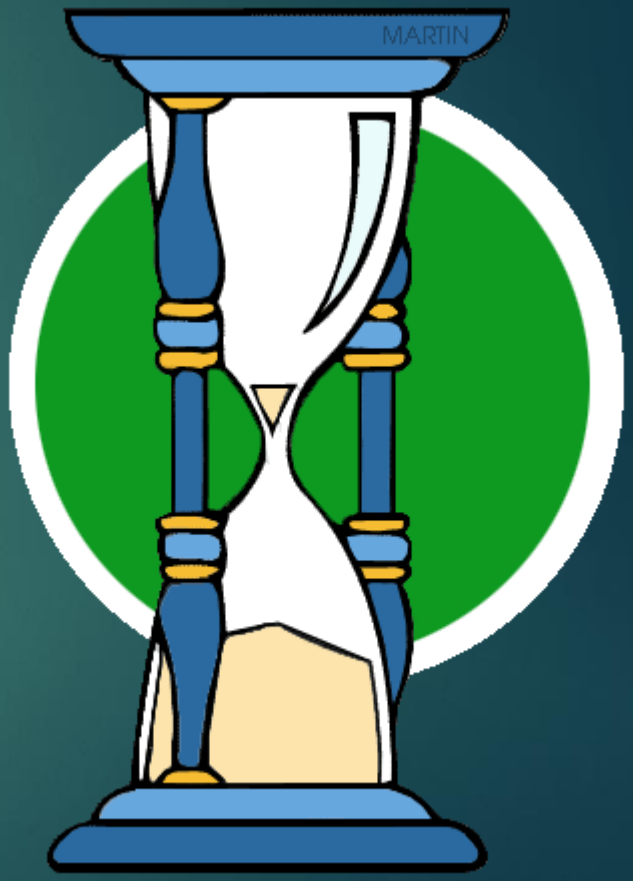
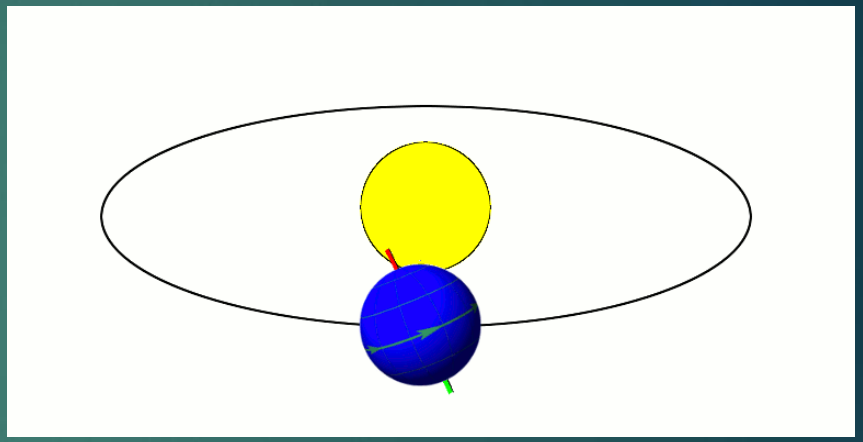
Time



Earth's revolution

- It takes the Earth 365.256 days (or rotations) to travel or revolve around the Earth once.
- This is called a year.



It is warmer on Earth during the summer because the Earth is closer to the Sun in the summer

FALSE!

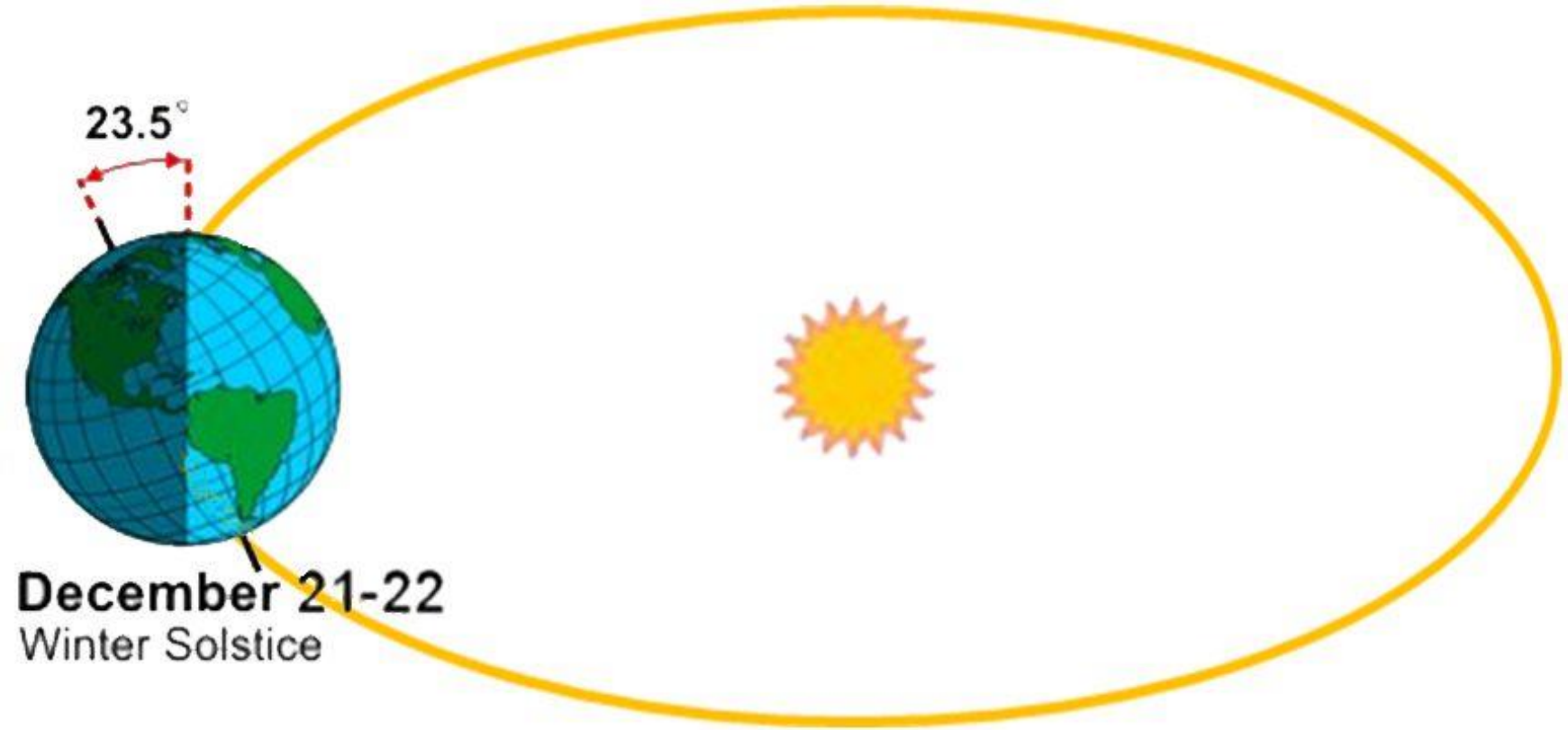
Why do we have seasons?

- It is true that the Earth's orbit around the sun is NOT a perfect circle. It is an ellipse.
- But seasons are not caused by how close the Earth is to the sun.
- In fact, the Earth is closest to the sun around January 3 and farthest away from the sun around July 4.

Why do we have seasons?

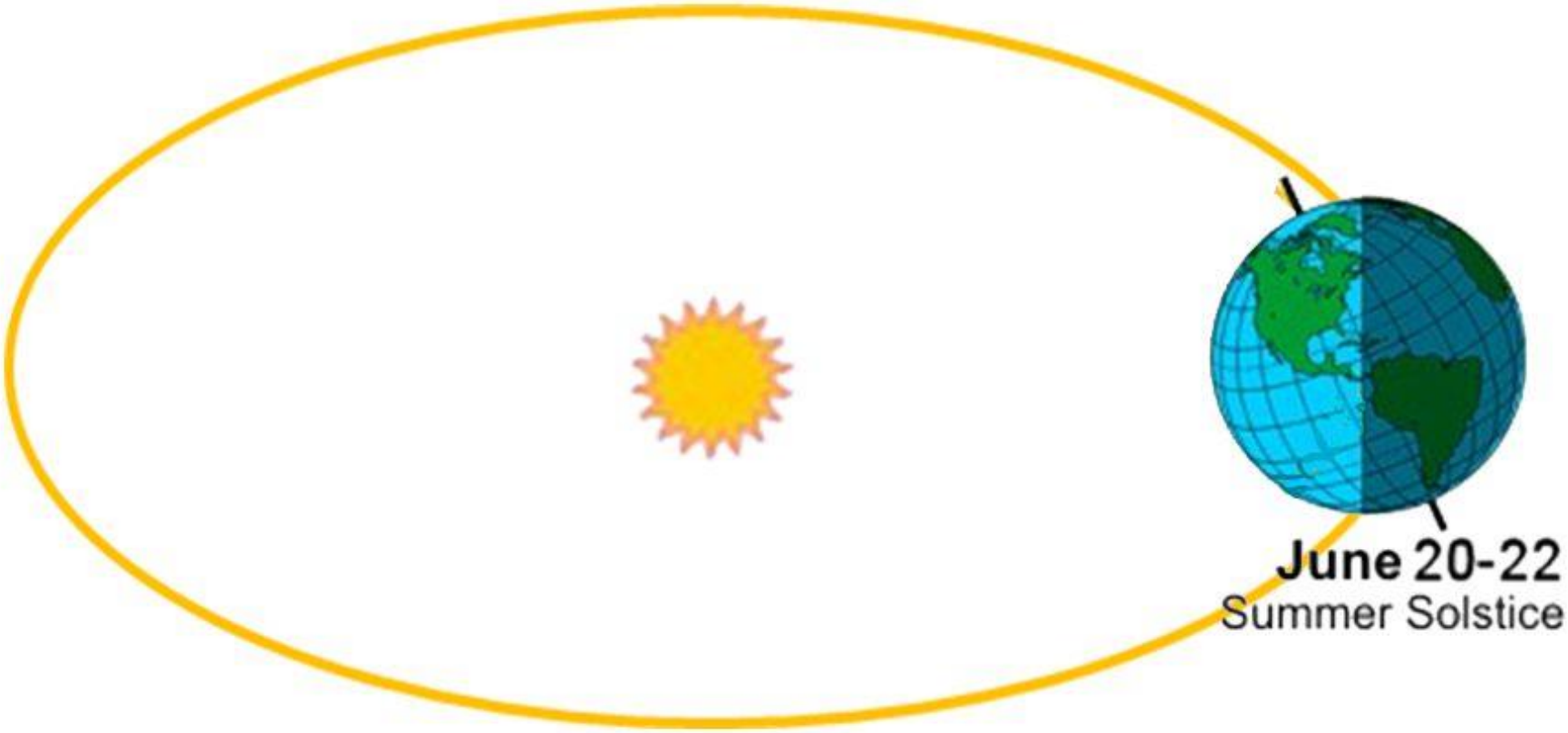
- Seasons are the result of the tilt of the Earth's axis.
- Earth’s axis is tilted 23.5°.
- This tilting is why we have SEASONS like fall, winter, spring, summer.
- The number of daylight hours is greater for the hemisphere, or half of Earth, that is tilted toward the Sun.

The Seasons



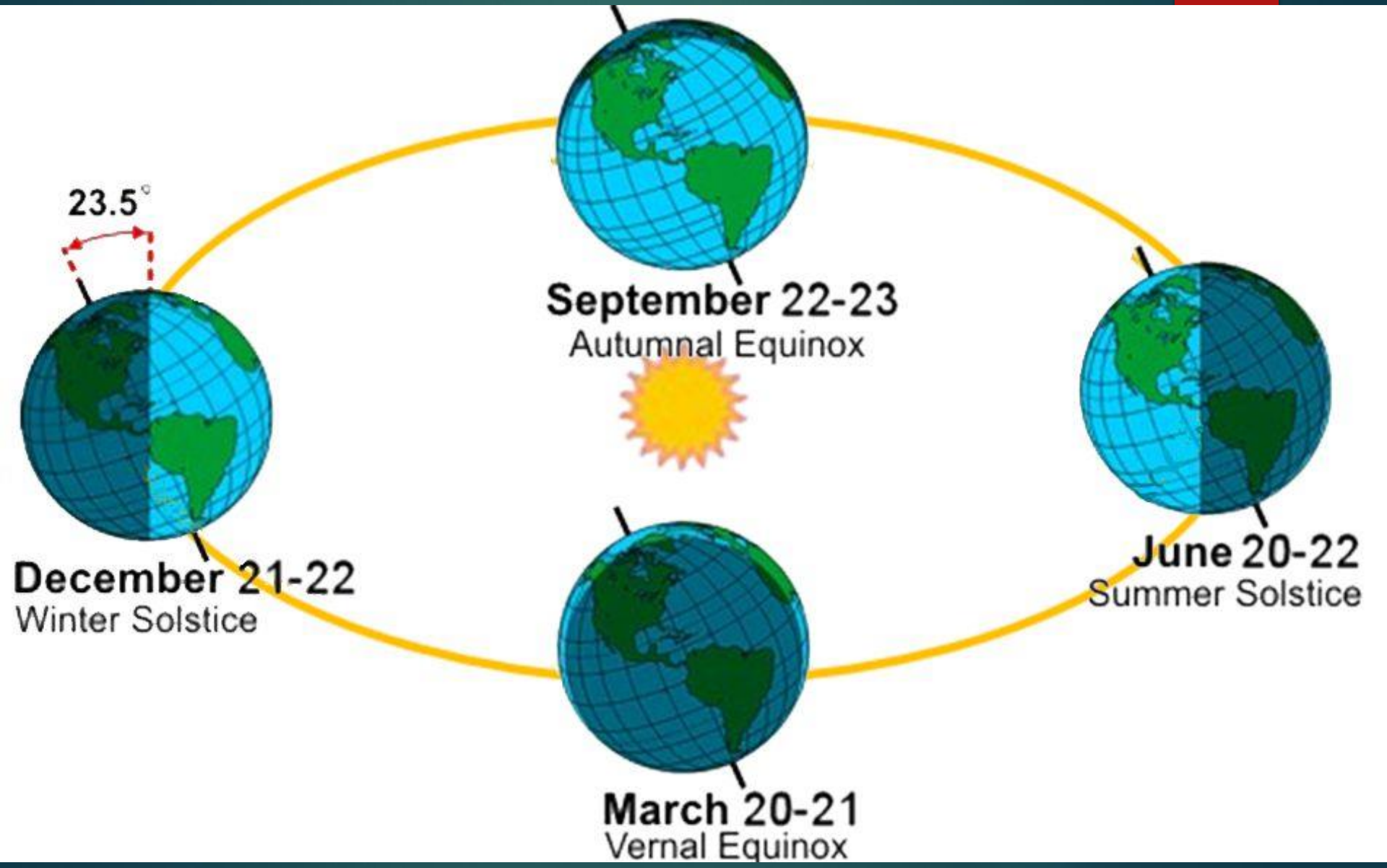
The Seasons

The Seasons



The Seasons

The Seasons


23.5°
September 22-23
Autumnal Equinox
December 21-22
Winter Solstice
June 20-22
Summer Solstice
March 20-21
Vernal Equinox

Days get shorter in the winter and longer in the summer.

FALSE!

Length of Daylight

- The shortest day of the year is the first day of winter, the winter solstice.
- The longest day of the year is the first day of Summer – the Summer Solstice.
- In Winter and Spring every day is longer than the previous day.
- In Summer and Fall every day is shorter than the previous day.

What is a Day

- The time interval between two successive transits by the Sun of the meridian.
- The meridian is a line across the sky half way between the sunrise and sunset.
- At the meridian the Sun is at its highest point in the sky.
- We divide the total time into 24 hours.
- The time before the Sun crosses the meridian is called AM (Ante Meridiem in Latin). After it crosses the Meridian is called PM (post meridiem)

Months

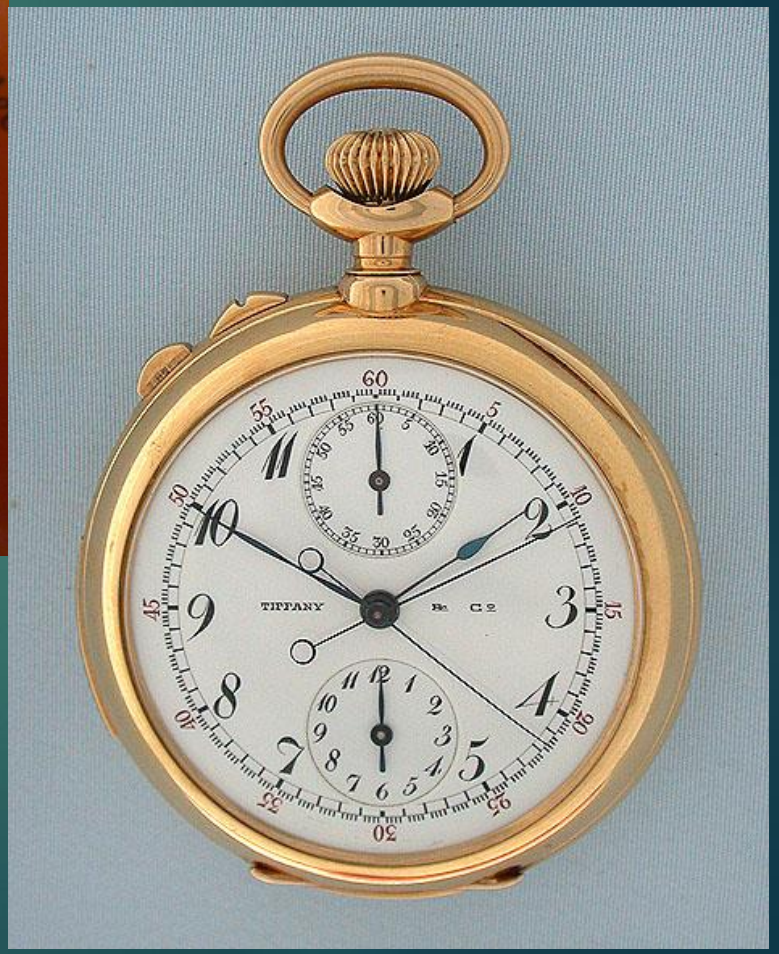
- **January** - named after JANUS, god of beginnings.
  February - named for Februa, the feast of purification.
  March - from Latin Martius, god of war, Mars.
  April – named after the Greek goddess of love, Aphrodite.
  May – named for the Greek Maia, goddess of spring.
  June - named after the goddess Juno, Queen of the gods.
  July – named for Julius Caesar.
  August – named for Augustus Caesar.
  September - from Latin Septem, Seven.
  October - from Latin Octo, Eight.
  November - from Latin Novem, Nine.
  December - from Latin Decem, Ten.

History of Time Zones

- Prior to the 19th century time measurement was local.
- Town Clocks were set to Solar Noon and everyone in town set their clocks/watches to this time.
- This was not a problem when the fastest transport was by horse.

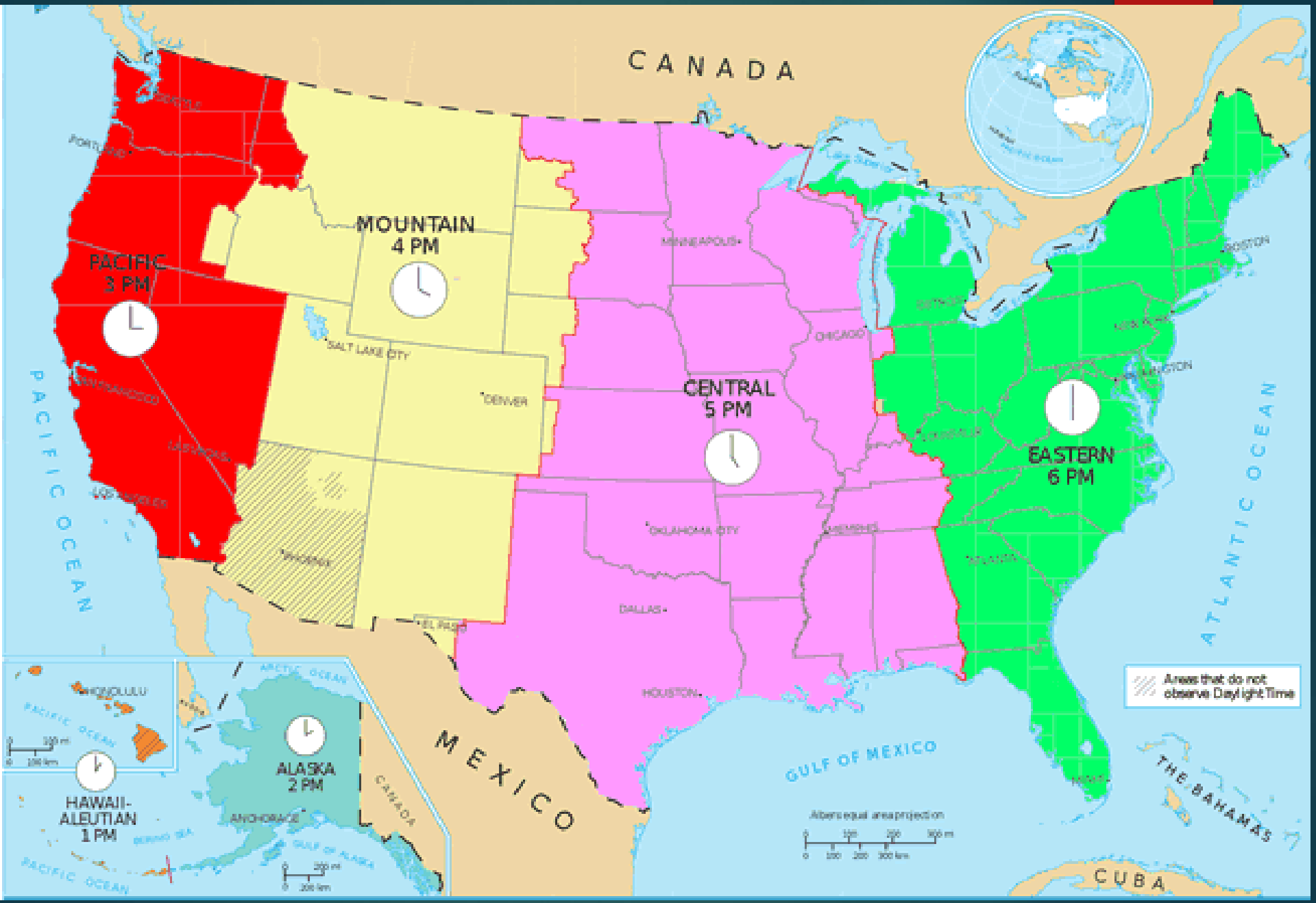
- When Railroads were built, local time became a problem.
- Two towns only a few miles apart would have different times.
- Railroads had to establish a standard railroad time for schedules and to avoid accidents.
- There were special watches to keep track of the different times.

Early Railroad Watches

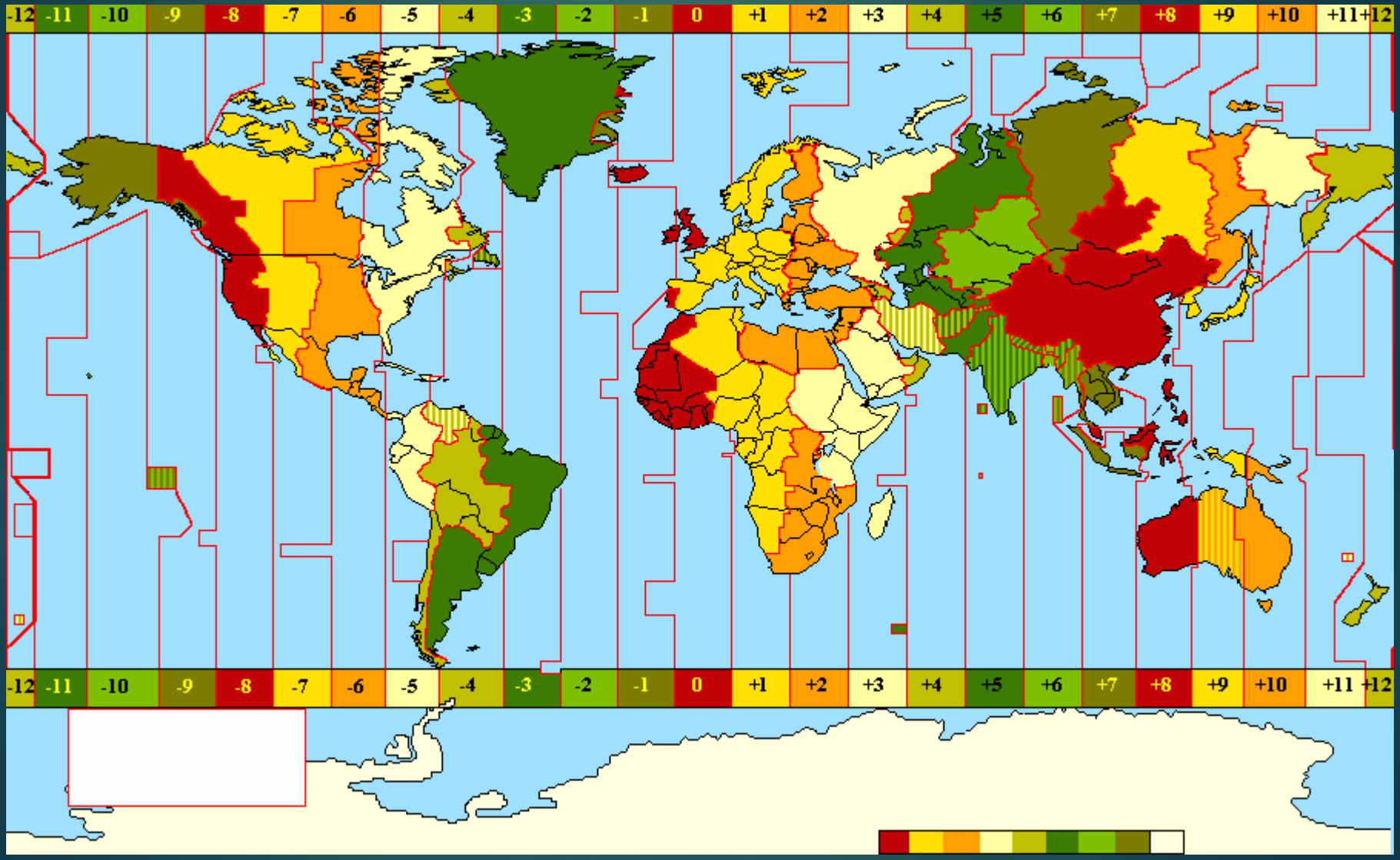


- Standard time in time zones was instituted in the U.S. and Canada by the railroads on November 18, 1883. It had started in Brittan in 1847.
- At first it was not law in the United States.
- Some towns, even some pretty big towns like Detroit, refused to use standard time.

- In 1918, the US Government made the system of standard time in time zones a law.
- It’s not the law all over the world. In some places, it's still voluntary,
- This can be confusing for travellers.


CANADA
PACIFIC
3 PM
MOUNTAIN
4 PM
CENTRAL
5 PM
EASTERN
6 PM
PACIFIC OCEAN
ATLANTIC OCEAN
MEXICO
GULF OF MEXICO
CUBA
THE BAHAMAS
HAWAII-
ALEUTIAN
1 PM
ALASKA
2 PM
HONOLULU
ANCHORAGE
SALT LAKE CITY
DENVER
MINNEAPOLIS
CHICAGO
BOSTON
OKLAHOMA CITY
DALLAS
HOUSTON
ATLANTA
MEMPHIS
Areas that do not observe Daylight Time
Albers equal area projection

Time Zones


-12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10 +11 +12
-12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10 +11 +12

Time Measurement

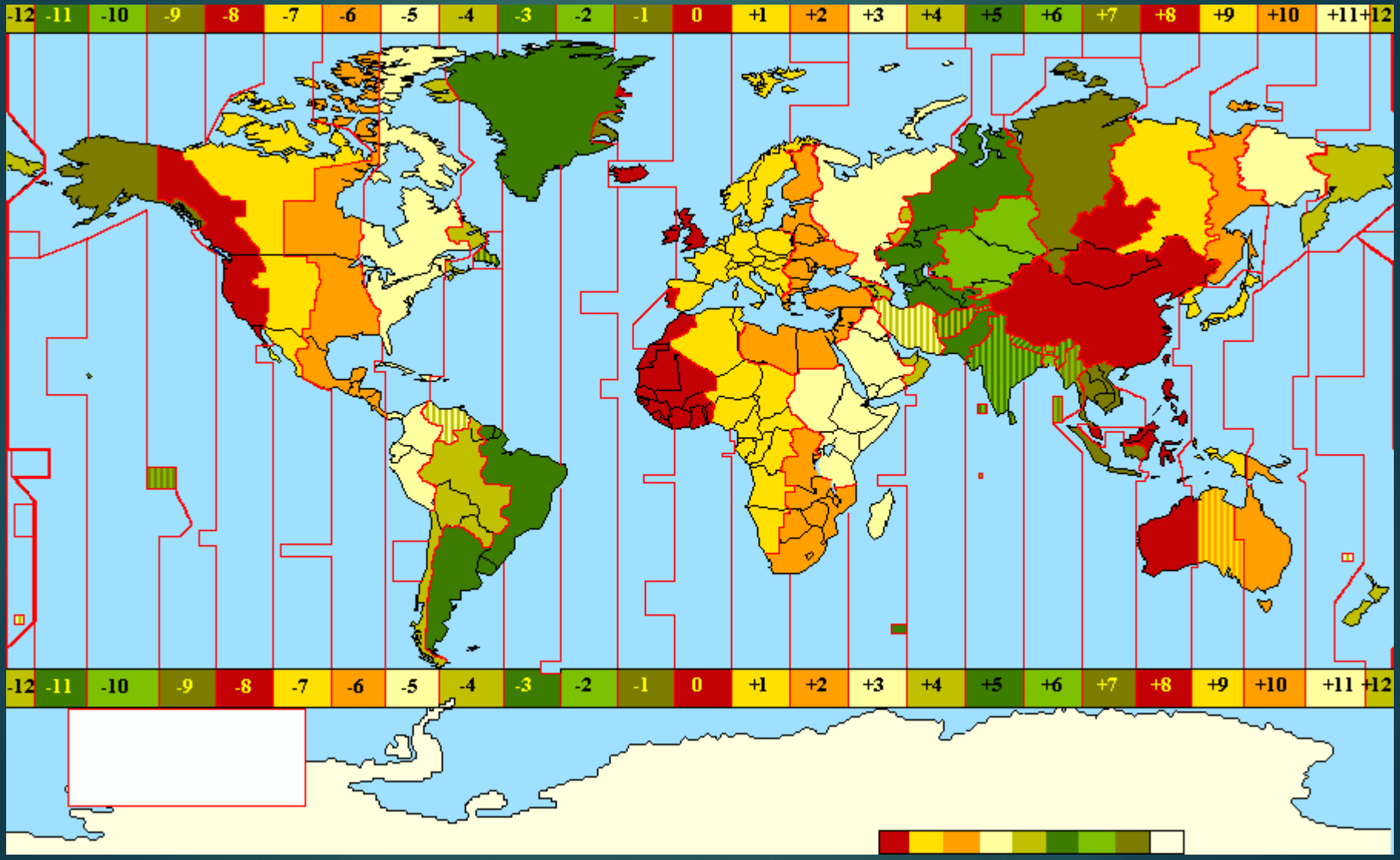
- All time on Earth is measure relative to the time in Greenwich England.
- It is called Greenwich Mean Time (GMT), Zulu Time, Universal Time, and by other names.
- Greenwich is a small suburb of London
- The Royal Observatory is in Greenwich.
- Time measurement is relative to astronomical observations.

The Clock at Greenwich

Why Greenwich?

- Navigation
  - Latitude fairly easy to determine – the North Star
  - Longitude difficult
  - Longitudinal Prize
  - Solution required an accurate clock.
- The solution was found in England – a Martine chronometer for time and a sextant to accurately measure angles of celestial bodies.

Time Zones


-12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10 +11 +12
-12 -11 -10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +10 +11 +12

The International Date Line

- Fixed, arbitrary boundary on the earth in the Pacific Ocean where the calendar date advances

Look at Fiji and Samoa again…

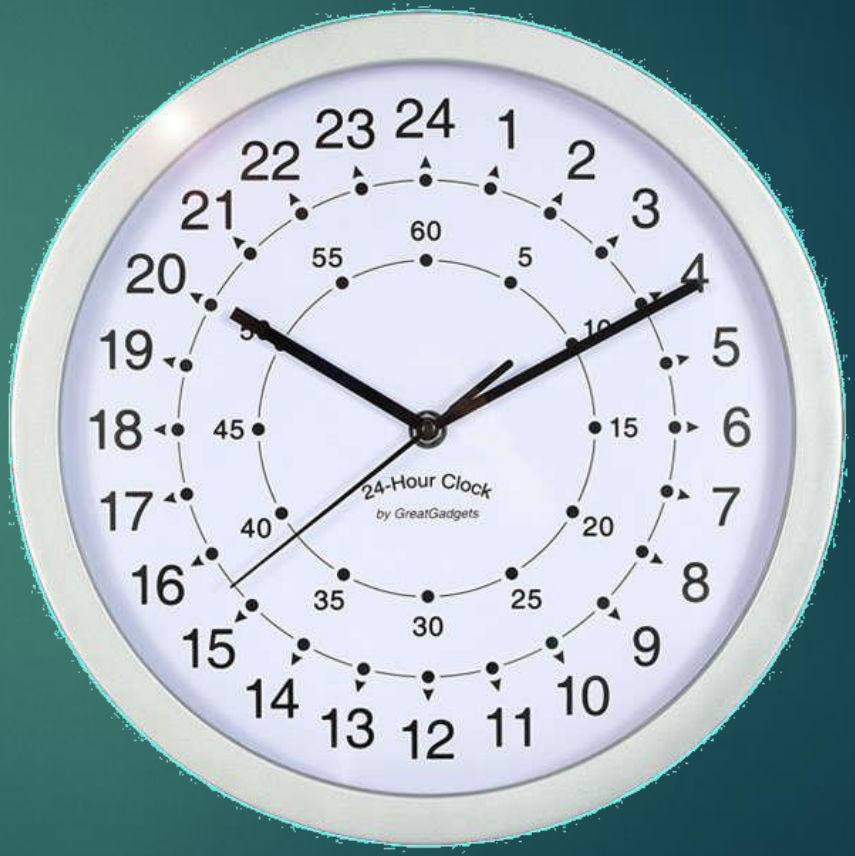
- If it's 2:23 am Thursday in Tonga…

- …it's 3:23 am Wednesday in Samoa!

(and they're only 552 miles apart!)

24 Hour Clock

1:00pm - 1300 Hours
5:00am - 0500 Hours
10:35pm – 2230 Hours



Used when it is important to avoid confusion.

- Military
- Medical Professionals
- Railroads
- Airline Pilots
- Astronomers

Daylight Saving Time

Daylight Saving Time was an idea first suggested by Benjamin Franklin. His idea was to enjoy more sunlight and save on the cost of oil for lamps. It sounded like a pretty good idea.

Daylight saving time did not go into effect until World War I, and then only to save on electricity to help the war effort.

Sure enough, there were many complaints about the use of Daylight Saving Time.

The farmers say that is confuses the hens.

Parents were worried about kids and safety when walking to school in the dark. Kids had trouble going to sleep.

Adults complained they couldn't sleep as well - not for weeks after the time change.

Astronomers don’t like it because they cant start observing until late at night.

And there is no evidence that it saves energy!

Daylight Saving Time

- After WWI ended DST was repealed
- It was again instituted year round for WWII.
- In 1966 it was set last Sunday of April and to end on the last Sunday of October.
- It was established year round again in 1966 because of the energy crises.
- Under legislation enacted in 1986, Daylight Saving Time in the U.S. began at 2:00am on the first Sunday of April and ended at 2:00am on the last Sunday of October.
- Starting in 2007, DST to begin at 2:00 am on the 2nd Sunday in March and reverts to standard time at 2:00 a.m. on the 1st Sunday in November.

"REMEMBER — WHEN DAYLIGHT SAVING TIME ENDS WE HAVE TO GIVE EVERYTHING A SLIGHT TURN TO THE LEFT."

The Earth rotates on its axis once every 24 hours.

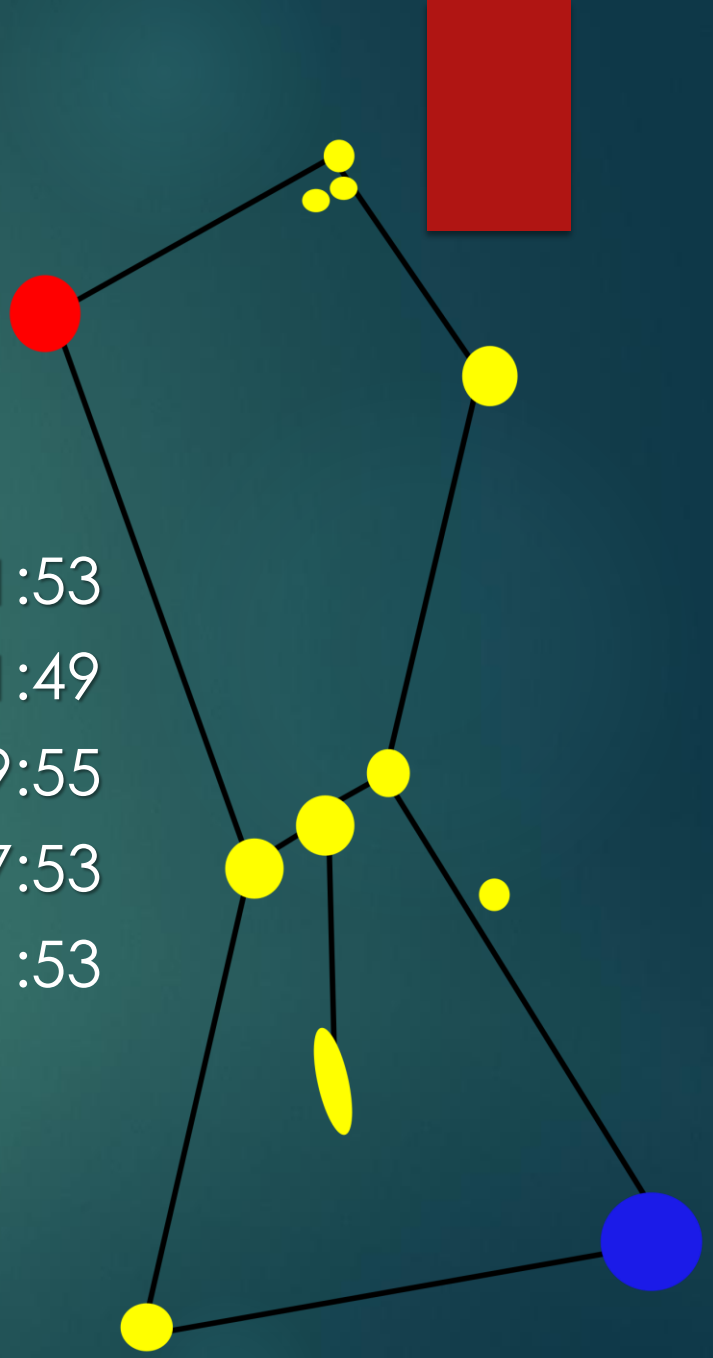
FALSE!

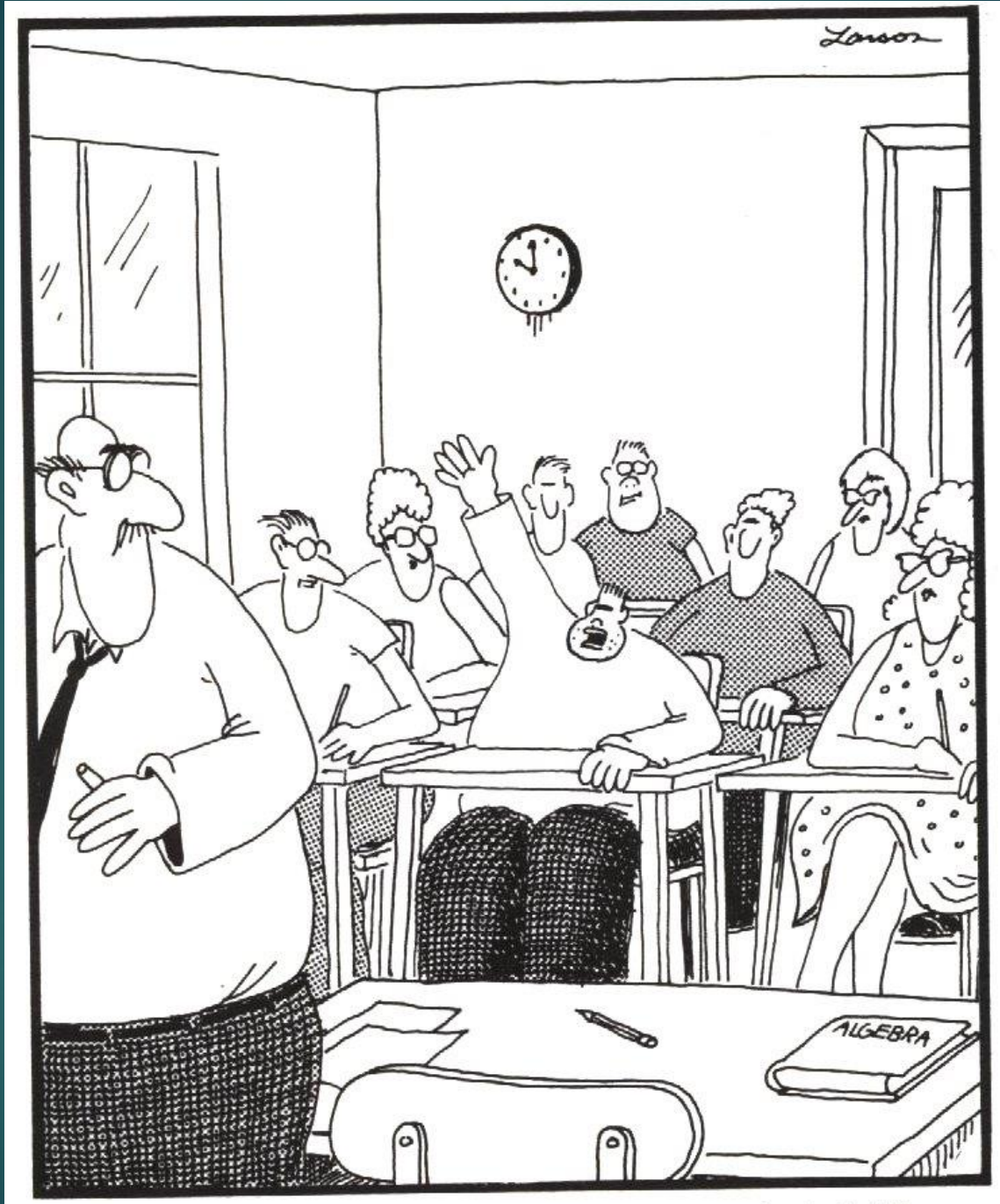
Earth Rotation

- The Earth takes 23hours 56 Minutes to rotate once on its axis.
- The additional 4 minutes in a day are because the Earth is at a different location in its revolution around the Sun.
- This means that celestial objects rise earlier on a fixed pattern:
  - About 4 minutes for every day
  - About 30 Minutes per week
  - About 2 hours per month
  - Exactly 24 hours per year.
- The stars in the sky always look the same on the same date each year.

Betelgeuse

- Rise on November 2 at 21:53
- Rise November 3 at 21:49
- Rise on December 2 at 19:55
- Rise on February 2 at 17:53
- Rise on November 2, 2021 at 21:53





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

What is Time?
What we believe:

Time is:

- Eternal
- Independent
- Universal
- Unique
- Our Experience
  - Past
  - Present
  - Future

Time is Eternal

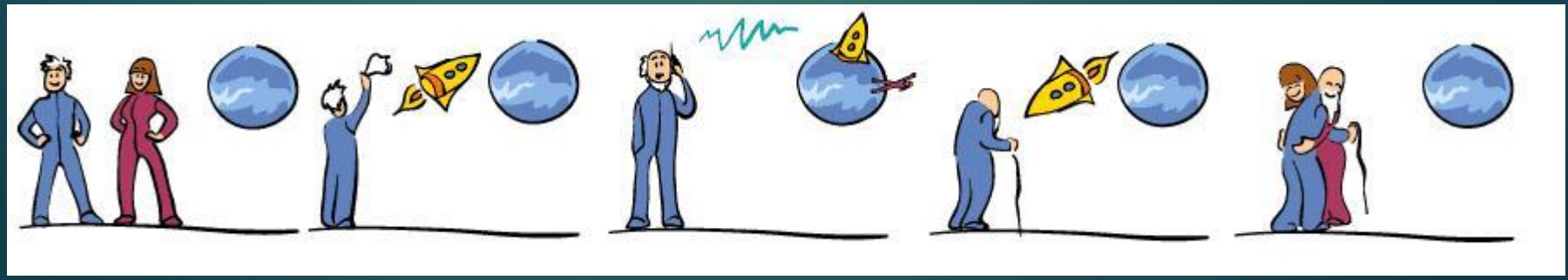
- If time is not eternal, it has a beginning and an end.
- You cannot ask what happened before the beginning of time or after the end of time because before and after are time concepts.
- Relativity says that time began at the Big Bang, so it makes no sense to ask "What happened before the Big Bang?"

Time Is Independent, Constant, Universal, Unique?

- Time moves faster in less gravity
  - The stronger the gravity, the slower time passes
  - Time on the surface of Earth passes 44/1000 of a second a year slower than it does in deep space beyond any gravity fields.
  - This has been measured in airplanes traveling at high altitudes.
  - The GPS system requires that adjustments be made to compensate.
  - If you were to fall into a black hole, the universe would age and end as you crossed the Event Horizon.

Time Is Independent, Constant, Universal, Unique?

- Time moves slower as you approach the speed of light
  - If you were to travel to another star and back at 87% the speed of light, everyone you know on Earth would have aged twice as fast as you did.
  - This is called the twin paradox.



Past, present and Future, Memory

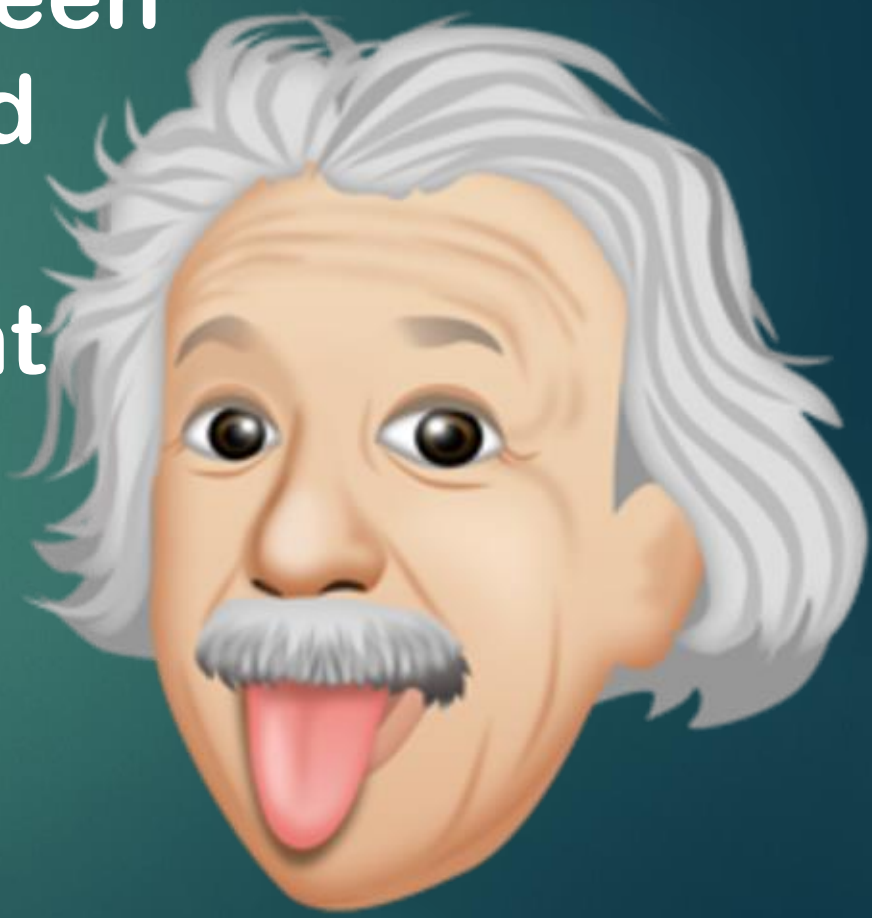
Alice and the White Queen discuss memory:

"I'm sure MINE only works one way,' Alice remarked. I can't remember things before they happen."

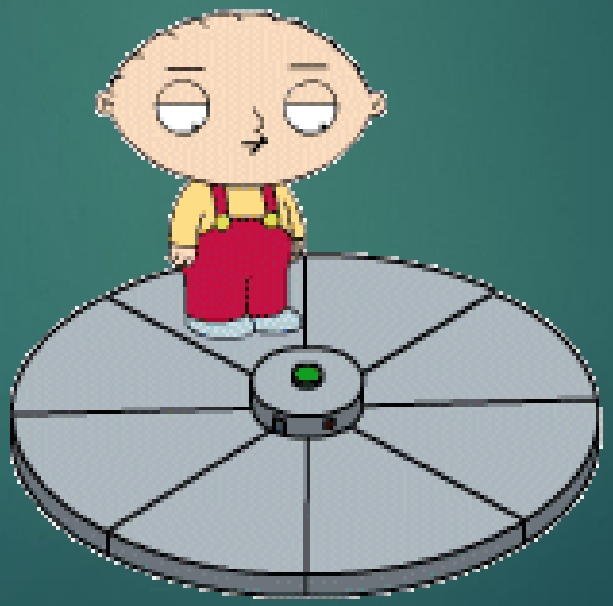
"It's a poor sort of memory that only works backwards." the Queen remarked.

The distinction between the past, present and future is only a stubbornly persistent illusion.

- Albert Einstein

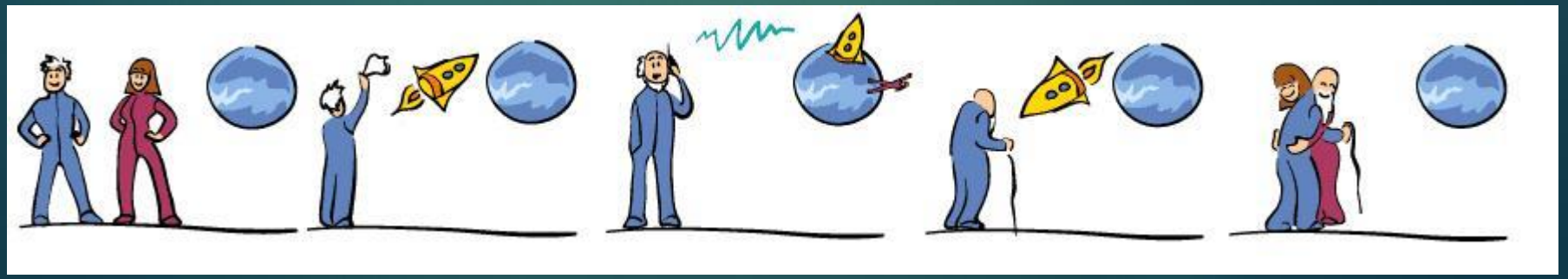


Time Travel



Time Travel In to the Future

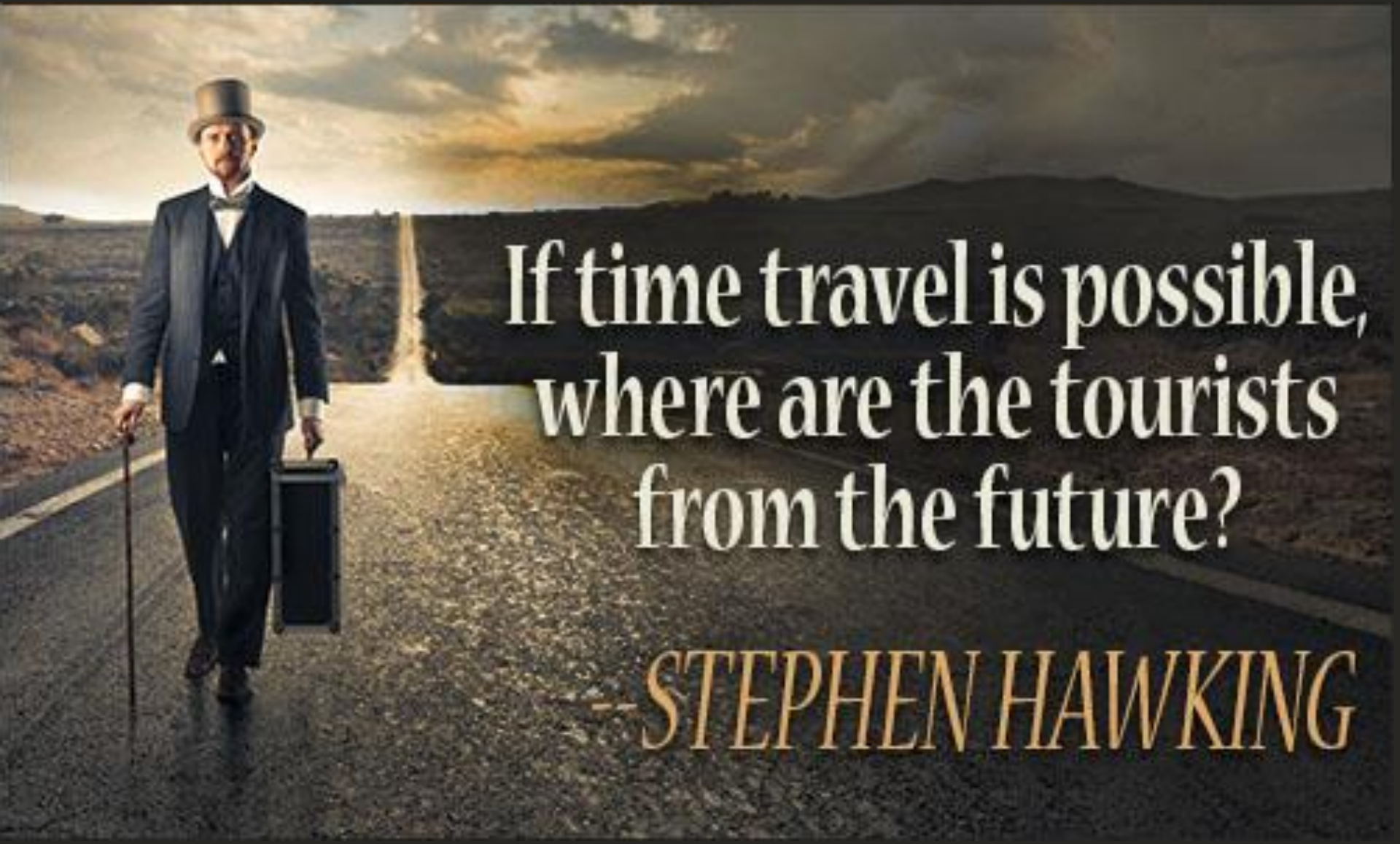
- We are all doing that right now.
- We can do it faster by going into higher gravity.
- We can do it faster by going at a high speed.
  - The closer to the speed of light, the slower time passes for us.
  - This is essentially traveling into the future.
  - At the speed of light, no time passes.



Time Travel Into the Past

- If you could travel faster than light, you would travel into the past.

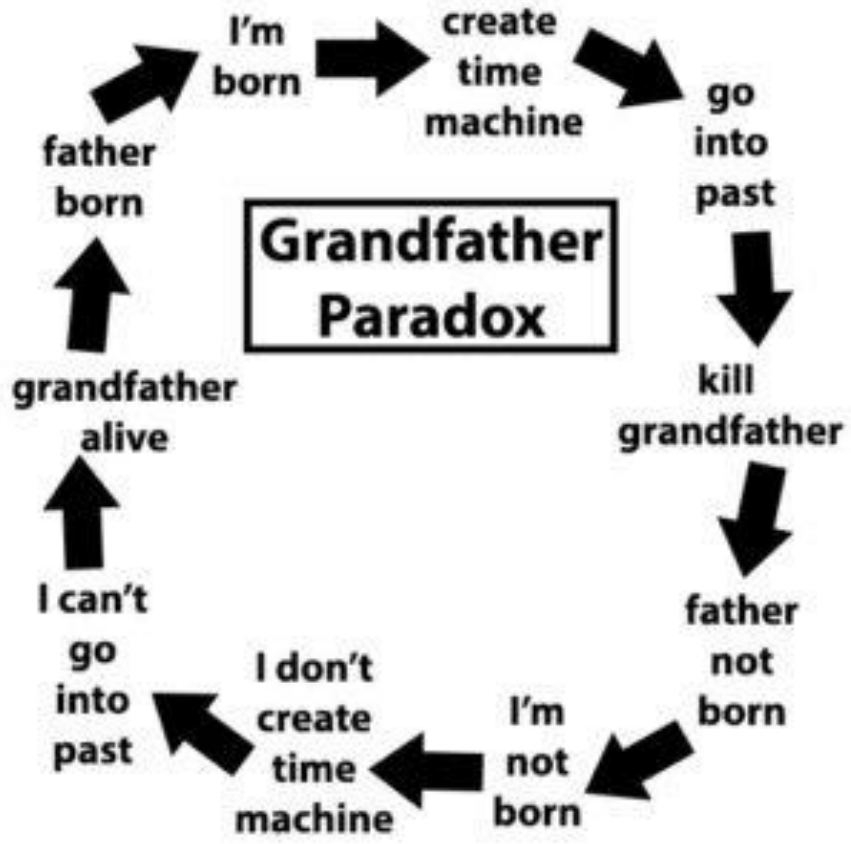
There was a young lady named Bright
Whose speed was far faster than light;
She set out one day
In a relative way
And returned on the previous night.


If time travel is possible,
where are the tourists
from the future?
--STEPHEN HAWKING

Time Travel Into the Past

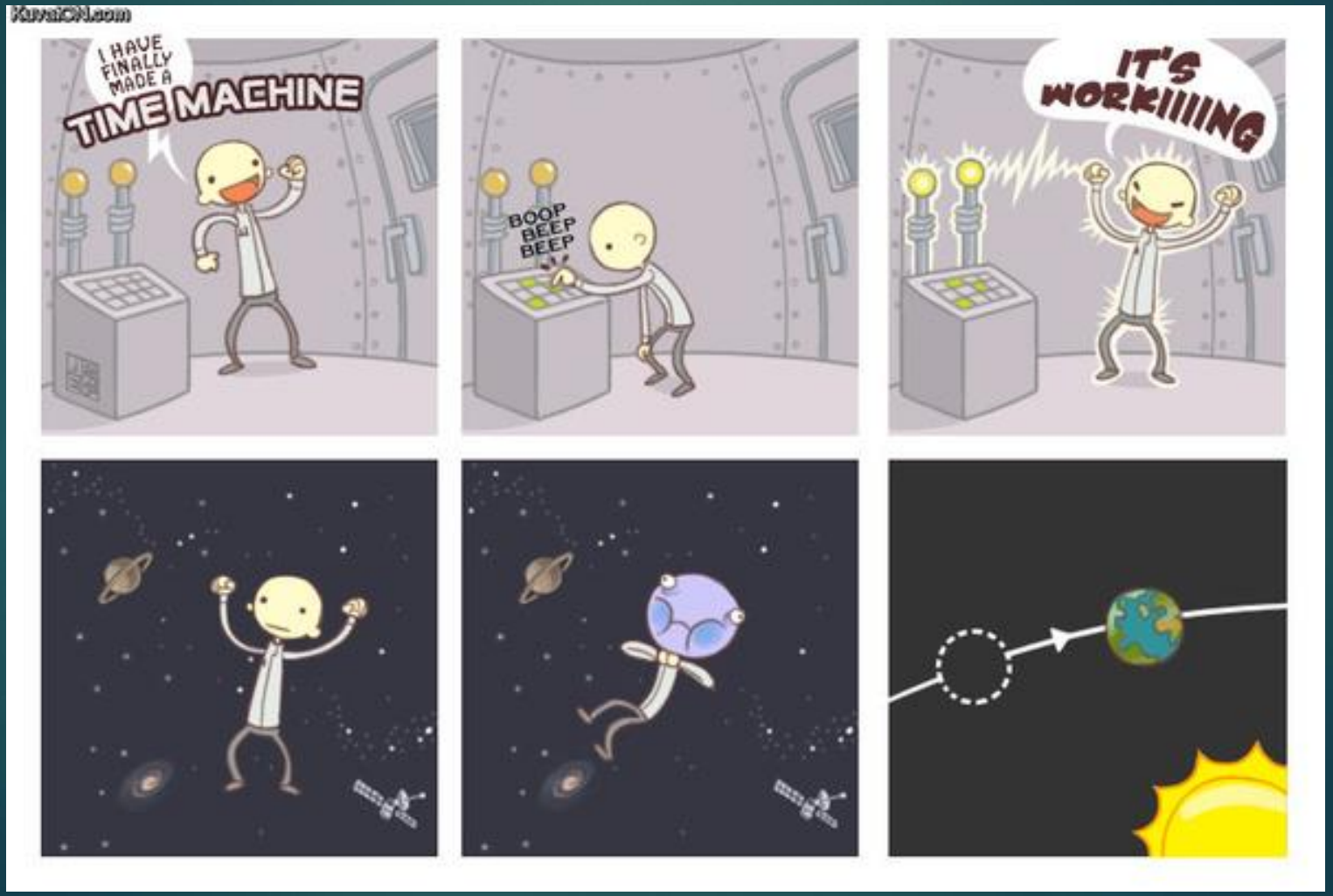
- There are serious problems.
  - Grandfather paradox
    - What would happen if you tried to change history
  - Duplication
  - If you traveled back in time, you would wind up in outer space.

Grandfather Paradox



Duplication

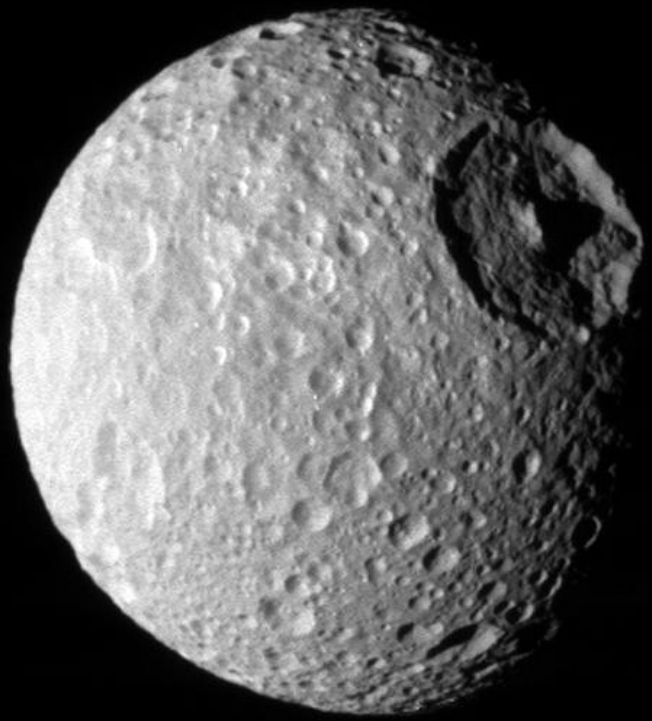
If you traveled in time, space would change.



Time Travel

- Into the future is possible, even at a faster speed.
- Into the past not possible, at least not in any way we can currently understand.

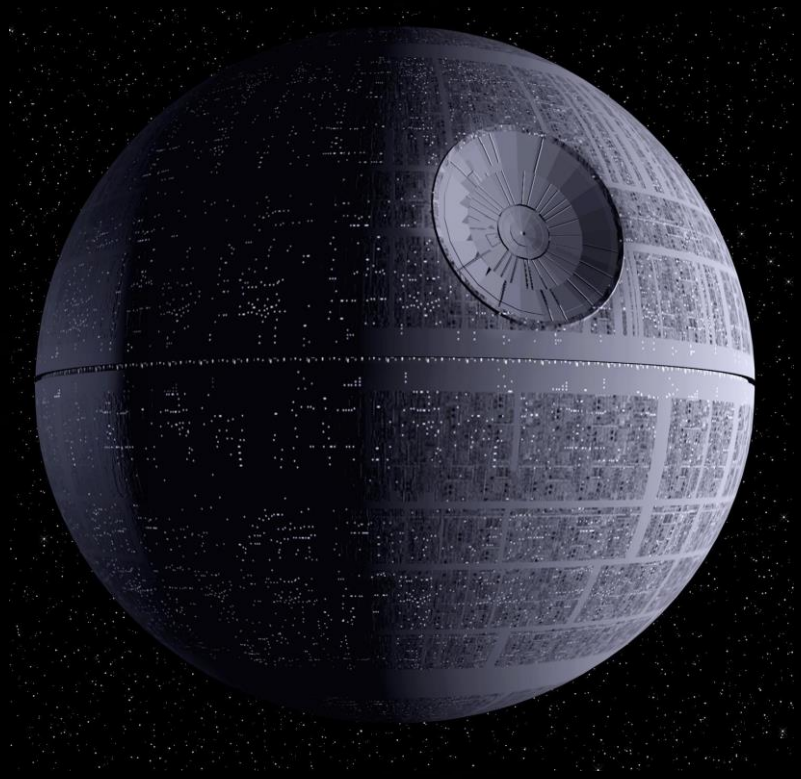

END



MIMAS PORTRAIT

YEAR: 2005
MISSION: CASSINI
TARGET: SATURN / MIMAS

The small Saturnian moon Mimas and it's Herschel crater



MIMAS PORTRAIT

YEAR: 2005
MISSION: CASSINI
TARGET: SATURN / MIMAS

The small Saturnian moon Mimas and it's Herschel crater


The Sombrero Galaxy — NGC 4594 (M104)
HUBBLESITE.org


Interacting Galaxies Arp 273
HUBBLESITE.org