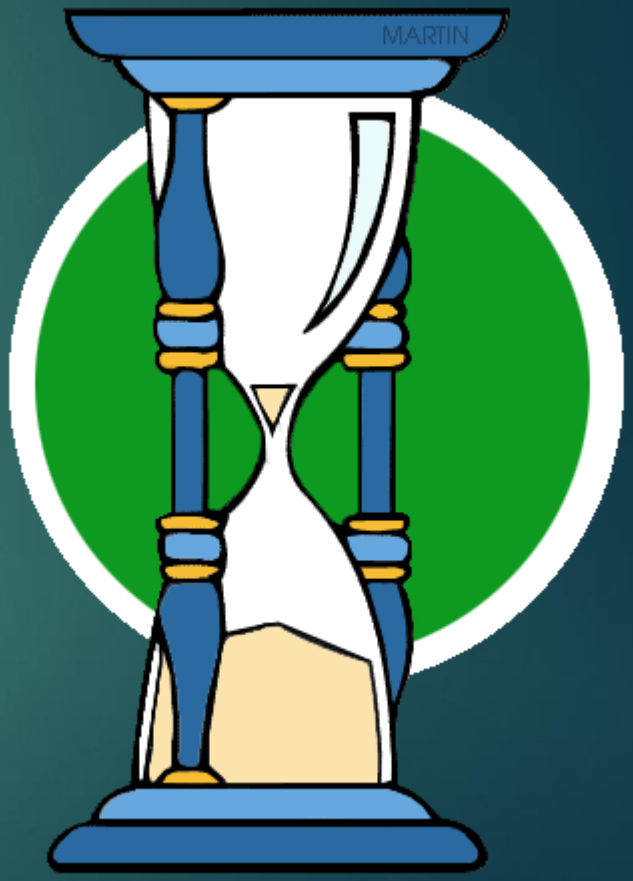
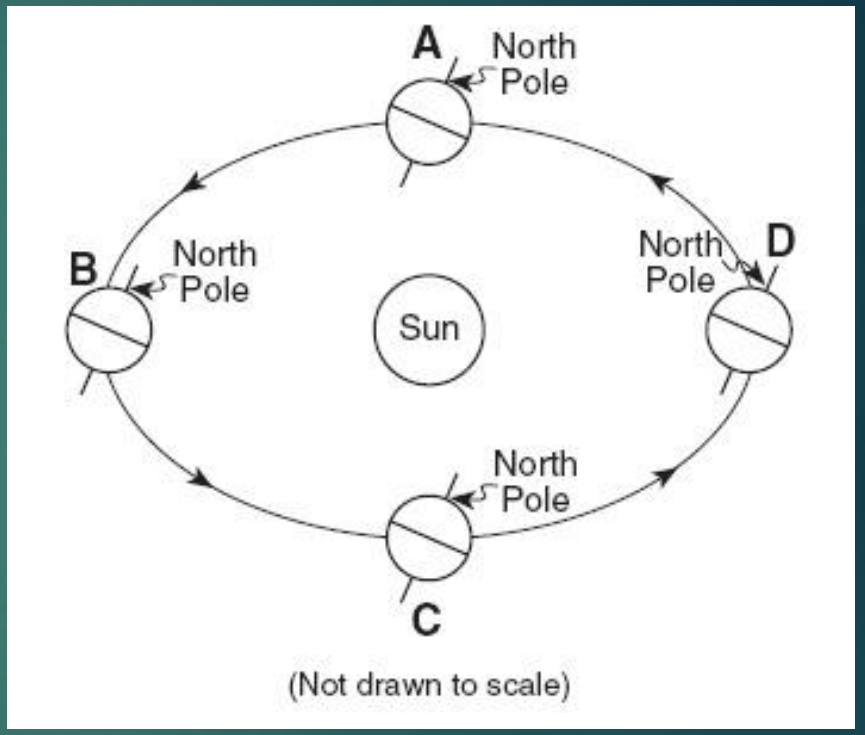
Time



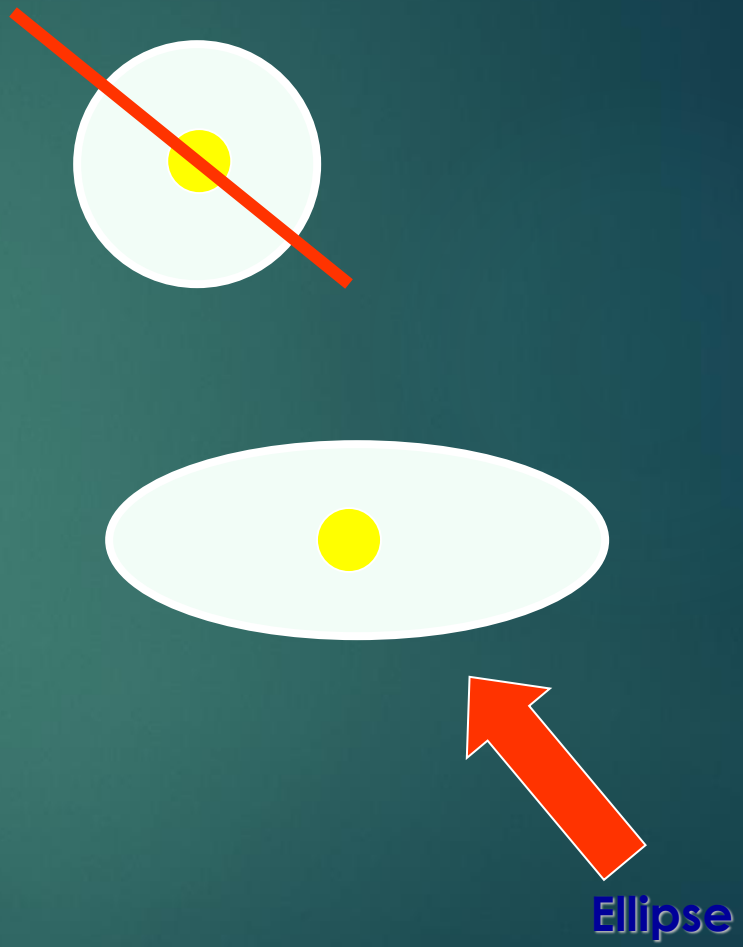
Earth's revolution

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



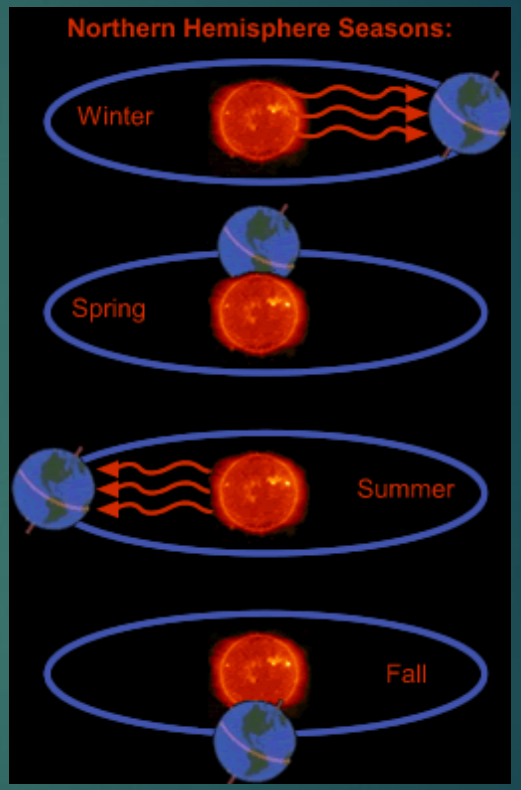
Why do we have seasons?

- The Earth's orbit around the sun is NOT a perfect circle. It is an ellipse.
- 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.



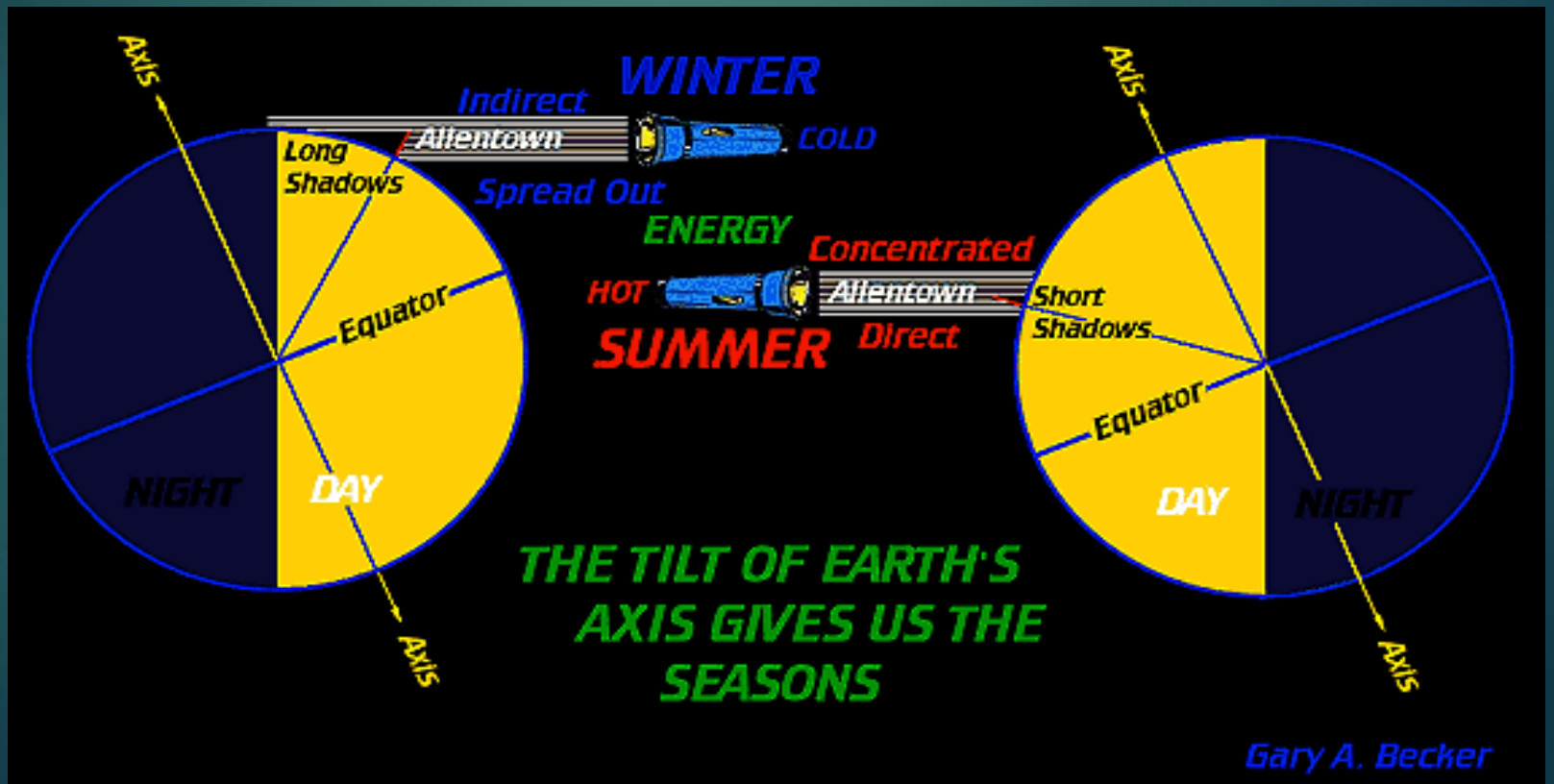
Why do we have seasons?

- 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.

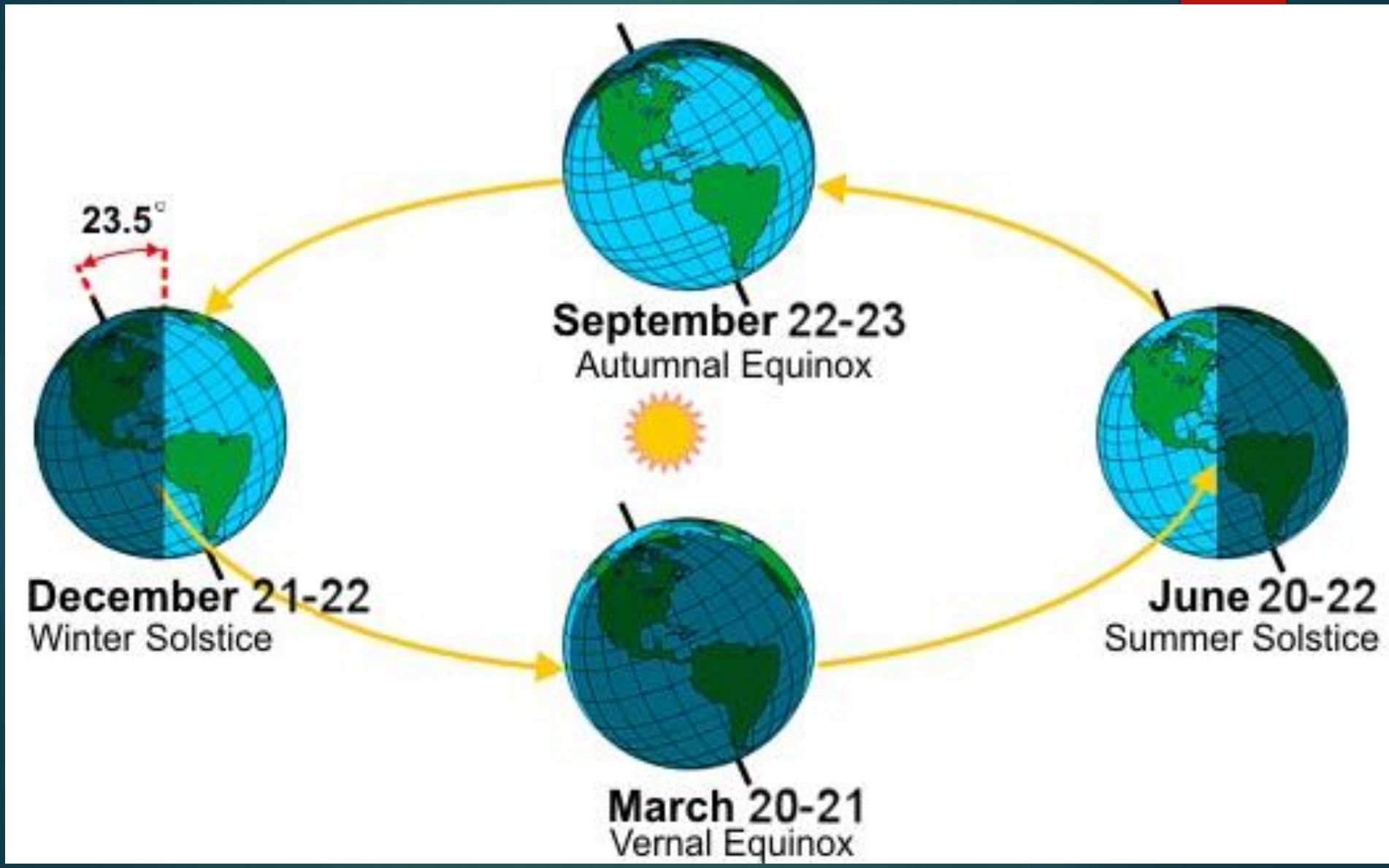


Why do we have seasons?

- Summer is warmer than winter (in each hemisphere) because the Sun's rays hit the Earth at a more direct angle during summer than during winter



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.

What is a Day

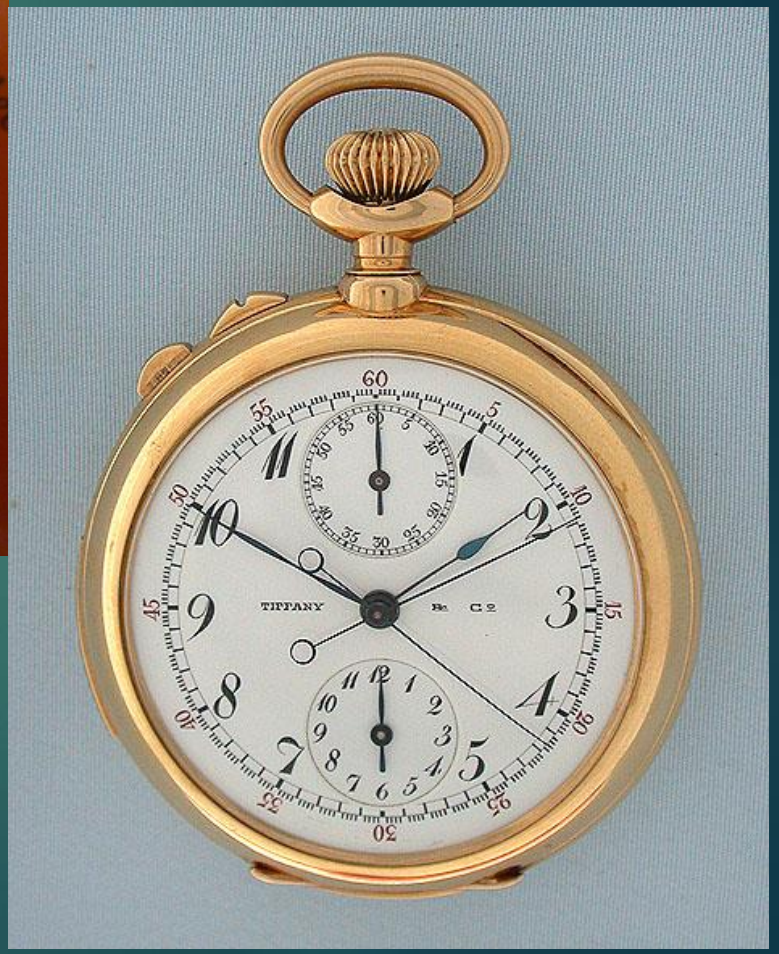
- The time interval between two successive transits by the Sun of the meridian.
- The meridian is a line across the sky half way between the sunrise and sunset.
- At the meridian the Sun is at its highest point in the sky.
- We divide the total time into 24 hours.
- The time before the Sun crosses the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

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.

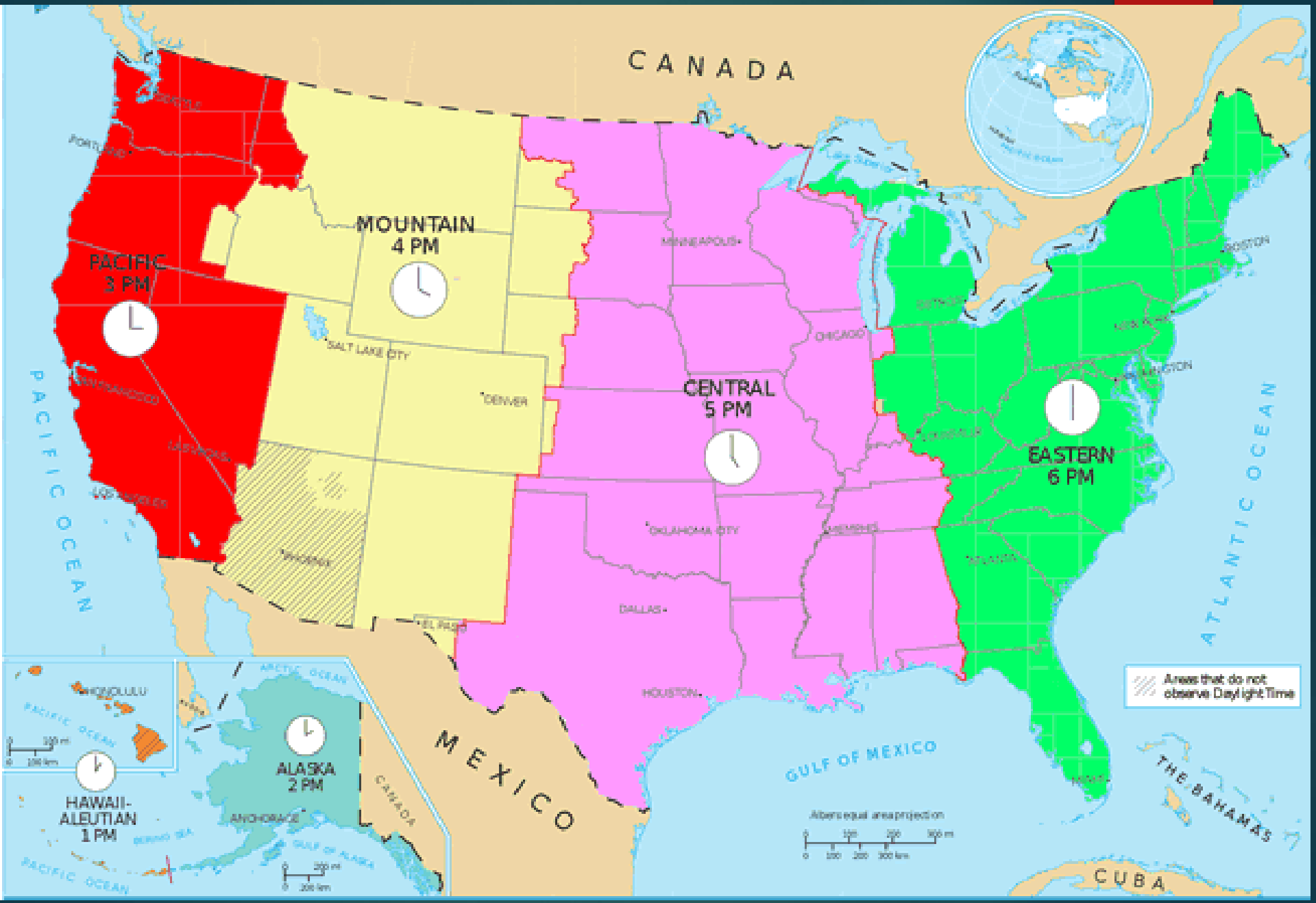
- When Railroads were built, local time became a problem.
- Two towns only a few miles apart would have different times.
- Railroads had to establish a standard railroad time for schedules and to avoid accidents.
- There were special watches to keep track of the different times.

Early Railroad Watches

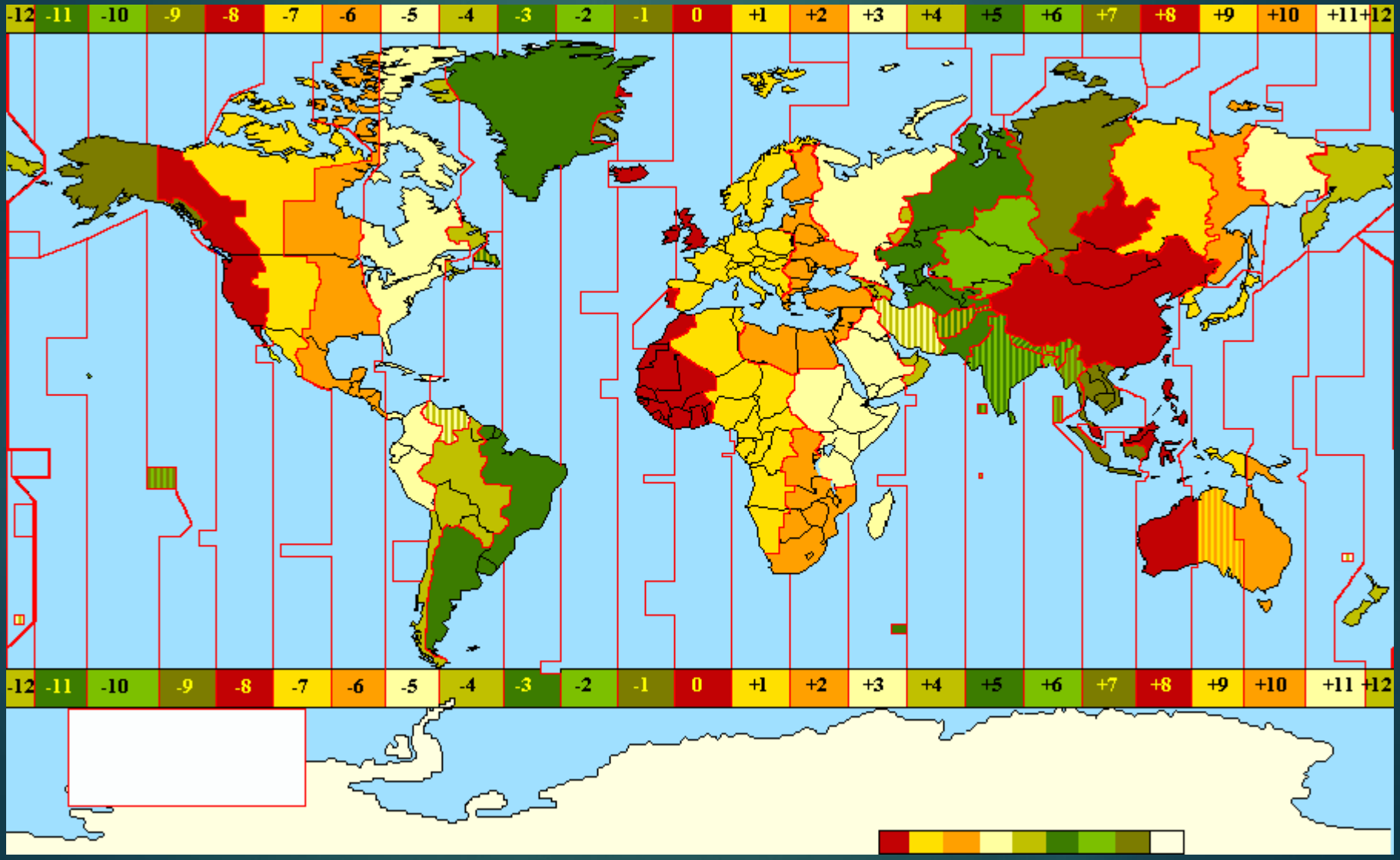


- Standard time in time zones was instituted in the U.S. and Canada by the railroads on November 18, 1883. It had started in Brittan in 1847.
- At first it was not law in the United States.
- Some towns, even some pretty big towns like Detroit, refused to use standard time.

- 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
MEMPHIS
ATLANTA
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.

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!

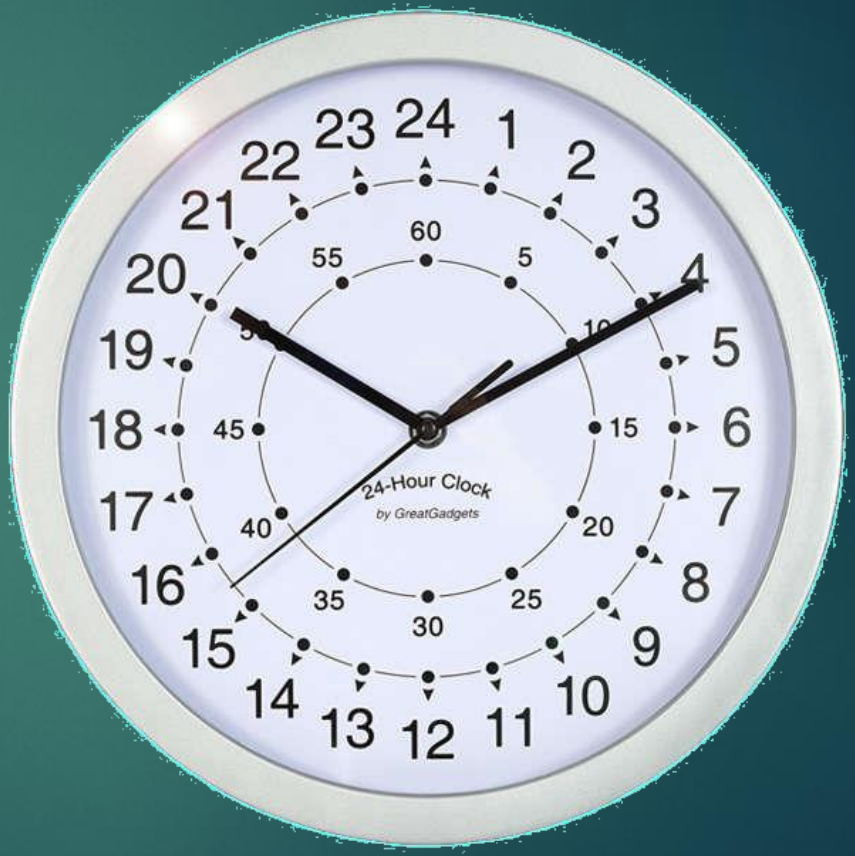
(and they're only 552 miles apart!)

24 Hour Clock

1:00pm - 13:00 Hours
5:00am - 05:00 Hours
10:35pm – 22:30 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

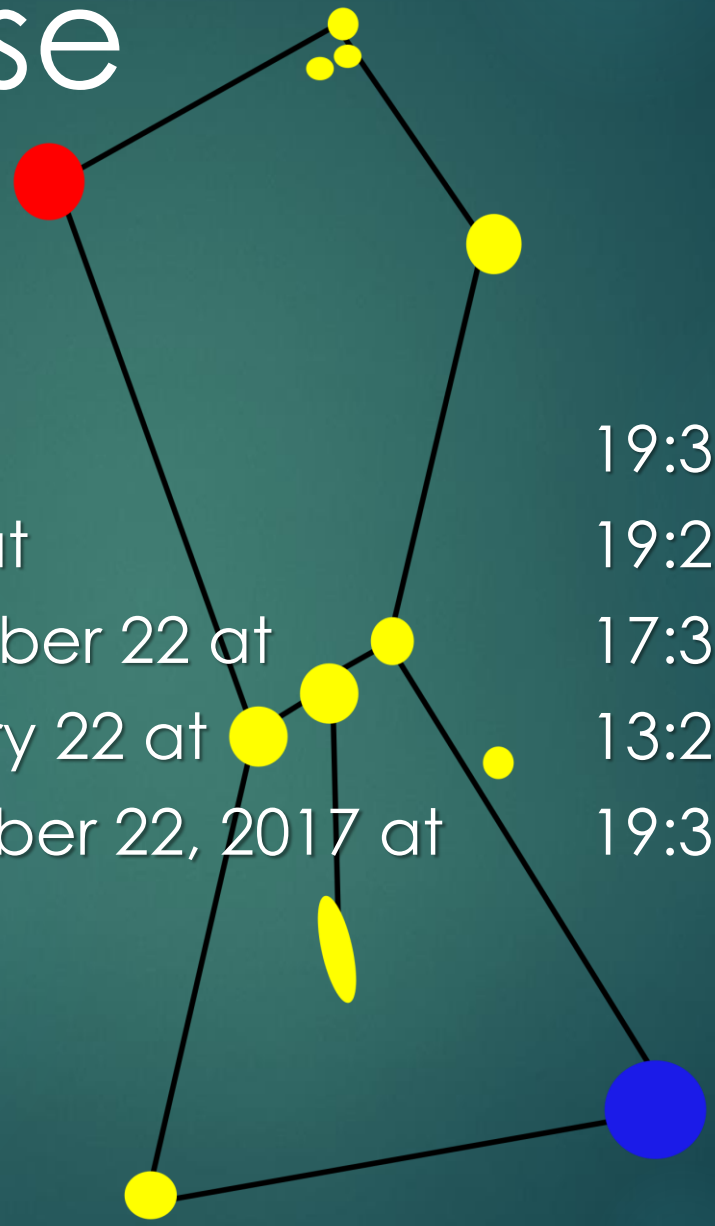
- After WWI ended DST was repealed
- It was again instituted year round for WWII.
- In 1966 it was set last Sunday of April and to end on the last Sunday of October.
- It was established year round again in 1966 because of the energy crises.
- Under legislation enacted in 1986, Daylight Saving Time in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

The Earth rotates on its axis once every 24 hours.

Earth Rotation

- The Earth takes 23hours 56 Minutes to rotate once on its axis.
- The additional 4 minutes in a day are accounted for 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



- Will rise tonight at 19:30
- Will rise tomorrow at 19:26
- Will Rise on December 22 at 17:32
- Will Rise on February 22 at 13:28
- Will Rise on November 22, 2017 at 19:30

What is Time?

- Does it have a beginning?
- Arrow of time
- Time as a dimension
- Einsteinian Relativity
  - Time is relative
  - Moves slower in Gravity Field
  - Moves slower if moving

Time Travel into the Future

- We are all doing it every day.
- It is possible to speed up the trip
  - Time moves faster if there is no gravity
    - The stronger the gravity, the slower time passes
    - 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 Horizion.
  - Time moves slower as you approach the speed of light
    - If you were to travel to another star and back at ½ the speed of light, everyone you know on Earth would be much older. When you returned.

Time Travel into the Past

- There are some theoretical possibilities.
- There are paradoxes.
  - Grandfather paradox
  - What would happen if you tried to change history
- Stephen Hawking said that he didn't believe in time travel because we don't see any tourists


12
1
2
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END