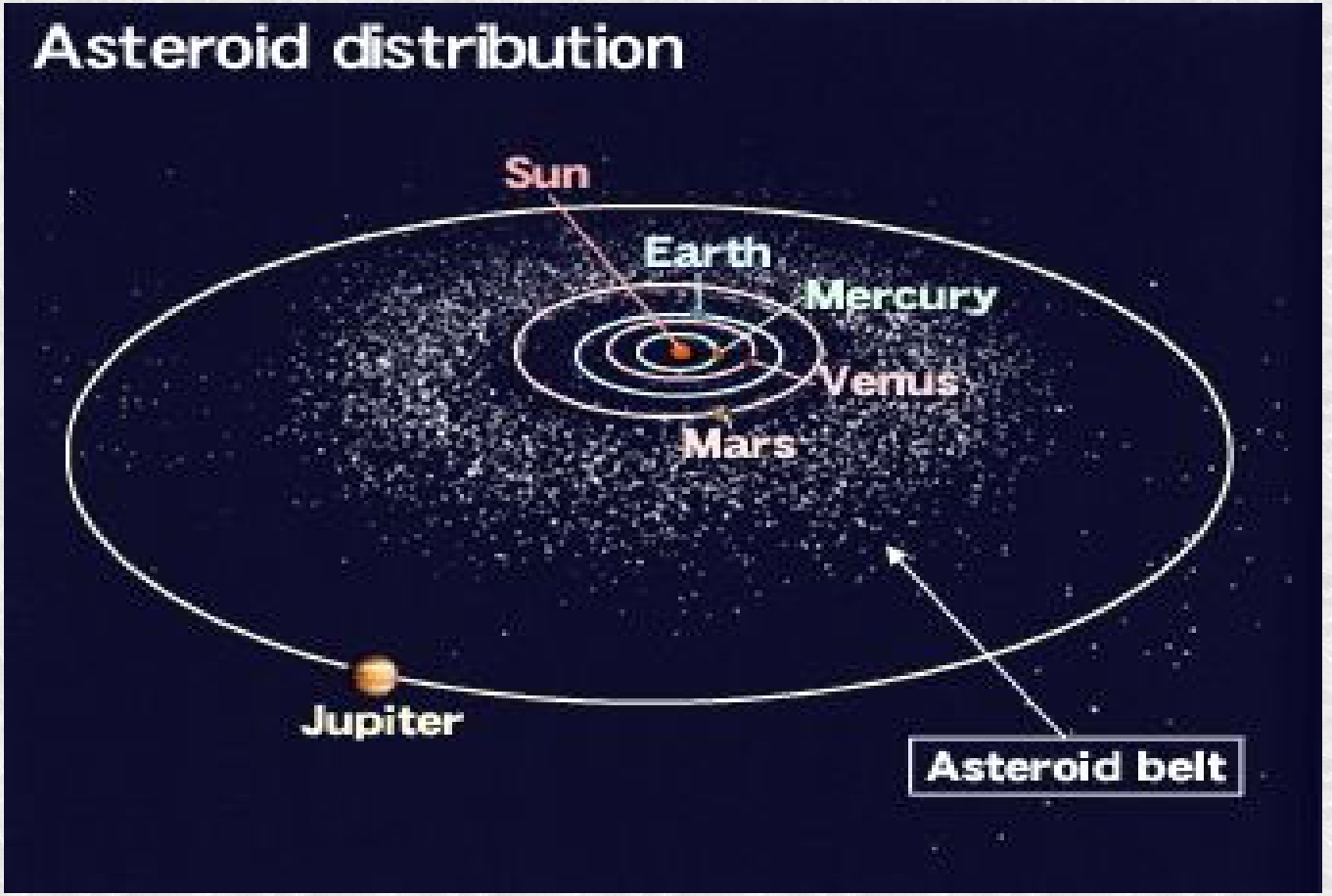
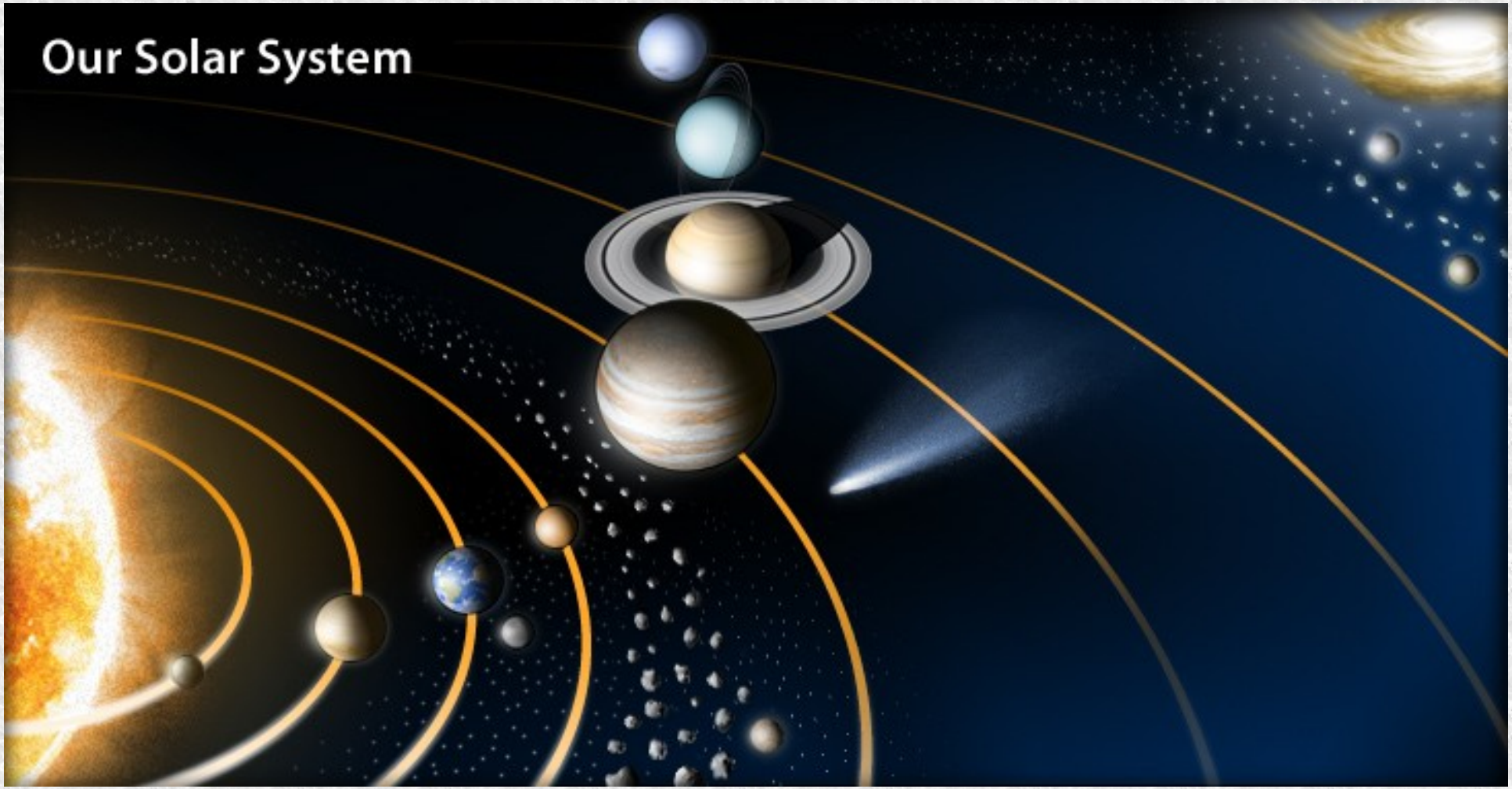
- If the sun was a beach ball, the planets would be tiny objects, at distances of up to 2 km, in random directions

Misconception: The asteroid belt is densely packed (thanks to misleading diagrams and cartoons). Not so!



How Do We Teach Solar System?



Misconception: There's a “Planet X”

NASA

- Before Pluto was demoted to "dwarf planet”, it was the 9th planet, and “Planet X” was an undiscovered 10th planet
- Sounded mysterious and conspiratorial!
- **But now there's a real suspected Planet IX!**

What is this? What's it doing?

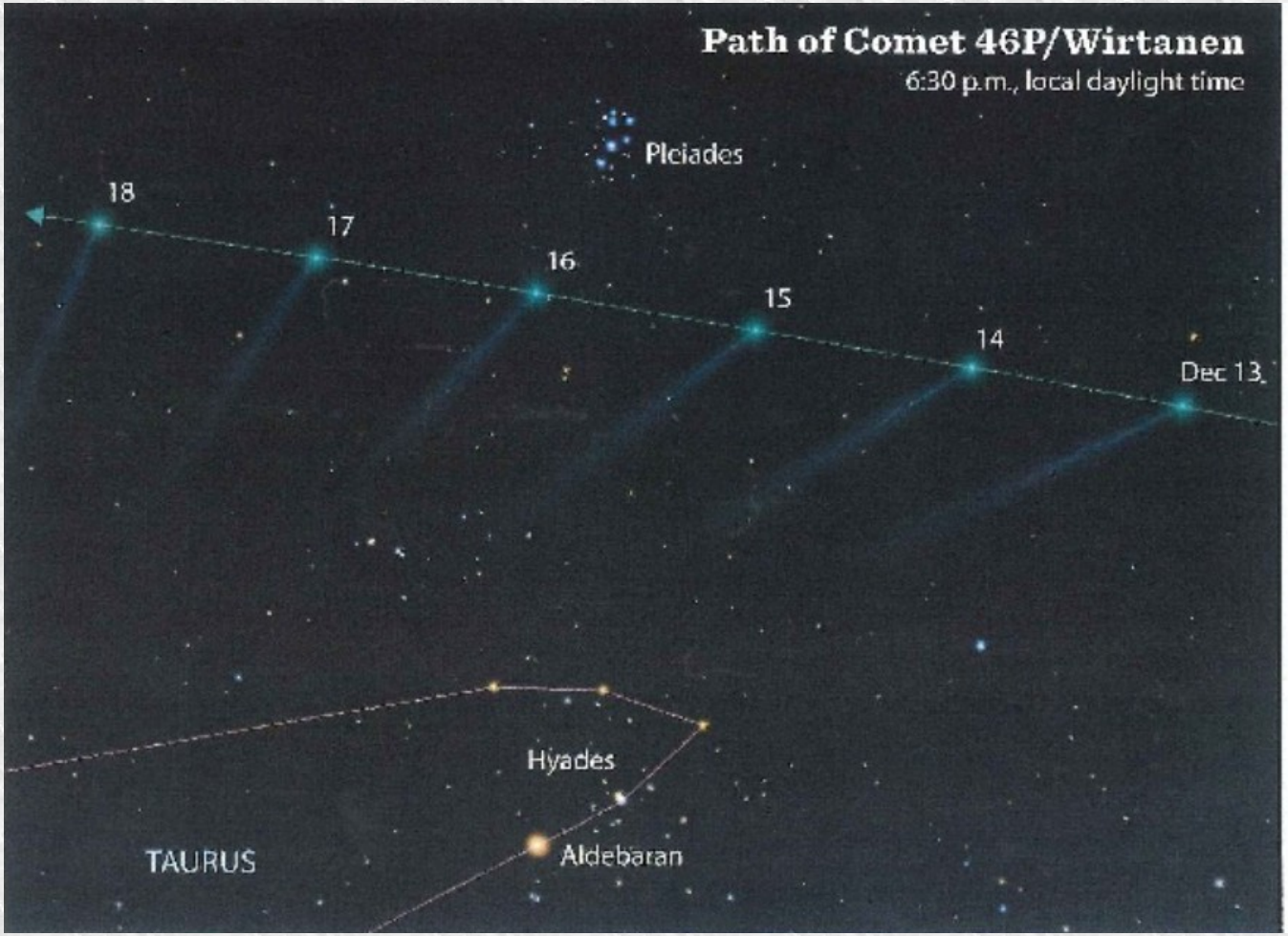
NASA

Misconception: (1) Comets streak across the sky, and (2) their tails trail behind, like a cat's

NASA

Comet Facts

(1) Comets move slowly across the sky and (2) their tails always point away from the sun.



Comet Catalina 2015-6

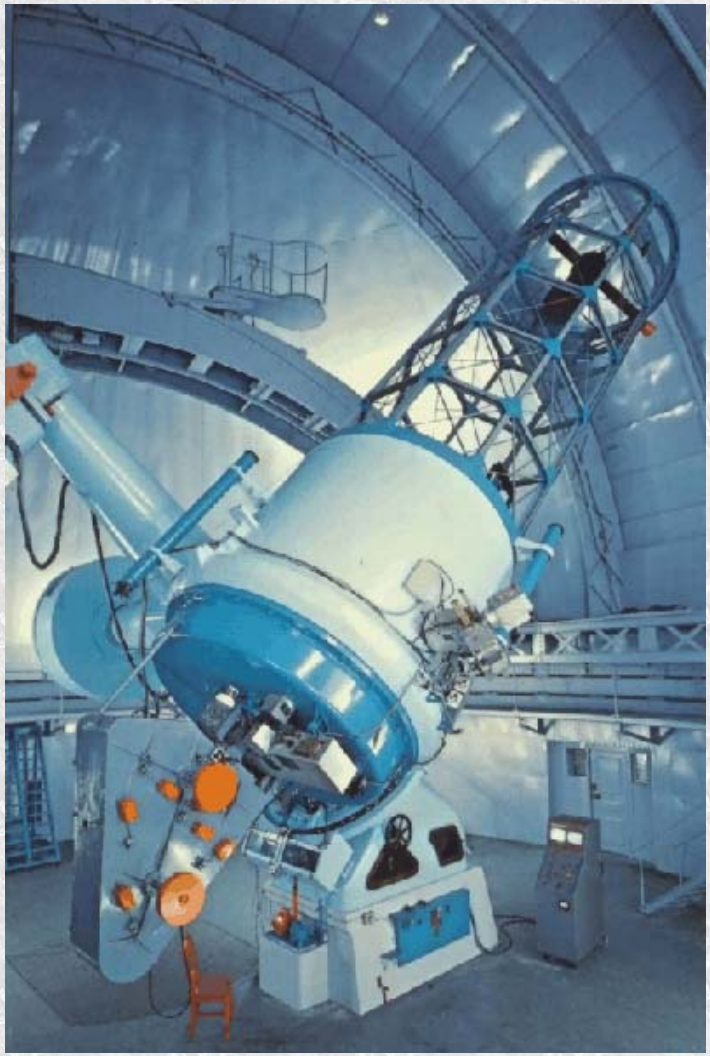
So why do we call it a comet “tail”?

Misconception: “Shooting stars” or “falling stars” are stars

Fact: they are meteors – streaks of light made by tiny space rocks as they pass through the atmosphere in a second

NASA

Misconception: The purpose of a telescope is to magnify



University of Toronto

- That's only true if you look through a telescope, which research astronomers seldom do
- A telescope is to gather light (light gathering power) and bring it to a sharp focus (resolving power)

Misconception: All stars are white

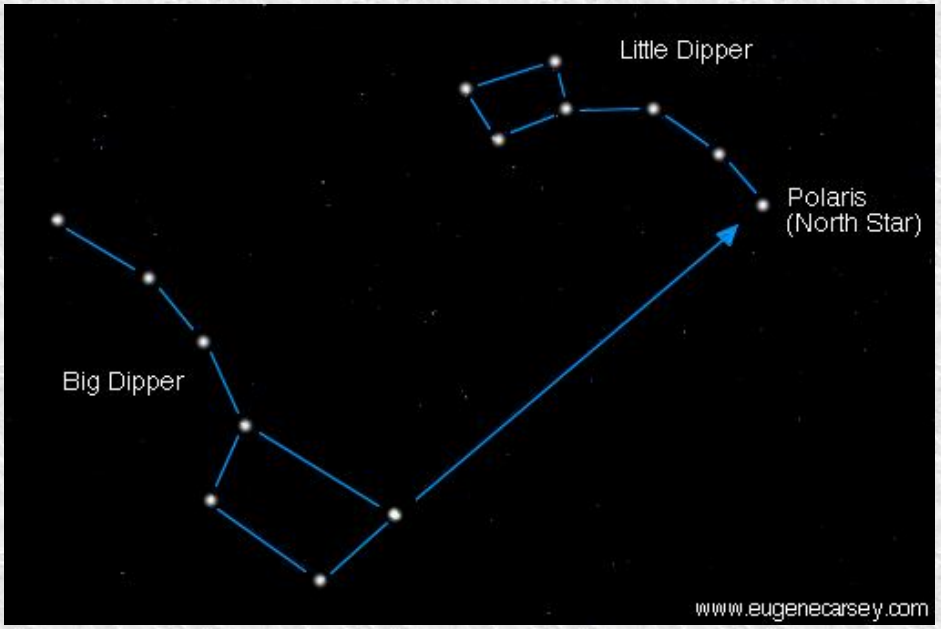
NASA

- No!! Check out Orion
- Betelgeuse is reddish
- Rigel is bluish
- Problem: looking at faint objects, our eyes have very little colour sensitivity
- Binoculars help!

What is the brightest star in the night sky?

Misconception

Polaris is the brightest star in the night sky



- Polaris, the North or Pole star, is well known because it is almost due north
- But -- Sirius is brightest; Polaris ranks about #47
- But it's interesting: a multiple, variable, supergiant star

Is the sun an average star?

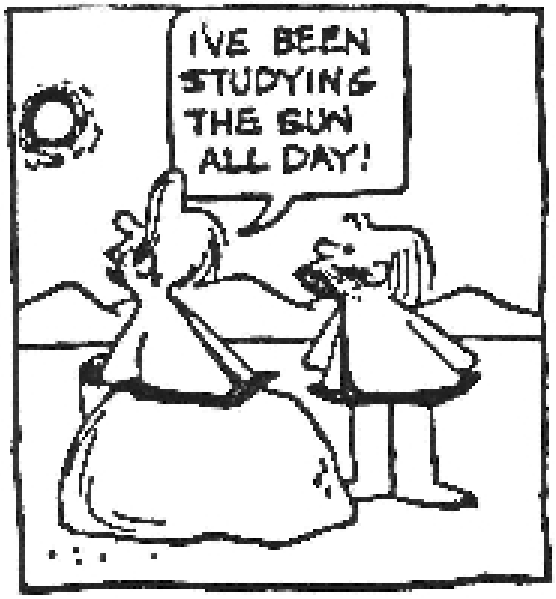
Misconception: The Sun is an Average Star
Fact: it is bigger and brighter than over 90 percent of all stars, which are red dwarfs

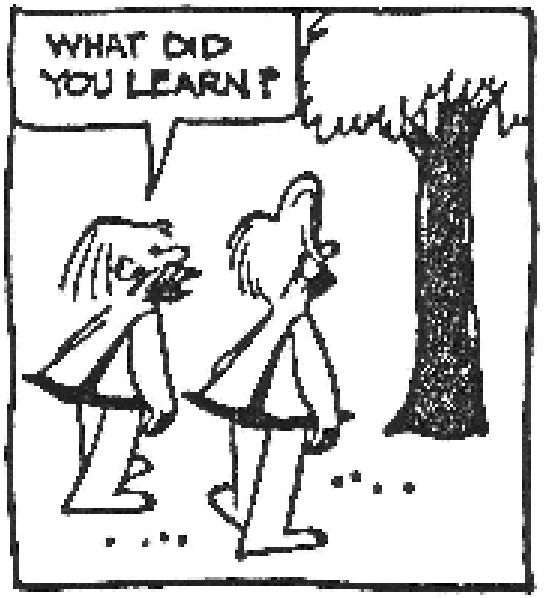
Misconception: The sun is on fire

- The sun shines by nuclear fusion
- The surface is too hot for burning!

Misconception: During an eclipse of the sun, it emits deadly rays

- People are told not to look at the sun during an eclipse
- Before and after a total eclipse, looking at the bright sun would burn your retina because of its normal heat and light
- Normally, people would have no reason to look at the sun!


I'VE BEEN STUDYING THE SUN ALL DAY!


WHAT DID YOU LEARN?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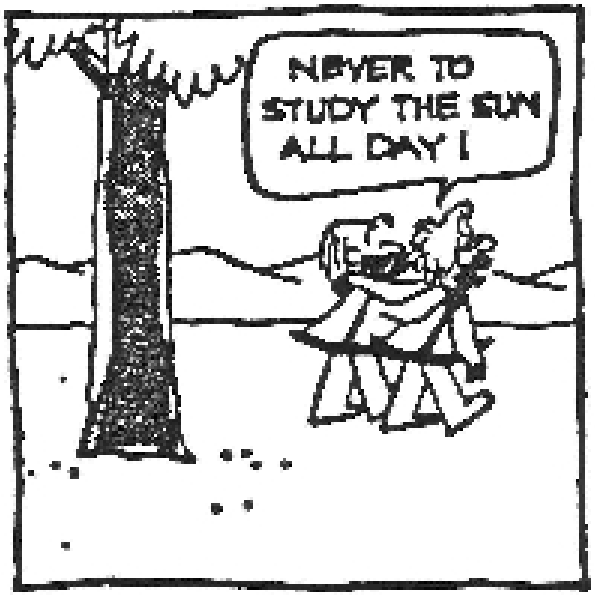
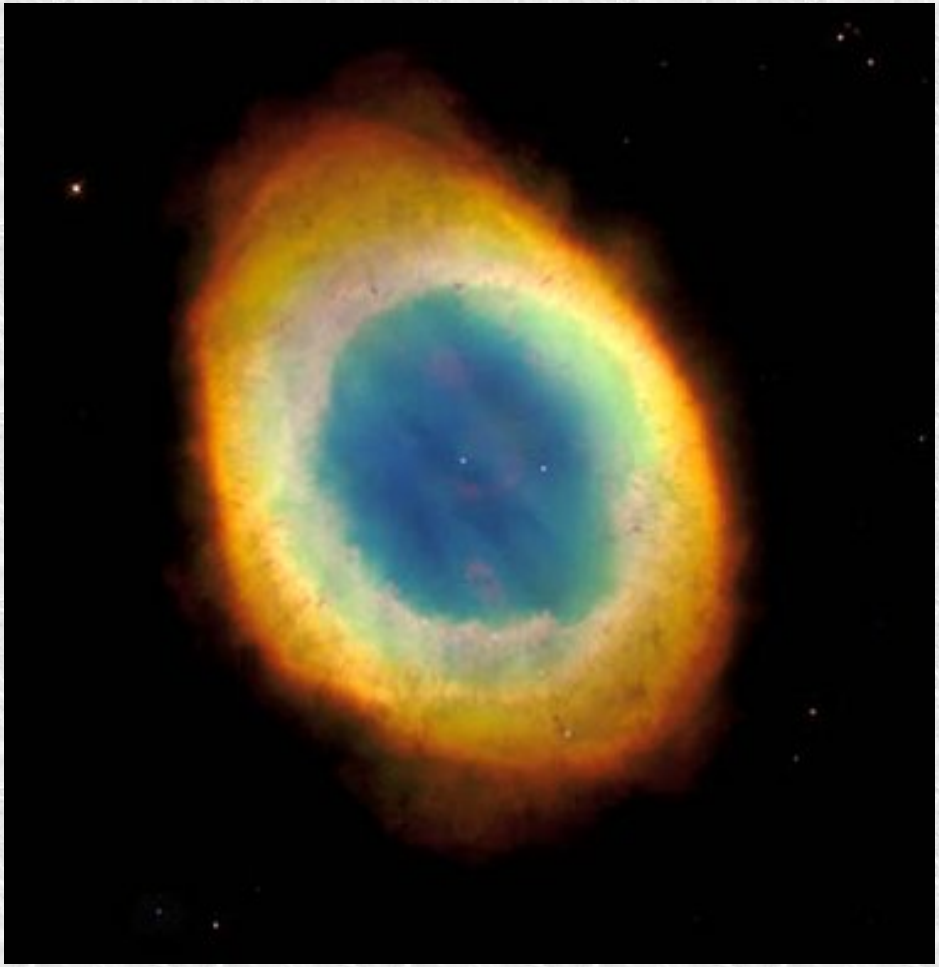

NEVER TO STUDY THE SUN ALL DAY!

Misconception: At the end of its life, the sun will explode, and turn into a black hole



NASA

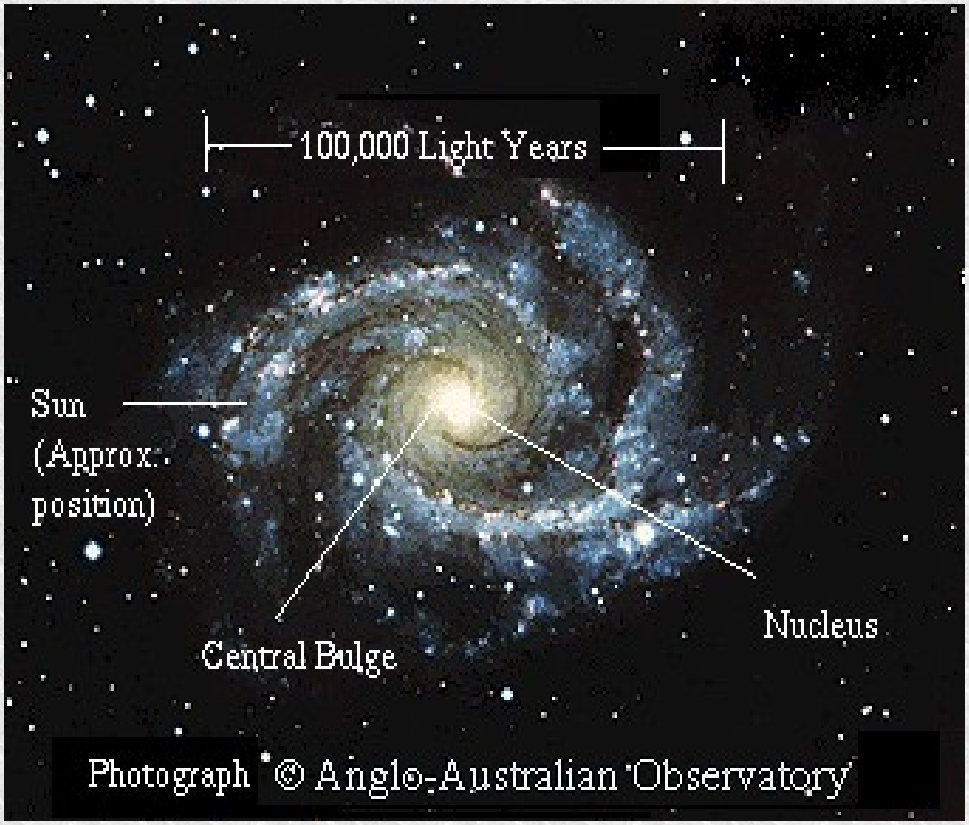
- No!! At the end of its life, the sun will run out of fuel, slowly expand and cool, gently eject its outer layers into space, exposing its white dwarf core.
- One cause of this misconception: *Trivial Pursuit (version 1)*

Misconception: Black holes are cosmic vacuum cleaners, consuming everything.

NASA

- A black hole is something whose gravity is so strong that nothing can escape – not even light
- Example: the end of a rare, very massive star
- But -- it only affects things that are very close to i

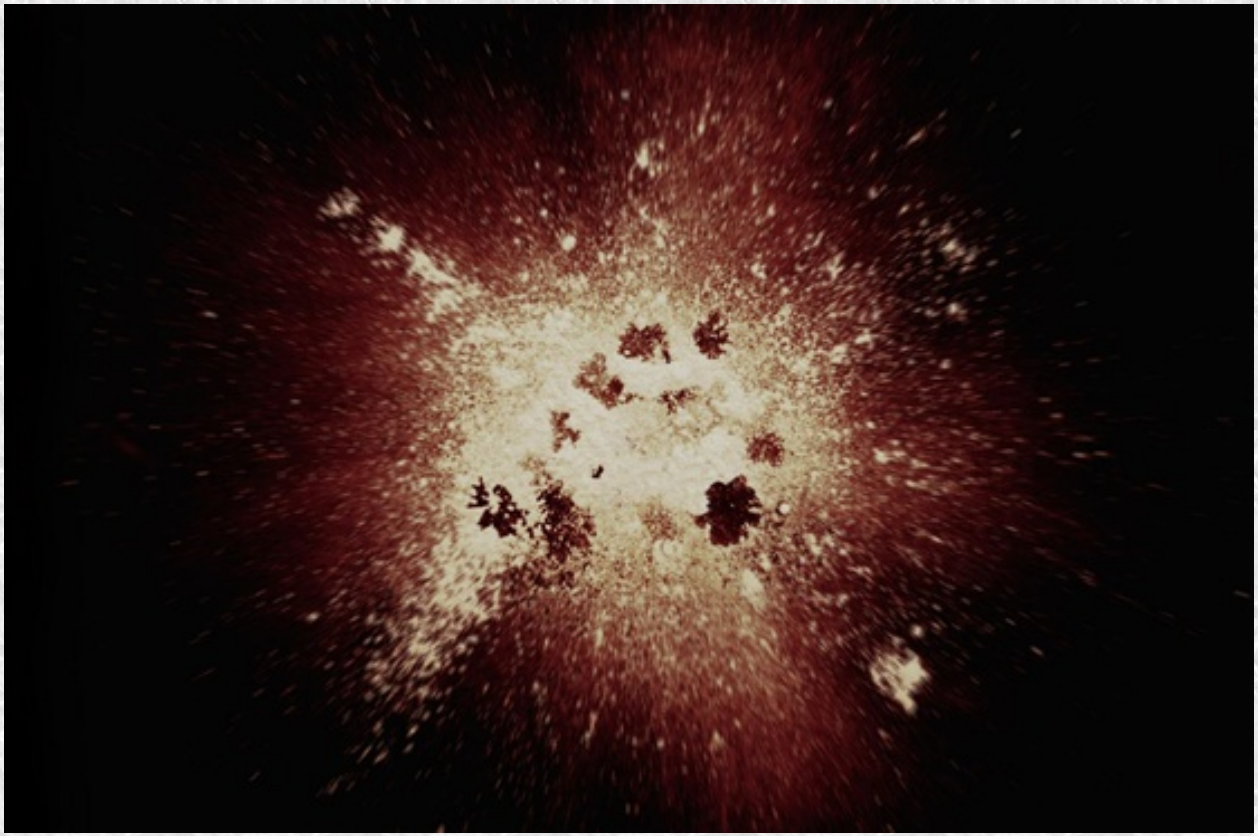
Misconception: Light Year a unit of time.



- No!! The light year is the distance that light travels in a year, travelling at 300,000 km/sec – about 10 million million km
- The misconception comes partly from language and partly because of its use in popular culture

Misconception

The Big Bang, the birth of the universe, was an explosion into pre-existing, empty space



Boston University

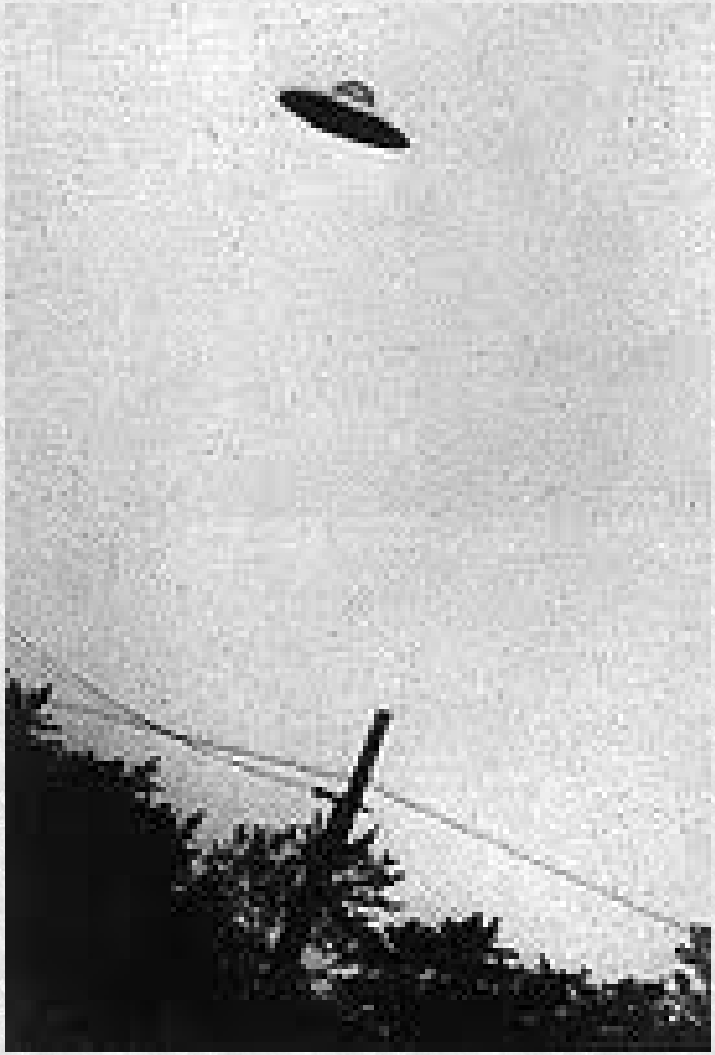
- The Big Bang was the origin of space, time, and matter
- Space is expanding, carrying matter with it

Three Subtle Misconceptions

Widely-Held Belief: Astrology: The positions of the sun, moon, and planets influence human events and behaviour

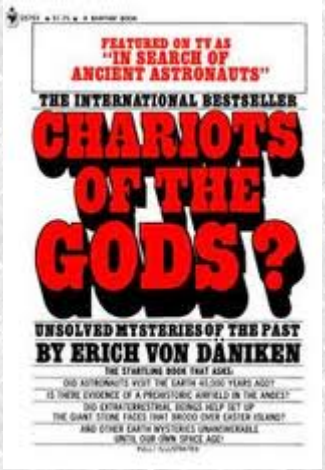
- No!! Numerous studies show that there is no evidence that astrology has an astronomical basis
- Basis for belief: media; culture; astrologer may be a good counsellor; “placebo effect”; but “it's not in the stars”

Widely-Held Belief: Space aliens have visited Earth



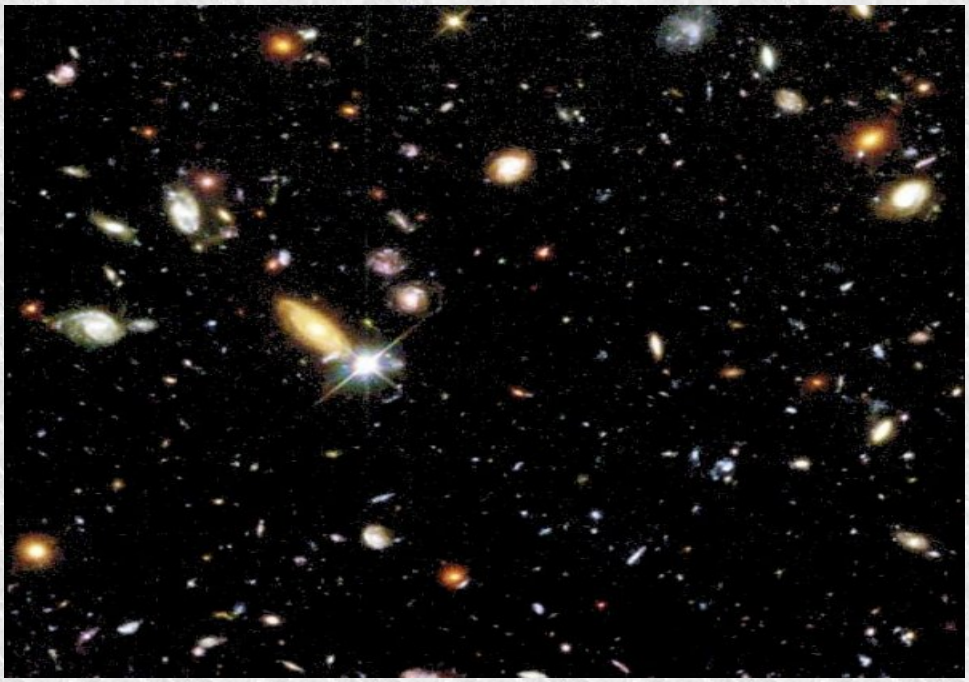
New Jersey, 1952; from FBI files

- Basis for belief: media, popular culture
- There is no evidence that space aliens are visiting Earth (“flying saucers”) or did so in the past (“Ancient Astronauts”)



Widely-Held Belief:

The universe, earth, and life were created in their present form, only 6,000 years ago



The Hubble Ultra-Deep Field, showing
Galaxies up to 10 billion light years away,
Seen as they were 10 billion years ago (NASA)

- Basis for belief: faith in one interpretation of one scripture of one religion
- There is overwhelming evidence, from many branches of science, that the universe is ancient, and evolving

Ways of Knowing

The word of people you respect: family, religious leaders, teachers and other professionals

Your community/culture/peers

Books, internet, “popular culture”

Finding out yourself, through evidence and critical thinking

Evidence and critical thinking are more important than ever!

Why Does it Matter?

- Quality of science teaching in schools and universities
- Prevalence of “fake news” in the media and society
- Science is important to our health, environment, planet, and society!
- Some examples: climate change, GMOs, vaccines

Important Caveat to Remember

- It's just as important to *appreciate* astronomy as to *understand* it!
- “Astronomy is useful because it is grand. It shows how small our bodies, how large our minds”. -- Henri Poincaré

THE FAR SIDE By GARY LARSON

"Mr. Osborne, may I be excused? My brain is full."

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www.astro.utoronto.ca/~percy/EPOindex.htm

www.astro.utoronto.ca/~percy/miscons.pdf

Useful reference: www.umaine.edu/heavenly-errors

“Heavenly Errors”, by Neil Comins (Columbia UP, 2001)