

# Astronomy



From Galileo to Spitzer and Beyond!



# Syllabus

Week 1: Introduction. Beginning Astronomy. Naked eye viewing, finding your way in the (Northern) sky, some interesting objects.

Week 2: Telescopes, history, types and use. Visual fields, understanding magnification, what sort of telescope to use for what sort of observation. Some minimal math.

Week 3: Basic physics. What are Stars, planets, asteroids, moons, comets, etc. What do we see in the night sky? What do we NOT see? What is our Galaxy?

Week 4: Telescope setup – how to get the most from your instruments.

Week 5: Local viewing – Moon and planets

Week 6: Stars, gas, dust and Pretty Pictures

Week 7: Looking at Deep-Sky Objects – Nebulae and Galaxies

Week 8: Astrophotography

# Introduction

Jack Chastain

10" Meade LS200-GPS scope



# Beginning Astronomy

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What can we do with our own eyes? You might be surprised.

Later, we will touch a bit on those instruments, but for the moment, the Instrument is your Eyes.

# Beginning Astronomy

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Nebulae (yes!)

Galaxies (yes again!)

Dust – both directly and indirectly.

# Beginning Astronomy

## Satellites

Rather than jump right into the Stars, let's start closer to home.

Artificial Satellites – What are they and Why do we care about them?

How are they different from Natural Satellites?

Where are they?



# Beginning Astronomy

## Satellites

Artificial Satellites – What are they?

An Artificial Satellite is placed into orbit around – something – by Humanity.

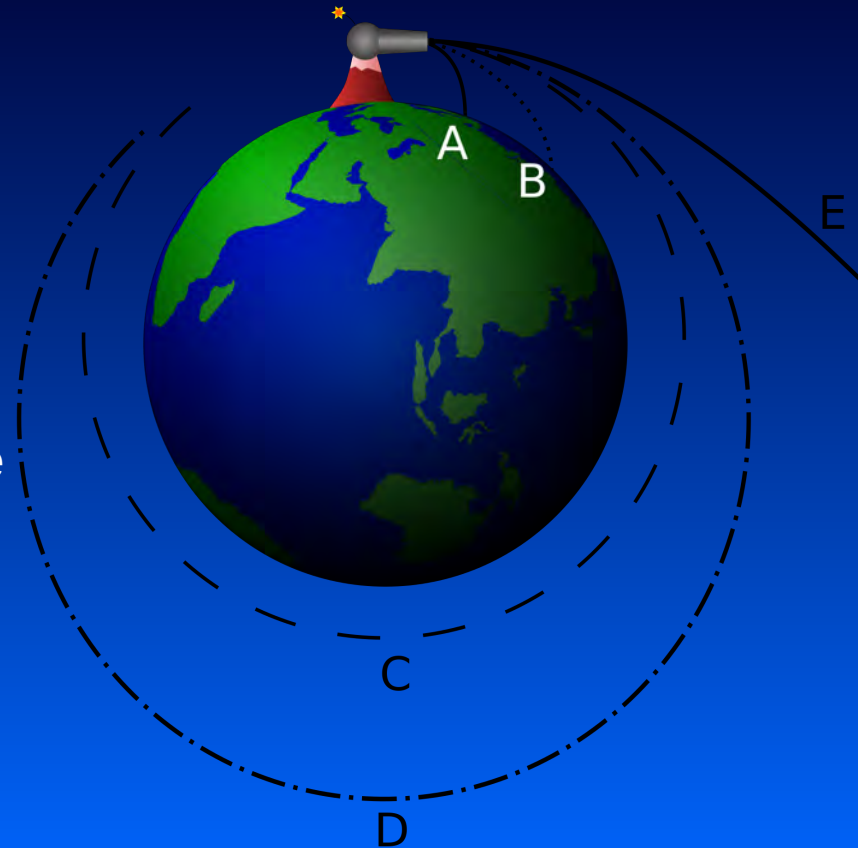
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In 1945, Arthur C. Clarke described how Communication Satellites placed in a Geosynchronous orbit could provide communication for the entire world.

From these beginnings, the idea that Humanity could place artificial objects in space became reality.

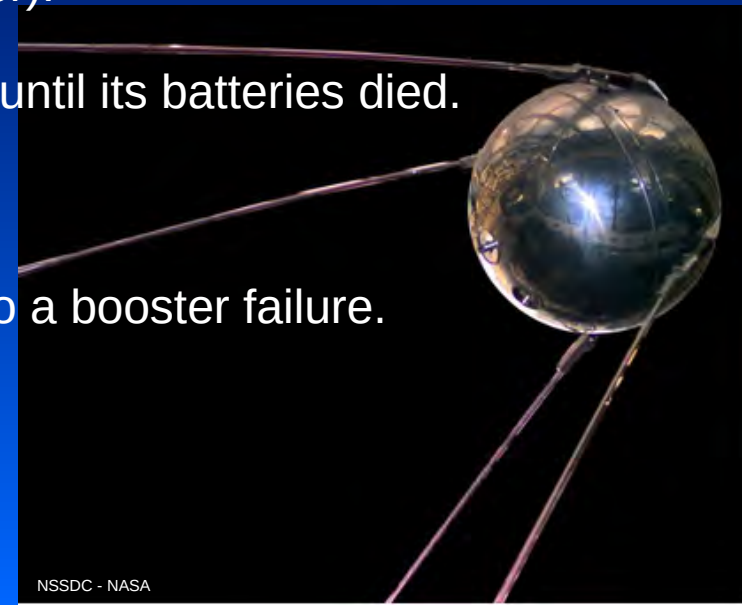
# Beginning Astronomy

## Satellites

### Artificial Satellites – What are they?

First satellite placed in orbit Oct 4, 1957 by the Soviet Union.

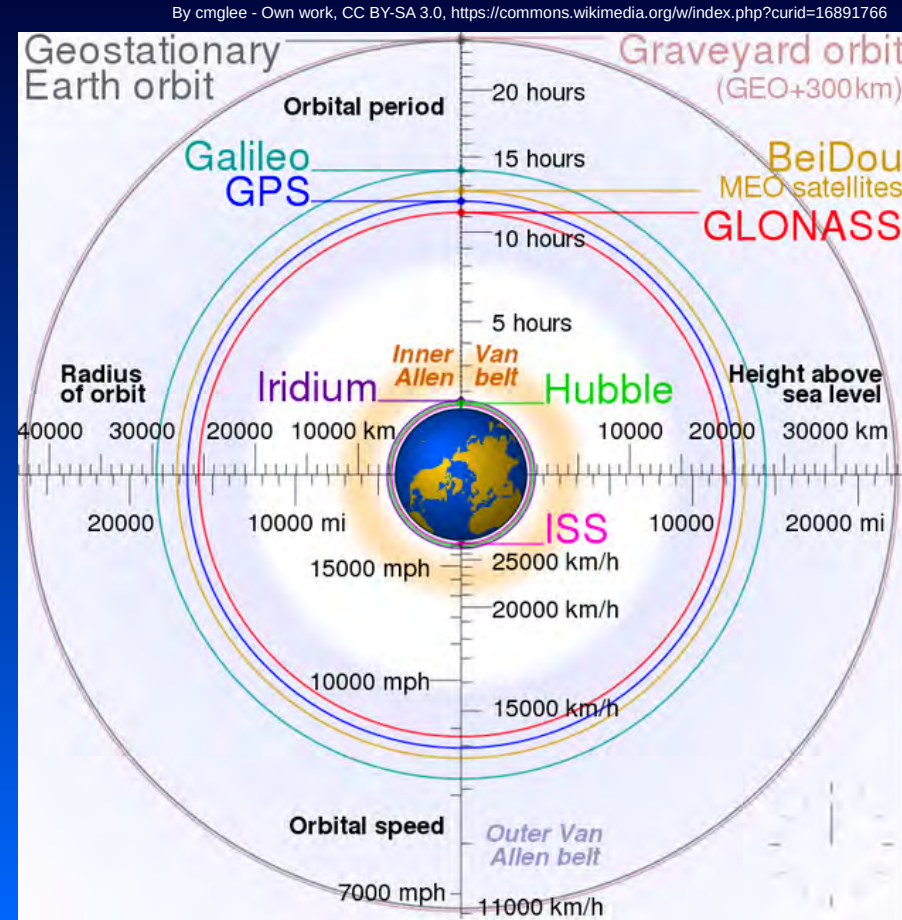
- About the size of a Beach Ball (58 cm / 23 inches diameter).
- Orbited Earth for a few months (fell in early 1958).
- Made beeps that were heard – and tracked – for 22 days until its batteries died.
- Means “traveling companion” in Russian.
- Scared the entire world.
- Initiated the Space Race.
- Actually was not orbiting where it should have been due to a booster failure.



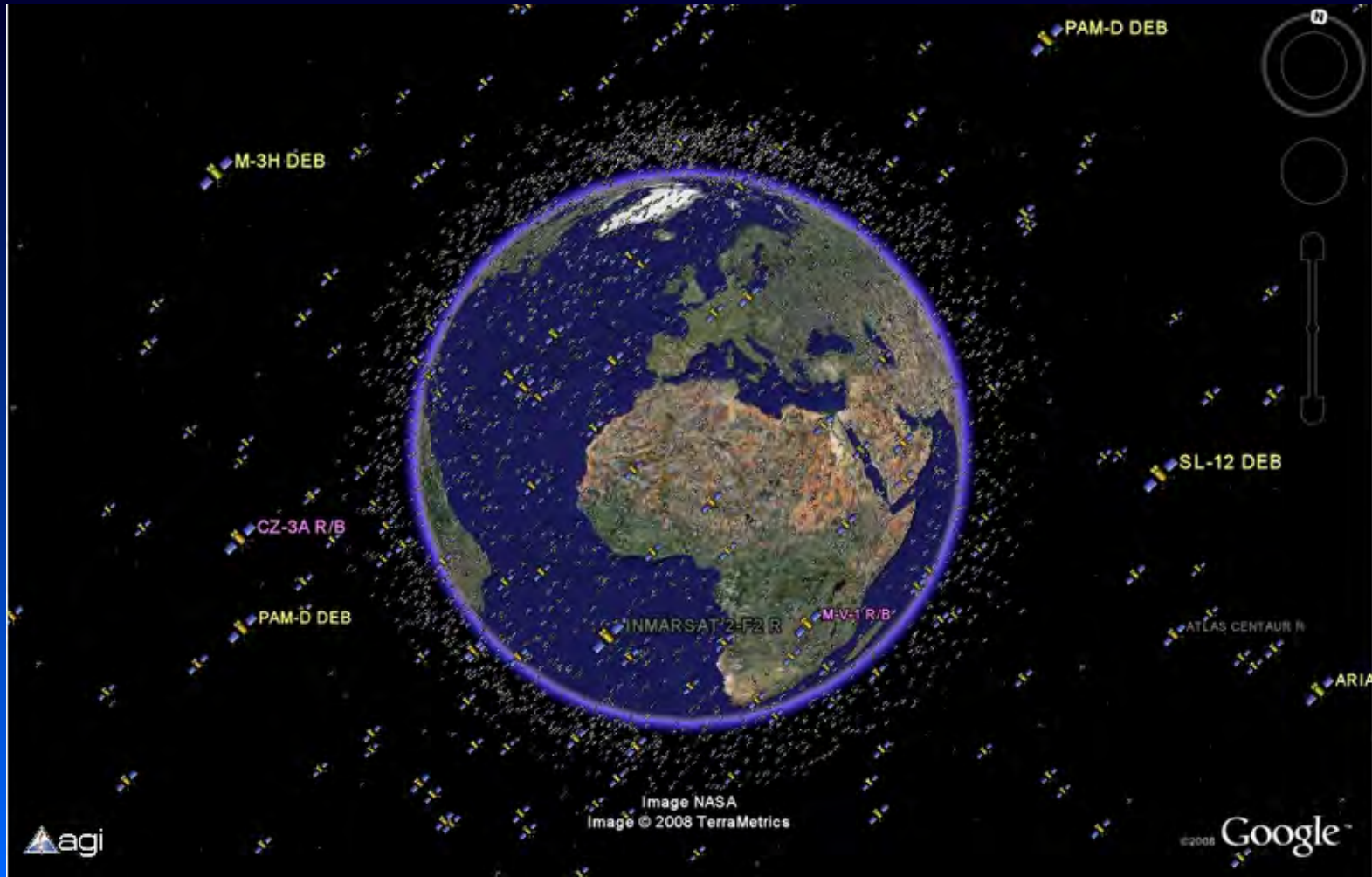
# Beginning Astronomy

## Satellites

Artificial Satellites – Where are they?



# Beginning Astronomy



# Beginning Astronomy

Earth and Moon  
from DSCOVR  
satellite





# Beginning Astronomy

## Satellites

Artificial Satellites – Why do we care about them?

- Technically interesting – or scary, depending on your point of view
- Natural result of ideas expressed by Isaac Newton
- First thing we tossed out of our atmosphere
- Usually Hated by Astrophotographers

# Beginning Astronomy

## Satellites

Natural Satellites – We can really see only one – our Moon. This will change when we begin to augment our vision with instruments, but for now, it's all alone.

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Always presents the same “face” to the Earth, but does wobble a little bit!

Also appears to “grow” and “shrink” while traveling along its orbit, but only a barely perceptible amount.

# Beginning Astronomy

## Planets

We can see most of our Solar System planets without telescopes – though some require some care. Of course, there may be some discussion about what a ‘planet’ really is. For now though, let’s set that aside and stick with the Big Eight:

- Mercury
- Venus
- Earth (Of course we can see Earth – just look down!)
- Mars
- Jupiter
- Saturn
- Uranus – if you have REALLY good vision and a good, dark sky.









# Beginning Astronomy

## Planets

As of the date scheduled for this presentation, Saturn, Mars and Venus make a beautiful line in the morning sky – Saturn rises about 0410, Mars about 0430, Venus about 0450 and finally, Jupiter about 0530. As the Sun rises at about 0620, it shouldn't wash out the view for at least a little while – well worth getting up early to see it in the morning!



# Beginning Astronomy

Planets





Altair

Capella

Mercury

Sun

Jupiter

Venus

Mars

Saturn

Uranus

Aldebaran

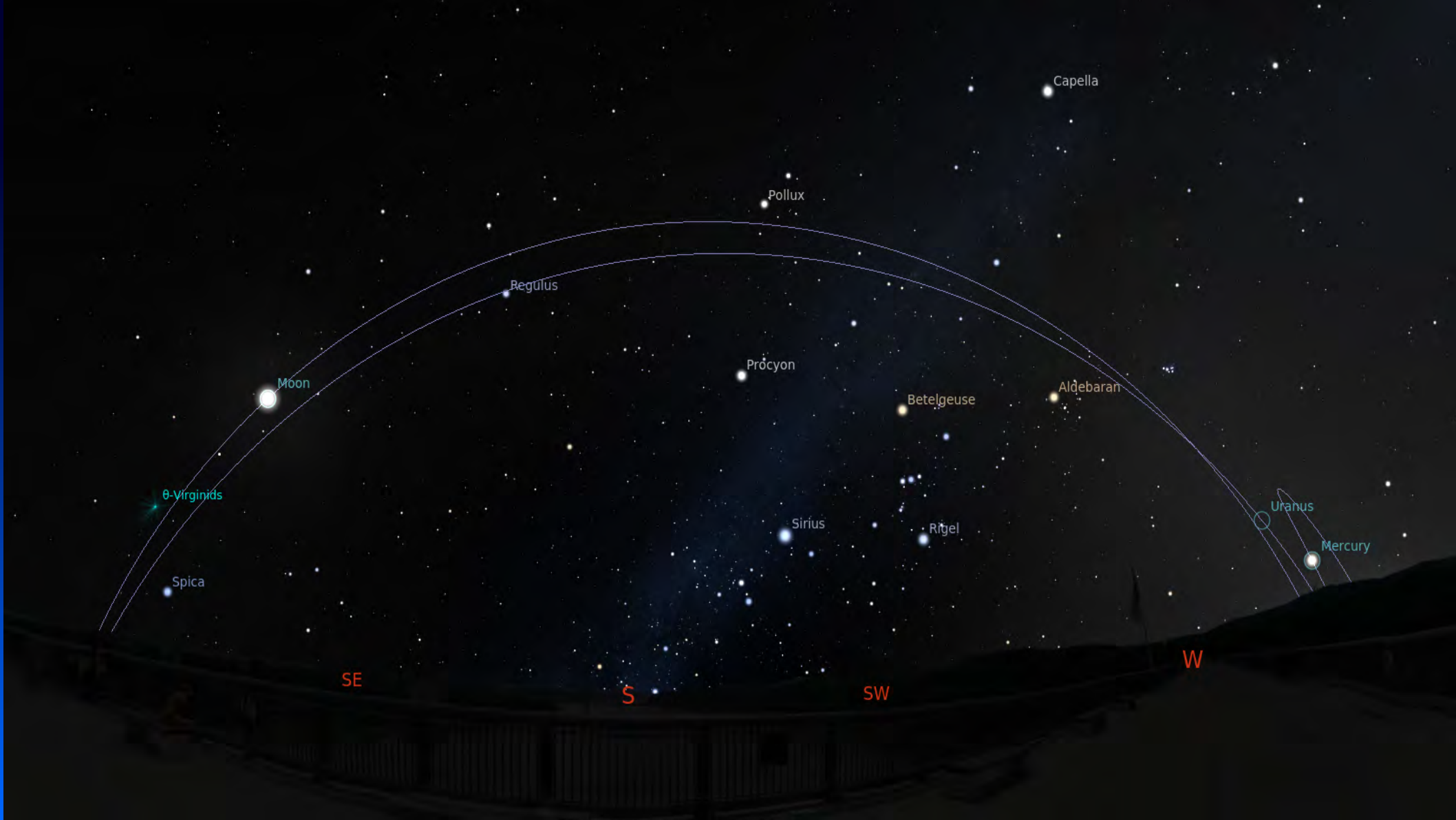
Fomalhaut

E

SE

S

SW



Capella

Pollux

Regulus

Moon

Procyon

Betelgeuse

Aldebaran

θ-Virginids

Spica

Sirius

Rigel

Uranus

Mercury

SE

S

SW

W

# Beginning Astronomy

## Stars

Finally, we get to the most prevalent thing we see in the night sky – stars.

The Sun is our star – and we CAN observe it with our eyes alone – as long as we are suitably protected. **ONLY** look at the Sun with protection rated for solar viewing – the light from the Sun includes infrared and ultraviolet light that is easily capable of damaging the eye. **BE CAREFUL!** It is not only dangerous around solar eclipses!



# Beginning Astronomy

## Stars

We see about 3000 stars any given clear night. Nearly all of these stars are within 600 light-years from Earth – though there are some notable exceptions.

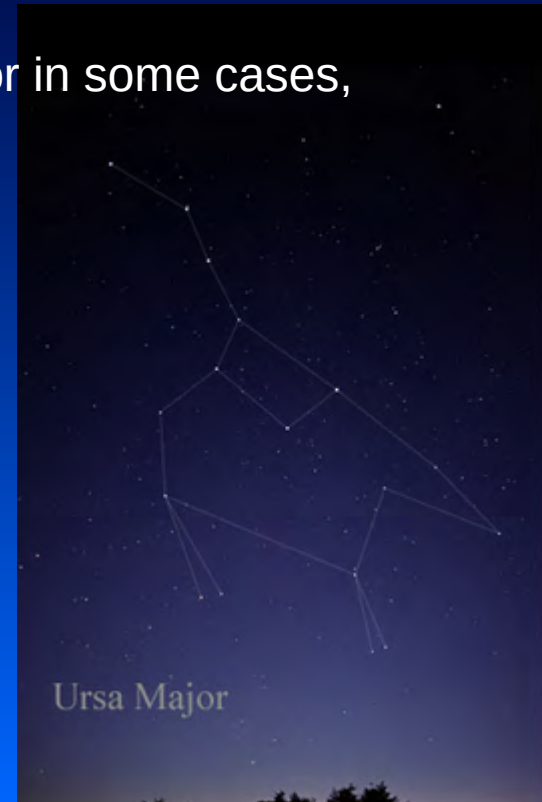
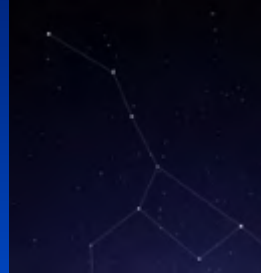


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There are 88 recognized constellations (as stated by the International Astronomical Union – IAU). They cover the totality of the sky – both Northern and Southern hemispheres, so we in the North will see about half of this number. They depict 42 animals, 29 inanimate objects and 17 humans or mythological characters. Yes, there is a list, no, we are not going to talk about every one

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The path of the Sun through the sky is called the Ecliptic. Constellations along this line are commonly called the Zodiac, meaning “circle of little animals” – even though a few aren’t animals (Libra, Aquarius, Gemini, Virgo)

# Beginning Astronomy

## Stars

Some familiar constellations (and notable stars):

Setting in the West: Easily identifiable Orion, with the Winter Triangle stars Betelgeuse, Procyon and Sirius, as well as bright Aldebaran.

Look for the distinctive line of stars of the belt, nearly horizontal. The four bright stars making out the “shoulders” and “knees” of the figure. Less visible are the stars of the club (to the left) and shield or bow (to the right)

We will revisit Orion shortly for something else!



# Beginning Astronomy

## Stars

By Till Credner - Own work, A Visual Guide to the Constellations, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=9296796>

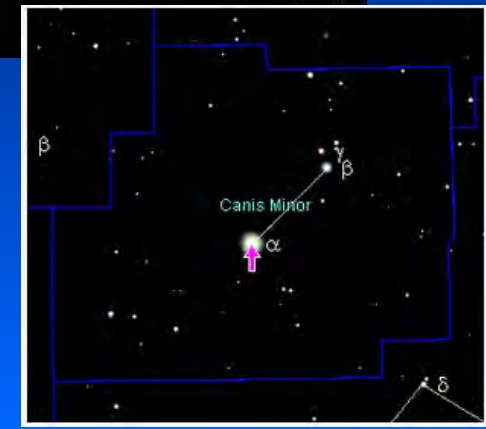
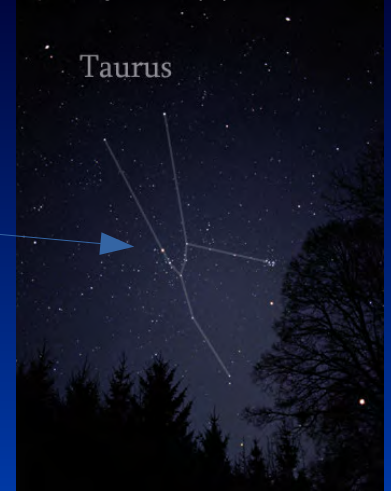
Some familiar constellations (and notable stars):

Aldebaran is the bright star in Taurus, the Zodiac constellation. 14<sup>th</sup> brightest in the sky, it is about 65 ly away.

Sirius – the brightest star in our sky – is the primary star of Canis Major, the Big Dog. It is one of Earth's nearest neighbor stars, only 8.6 ly distant.

Procyon is the main star in Canis Minor – though the constellation consists of only two stars. It is the eighth brightest and 11.46 ly distant.

Aldebaran



# Beginning Astronomy

## Stars



# Beginning Astronomy

## Stars

The dipper is important as it assists us in finding North.

The two stars in the end of the “bowl” though – Merak and Dubhe – form “guide stars” that point towards another important location – our geographic North. An imaginary line extended five times the distance between Merak and Dubhe comes very close to Polaris, our Pole Star.



# Beginning Astronomy

## Stars



What's so special about Polaris?





# Beginning Astronomy

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Have you heard that it is the "brightest star in the sky"?



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"You've been as constant as a Northern Star  
The brightest light that shines"

- Gerry Rafferty – [Right down the Line](#) (1978)



# Beginning Astronomy

## Stars

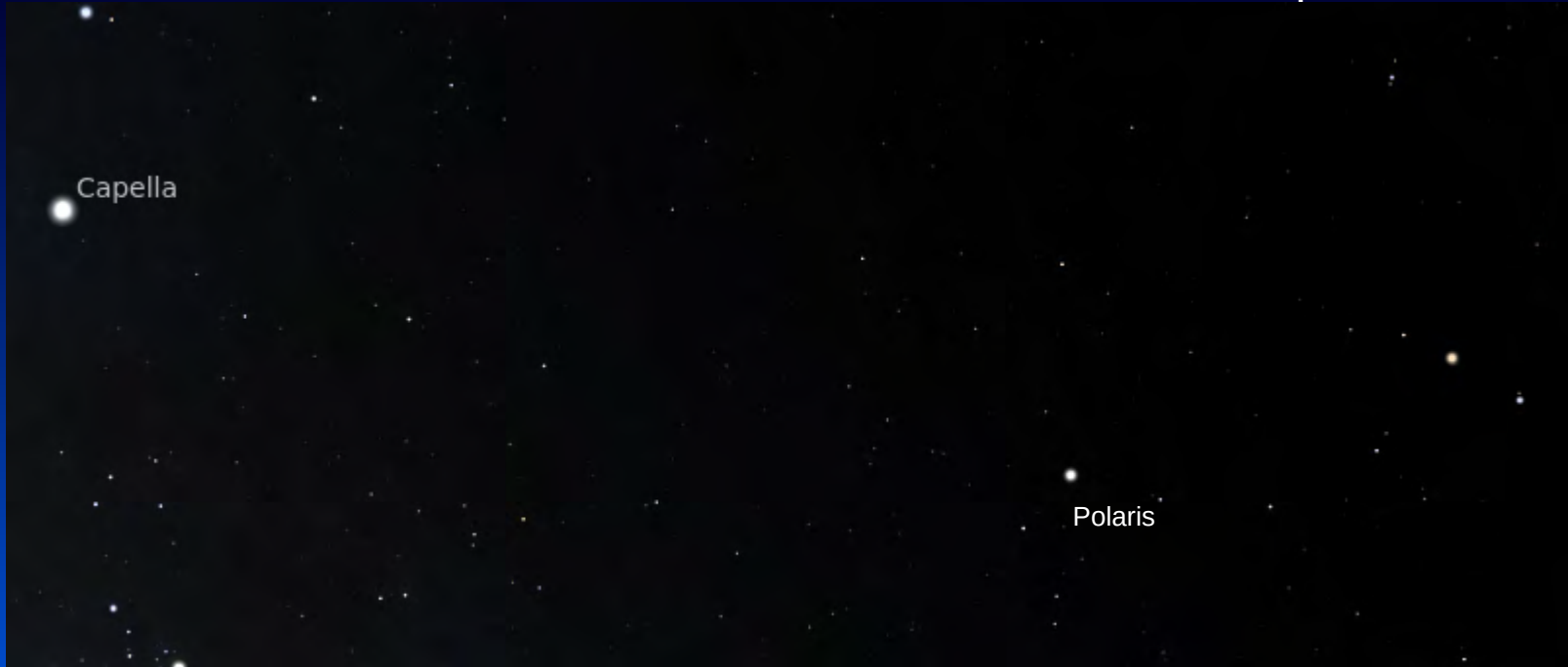
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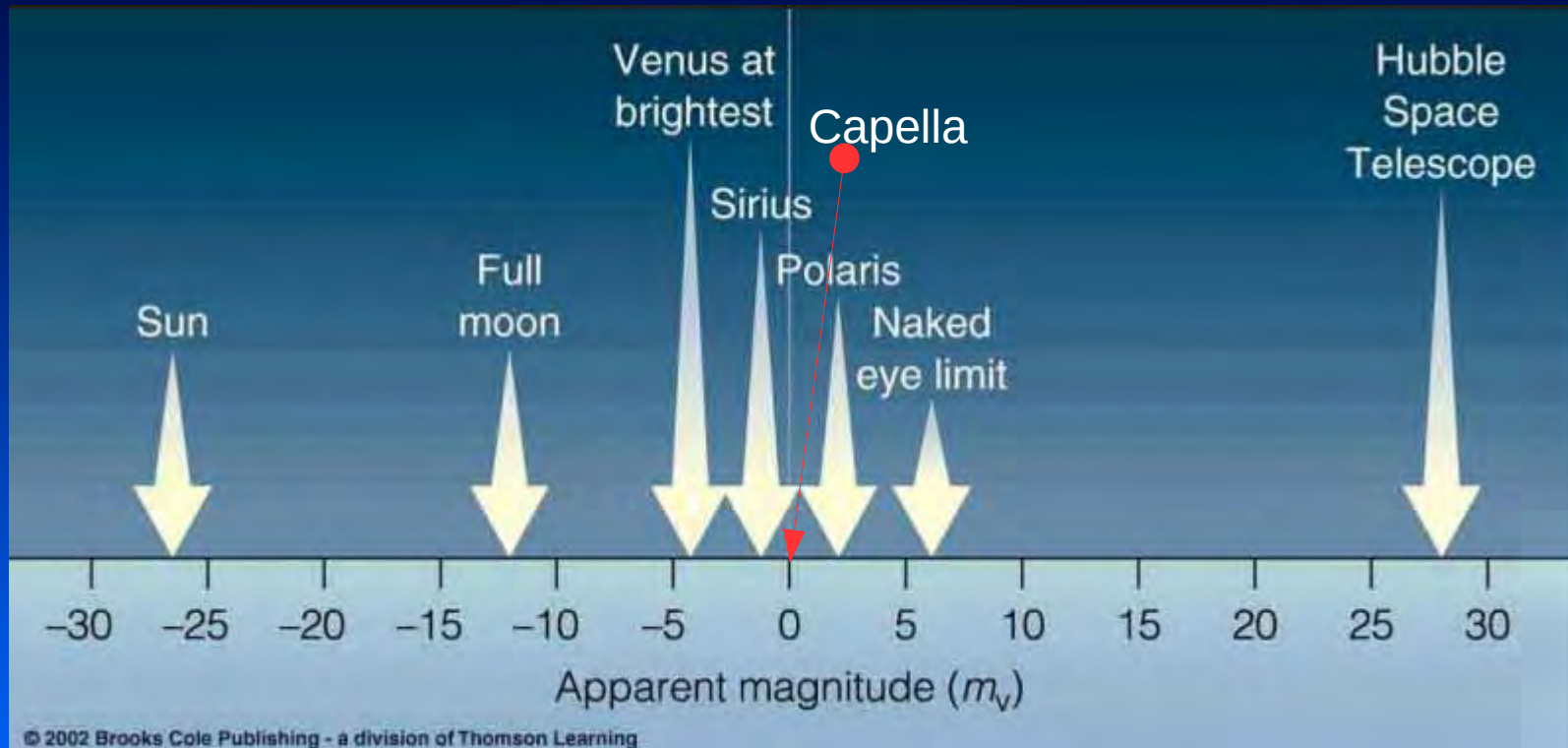


It's not particularly bright – nearby  
Capella is FAR brighter.

# Beginning Astronomy

Luminosity: How bright a star actually is.

Magnitude: How bright that star actually LOOKS



# Beginning Astronomy

Magnitude: It's like golf – the lower, the better – brighter

Each magnitude is a change of 2.512 times – a difference of 5 is 100 times

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$$m_x = -5 \log_{100} \left( \frac{F_x}{F_{x,0}} \right)$$

$m_x$  = magnitude in the spectral band

$F_x$  = observed flux density using spectral filter  $x$

$F_{x,0}$  = reference flux (zero-point) for that photometric filter

That's nice. Moving on.

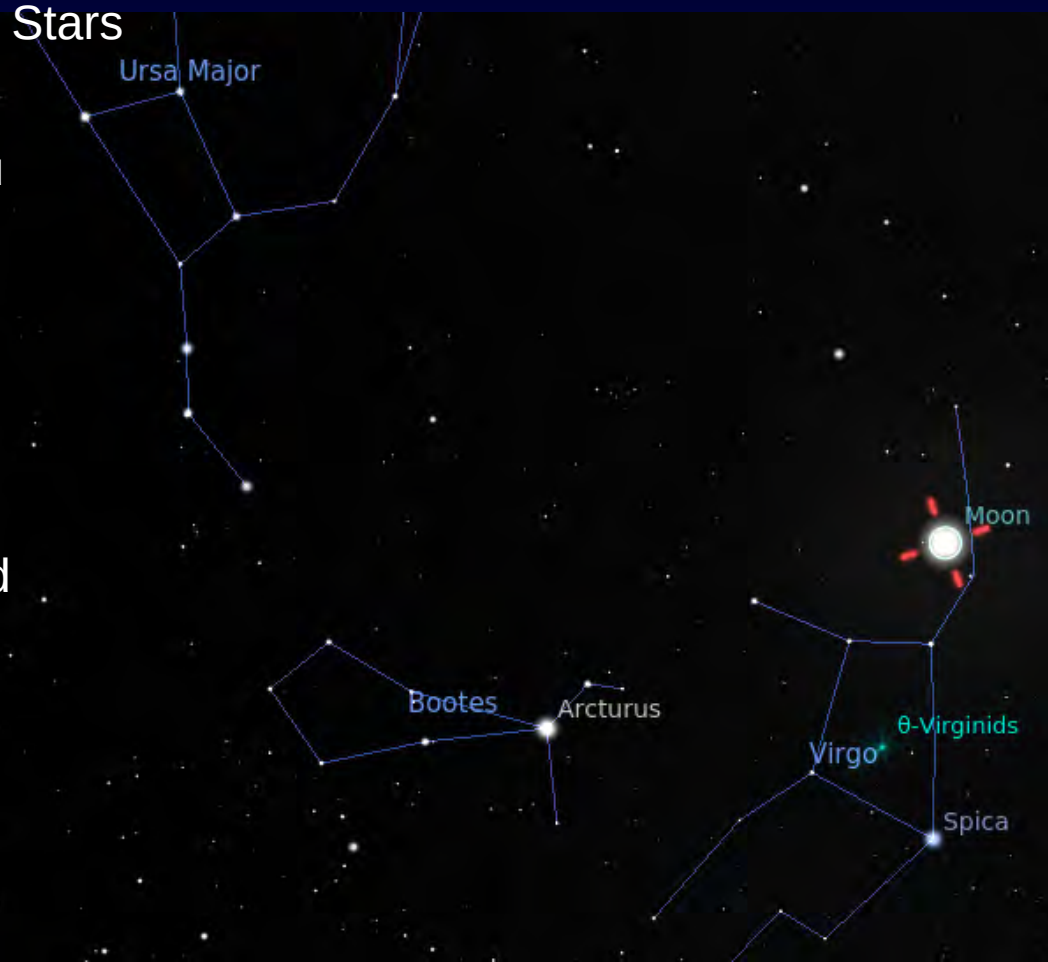
# Beginning Astronomy

Back to the Big Dipper, follow the 'arc' of stars in the handle of the Big Dipper and you will find another bright star, Arcturus. We sometimes say "Arc to Arcturus" as a reminder.

Arcturus is the primary star in Bootes, the Herdsman.

Continue further on from Arcturus to find Spica, the main star in Virgo. We say "Speed on (or 'spike') to Spica."

At the time of this presentation, Spica tomorrow night should be just below the nearly full moon.





# Beginning Astronomy

Another easily recognized constellation is Cassiopeia – the Queen. It looks like a slightly squished “W” or “M” but I tend to think of it as a double “V”.

## Stars



# Beginning Astronomy

## Other Things

Before ending tonight, there are (at least) two things we can actually see that you may not have expected.

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Before ending tonight, there are (at least) two things we can actually see that you may not have expected.

I said we would revisit Orion. Many folks are familiar with the belt stars – and the Sword, Knife or Scabbard hanging from it. Look at that sword now – and know that most of what you are looking at is actually the Orion Nebula – not individual stars at all! This nebula is the largest and one of the brightest known and the only one visible from Earth.





# Beginning Astronomy

## Other Things

Before ending tonight, there are (at least) two things we can actually see that you may not have expected.

We can see at least one star cluster – though a few others (double cluster near Cassiopeia) are BARELY visible.

The Pleiades though is clearly visible near Orion.

## Orion



# Beginning Astronomy

Other Things

Double cluster near Cassiopeia



# Beginning Astronomy

## Other Things

Finally – the largest thing we can see with our own eyes – Galaxies! There are (at least) three, but only two we can see from our area – and yes, I am cheating a bit.



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v And



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It is also approaching us and will merge with the Milky Way – in about 5 BILLION years.

# Beginning Astronomy

## Other Things

There are two other objects that can only be seen in Southern skies but are worth noting here as they are also Galaxies – the Magellanic Clouds (Large and Small).

These are Irregular galaxies, relatively small, 163,000 (Large) and 206,000 (Small) light years distant.

If you find yourself south of our continent – like in South America or Africa – be sure to look for them.

You can't see them from Hawaii, but you can from Guam!

(Well – MAYBE if you are on top of Diamond head or Haleakala – but it will be very low if so!)



# Beginning Astronomy

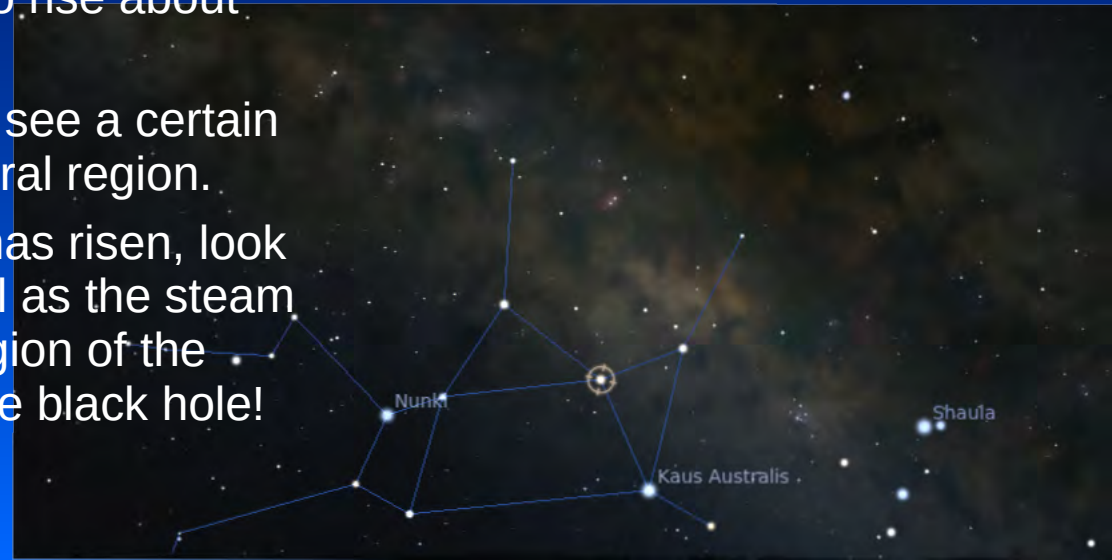
## Other Things

There is one more Galaxy that you can see naked-eye – our own.

The Milky Way is the one we live in. It's characteristics change throughout the year, but at the time of this presentation, it is showing us mostly the outer regions, so it is very dim until the central region begins to rise about 0100.

Looking South-East, you should be able to see a certain “cloudiness” that is the outskirts of the central region.

Around 0230, the constellation Sagittarius has risen, look for the recognizable “teapot” shape, as well as the steam rising from the spout. This is the central region of the Milky Way, hiding our central super-massive black hole!



Next Time: Telescopes!!  
History, Types,  
Understanding Magnification...  
And a LITTLE bit of Math!