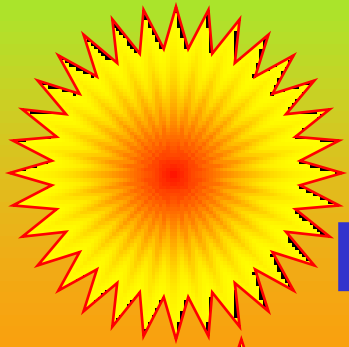


Movimentos aparentes dos Astros:

Movimento Anual Aparente do Sol

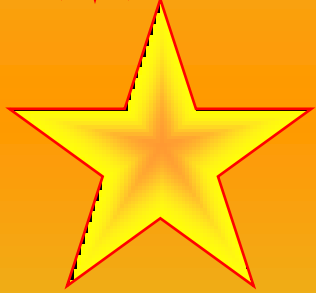
Prof. J. Meléndez,
baseado no Prof. R. Boczko

Movimentos aparentes

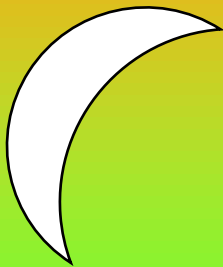


Movimento diurno aparente do Sol

Movimento anual aparente do Sol



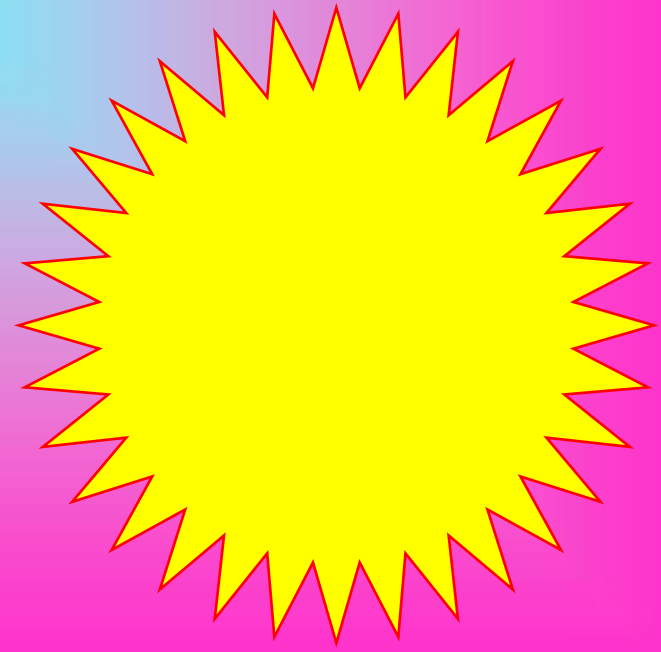
Movimento diurno aparente das estrelas



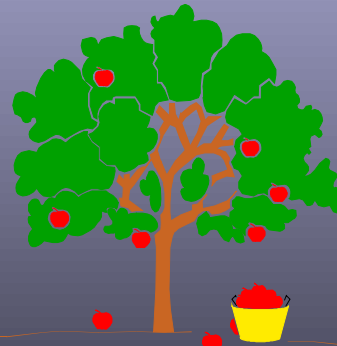
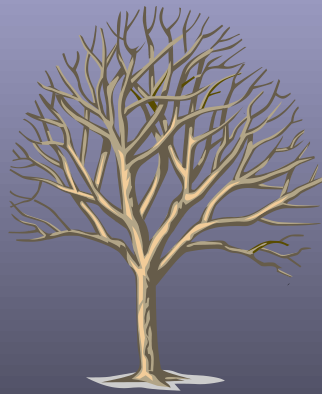
Movimento diurno aparente da Lua

Movimento mensal aparente da Lua

**Movimento Anual
Aparente do Sol:
ANO**



Repetição de características meteorológicas



Quente

Ameno

Frio

Ameno

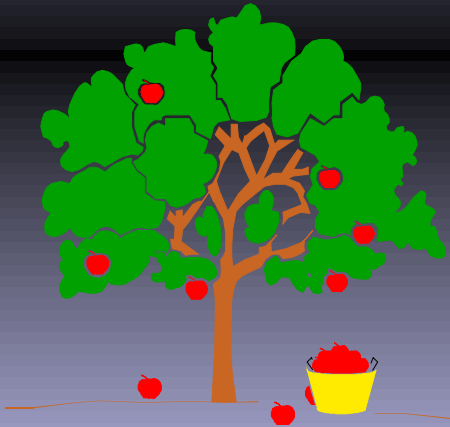
Quente

Noção de ano e de estações do ano usando o GNOMON

Ano das Estações ~ 365 dias



Representação do Ano das Estações



Primavera



Verão



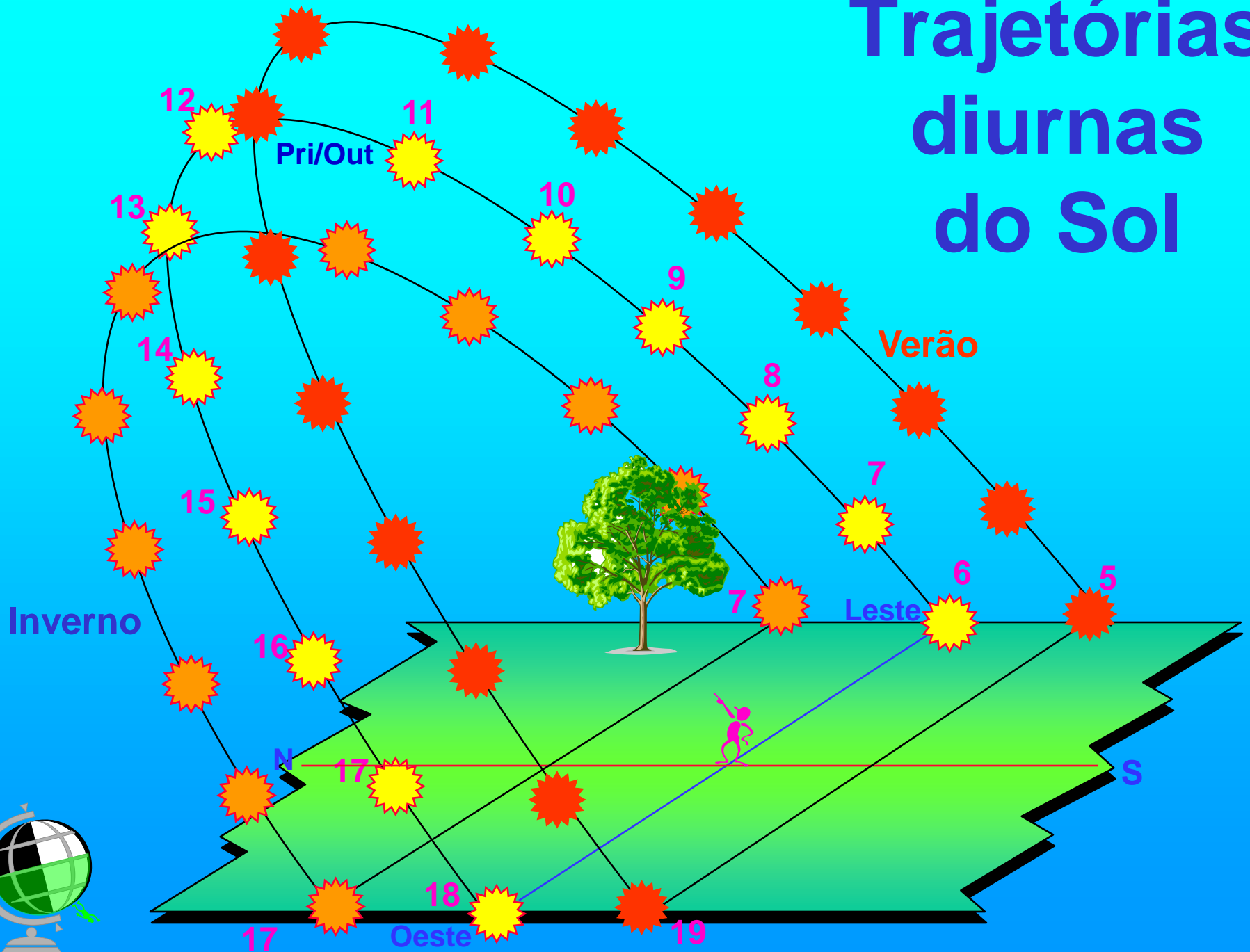
Outono



Inverno

Ano das Estações

Trajetoórias diurnas do Sol



Movimento aparente do sol com relação às constelações

Horizonte visto no crepúsculo



Horizonte visto no crepúsculo

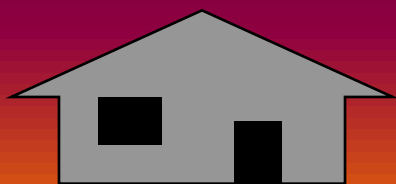
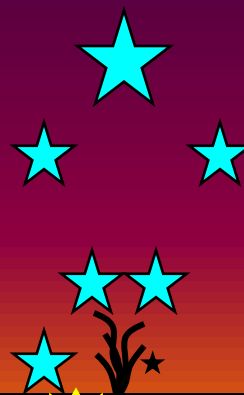


Horizonte visto no crepúsculo

Lib



Vir

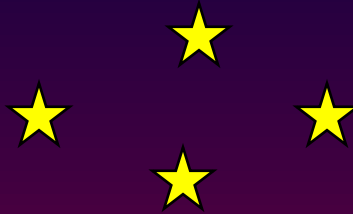


Horizonte visto no crepúsculo

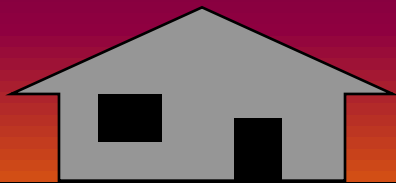
Esc



Lib



Vir

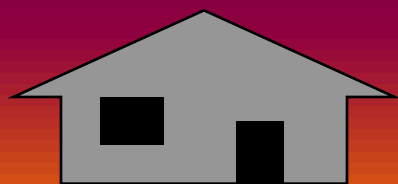


Horizonte visto no crepúsculo

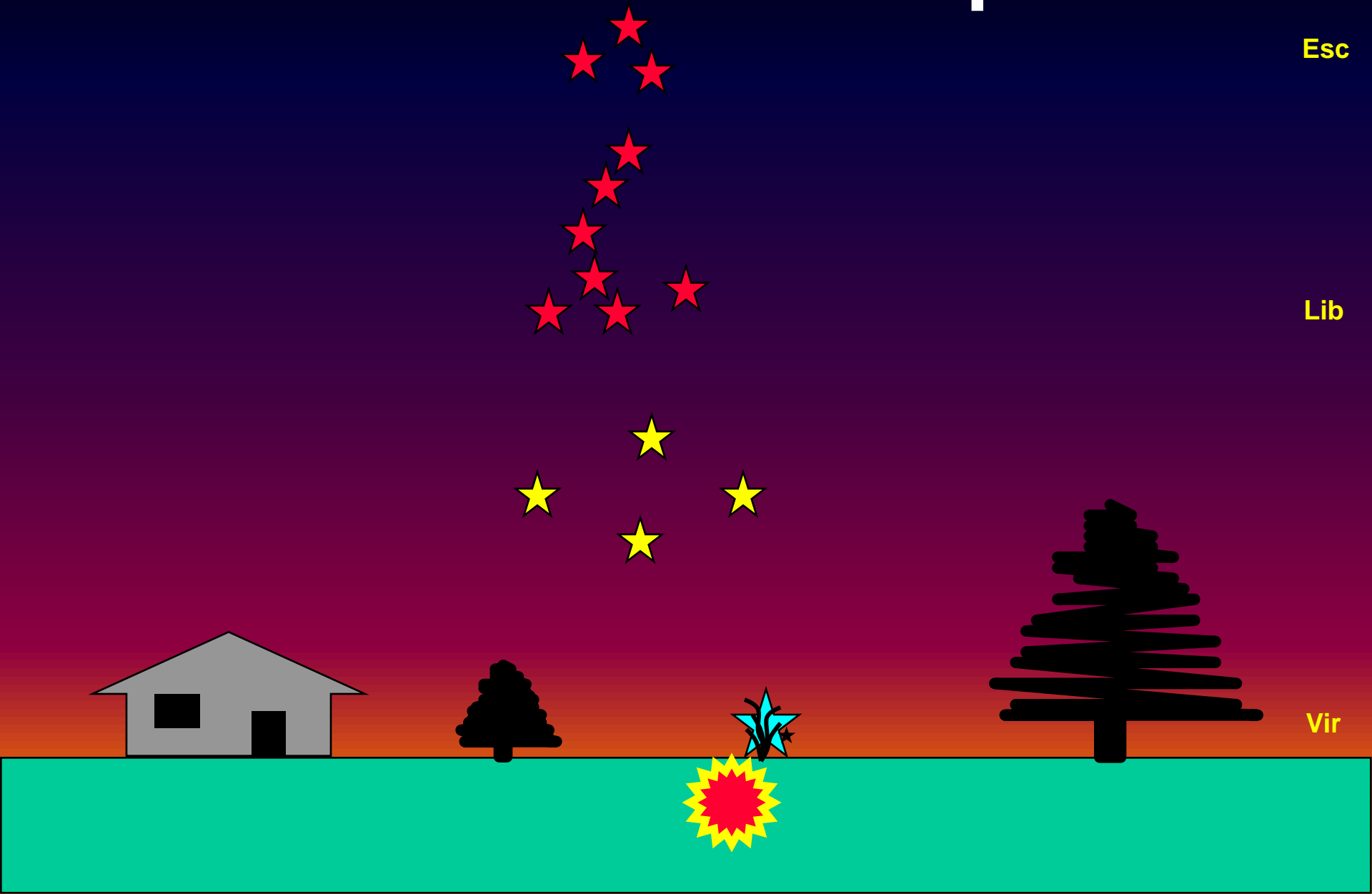
Esc

Lib

Vir



Horizonte visto no crepúsculo

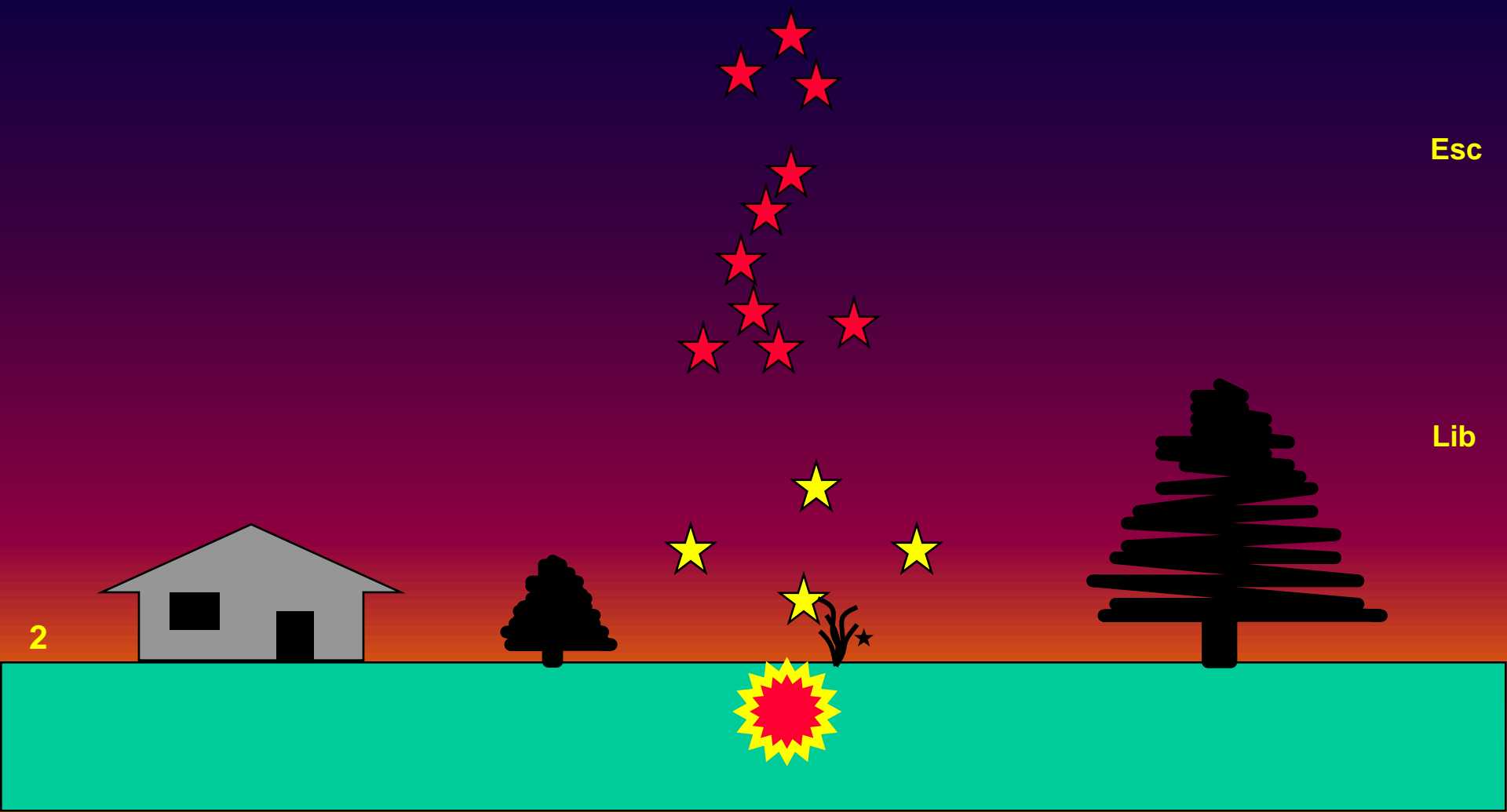


Esc

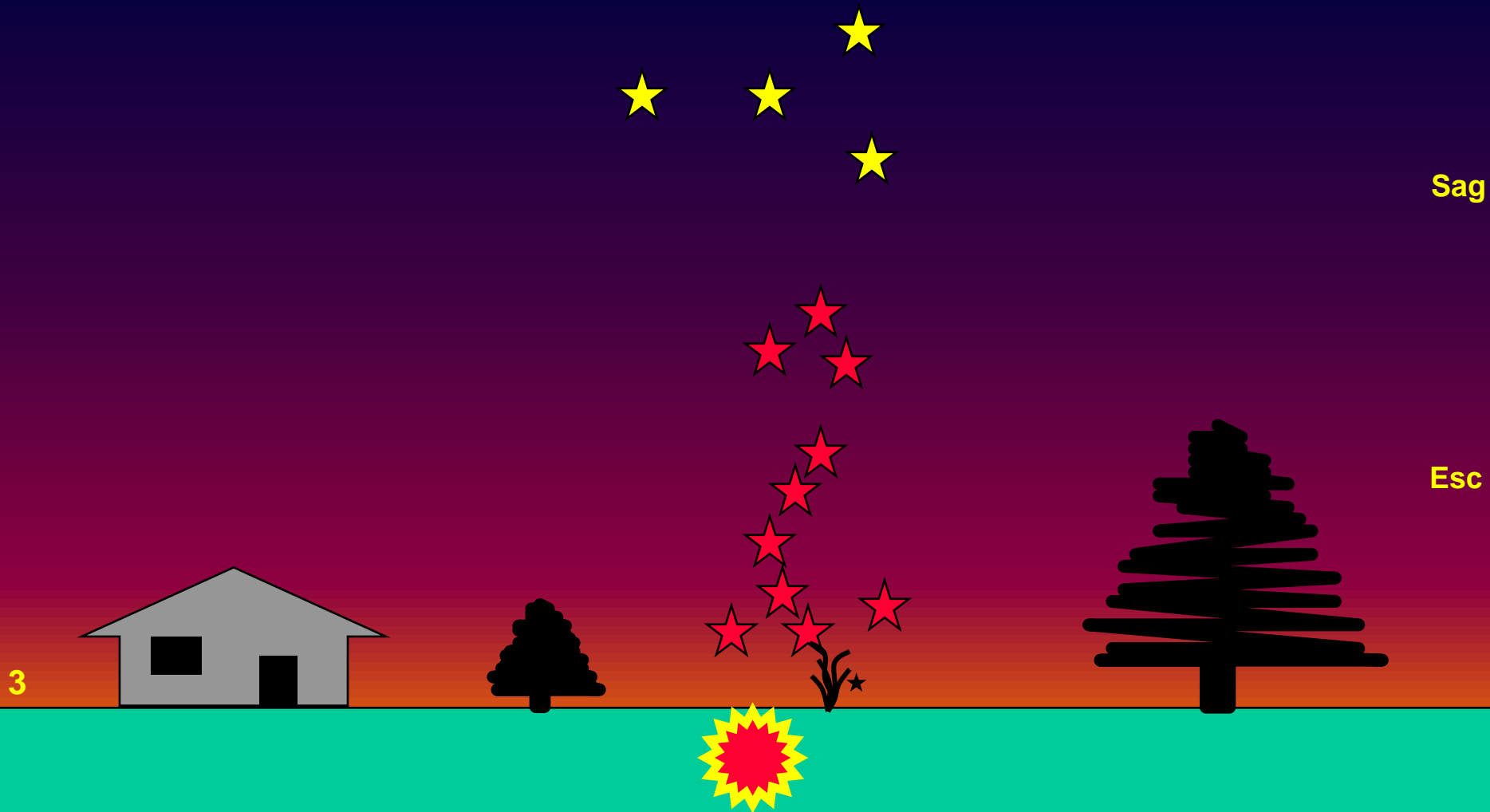
Lib

Vir

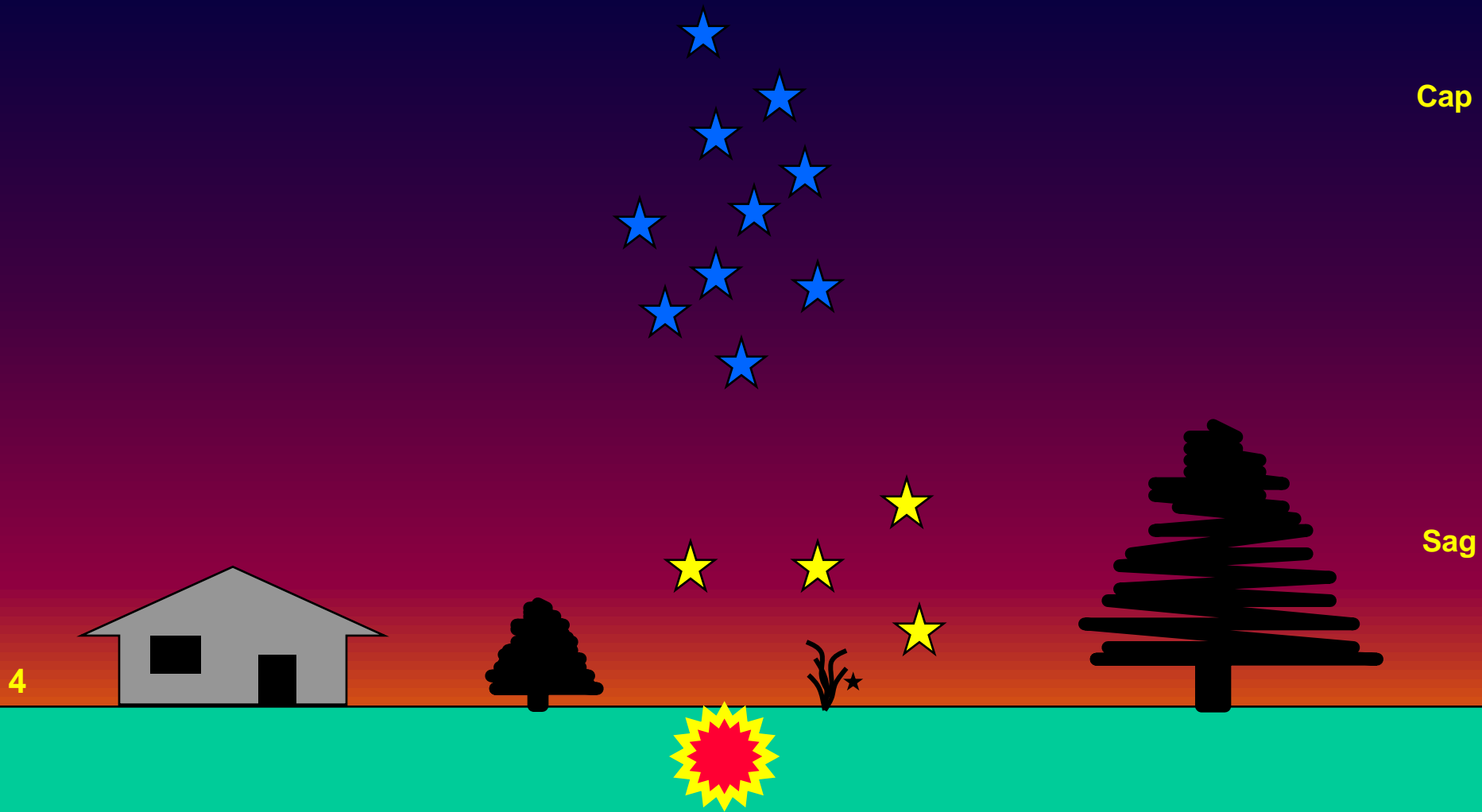
Horizonte visto no crepúsculo



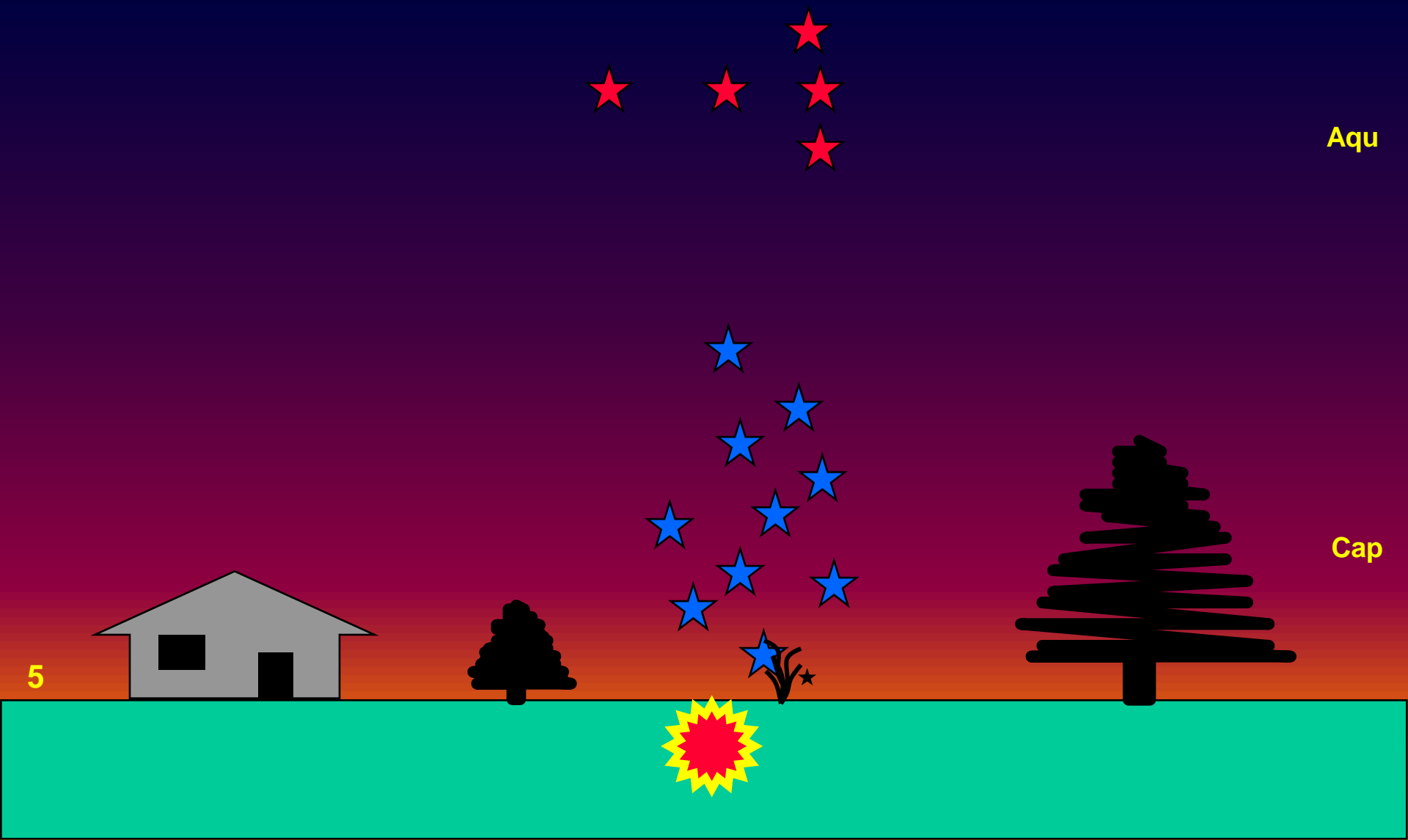
Horizonte visto no crepúsculo



Horizonte visto no crepúsculo



Horizonte visto no crepúsculo



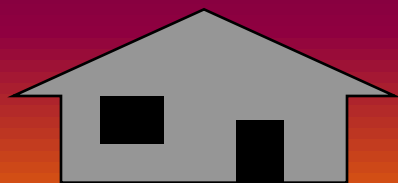
Aqu

Cap

5

Horizonte visto no crepúsculo

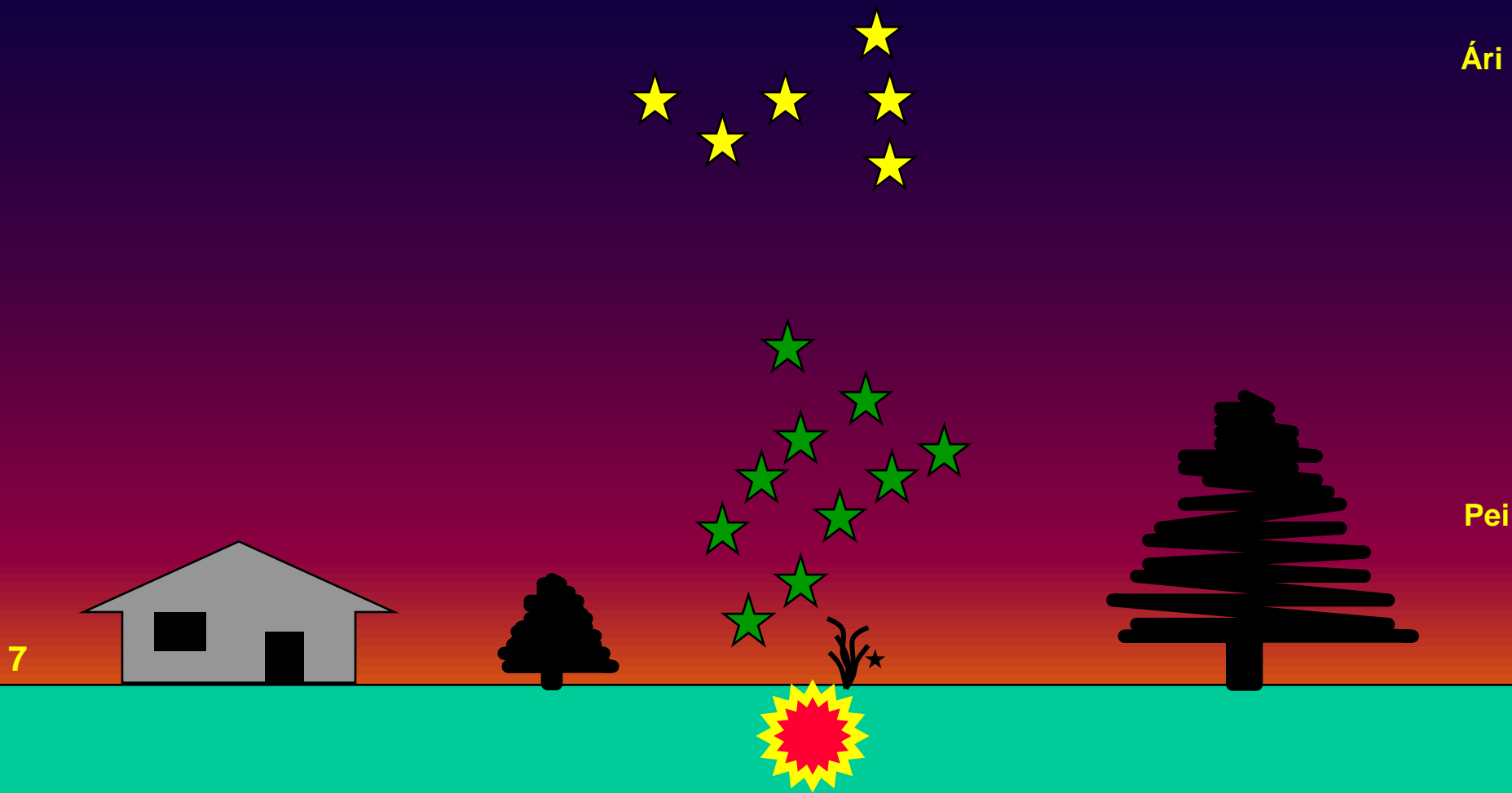
6



Pei

Aqu

Horizonte visto no crepúsculo



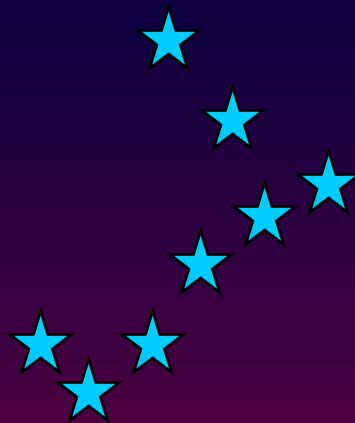
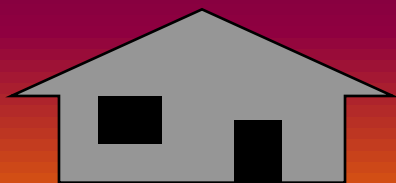
7

Ári

Pei

Horizonte visto no crepúsculo

8

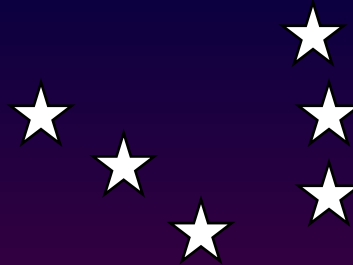
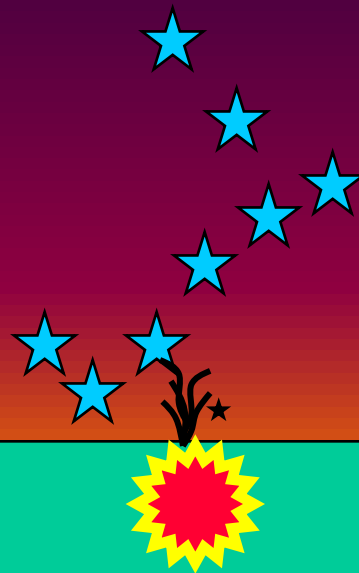
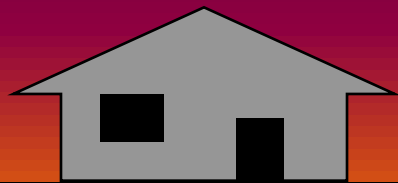


Tou

Ári

Horizonte visto no crepúsculo

9



Gêm

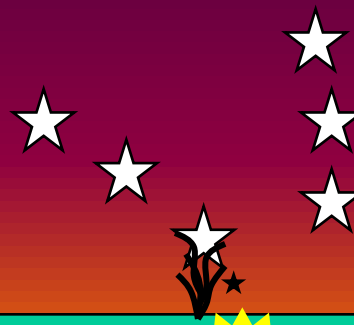
Tou

Horizonte visto no crepúsculo

Cân



Gêm

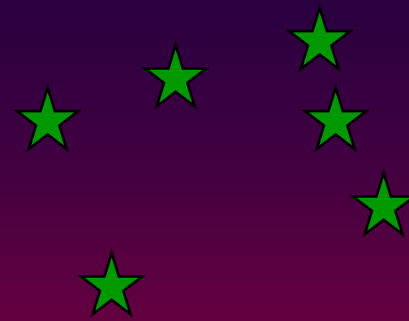


10



Horizonte visto no crepúsculo

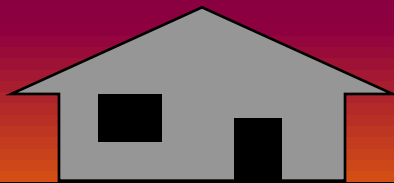
Leã



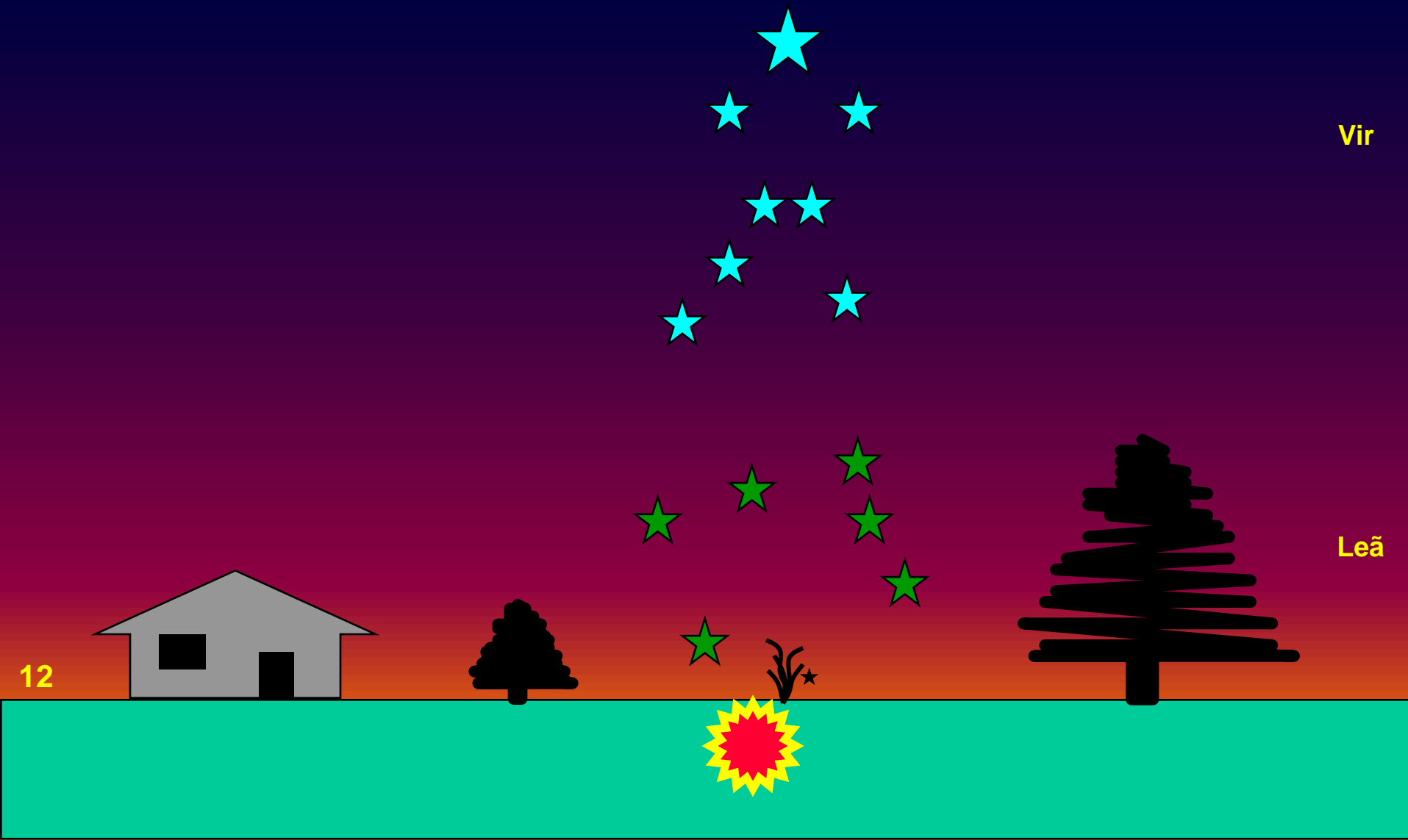
Cân



11



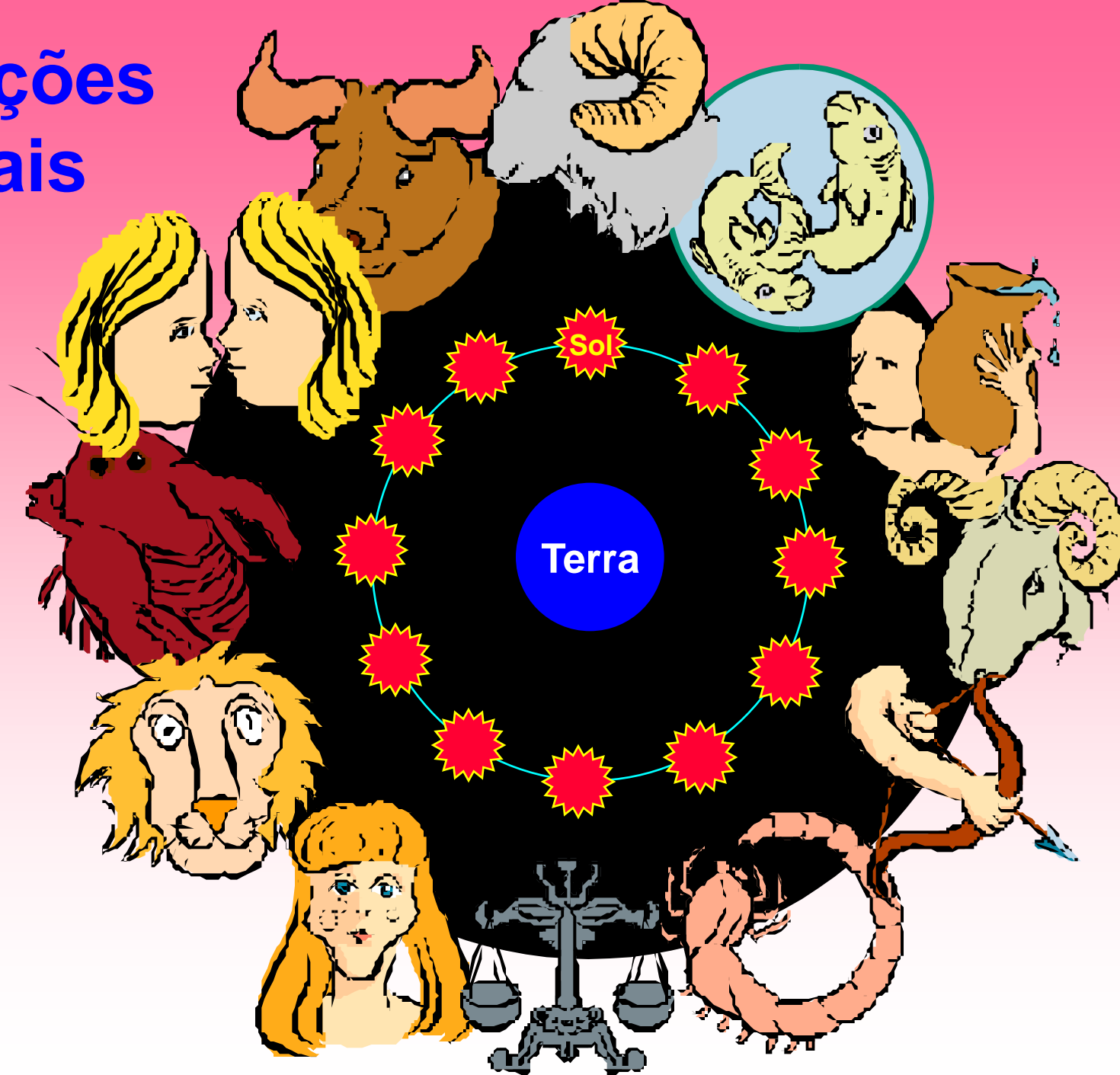
Horizonte visto no crepúsculo



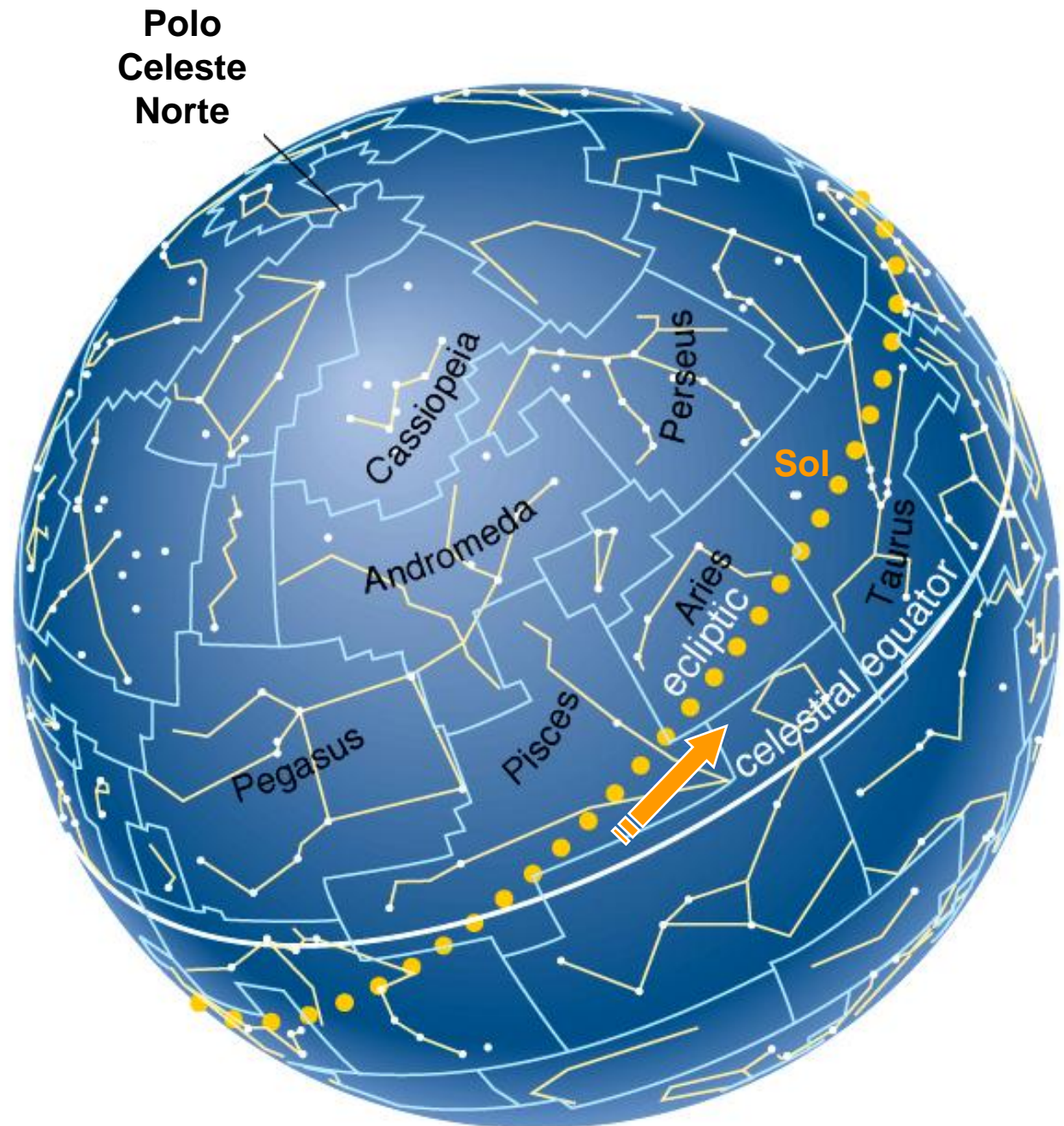
Horizonte visto no crepúsculo



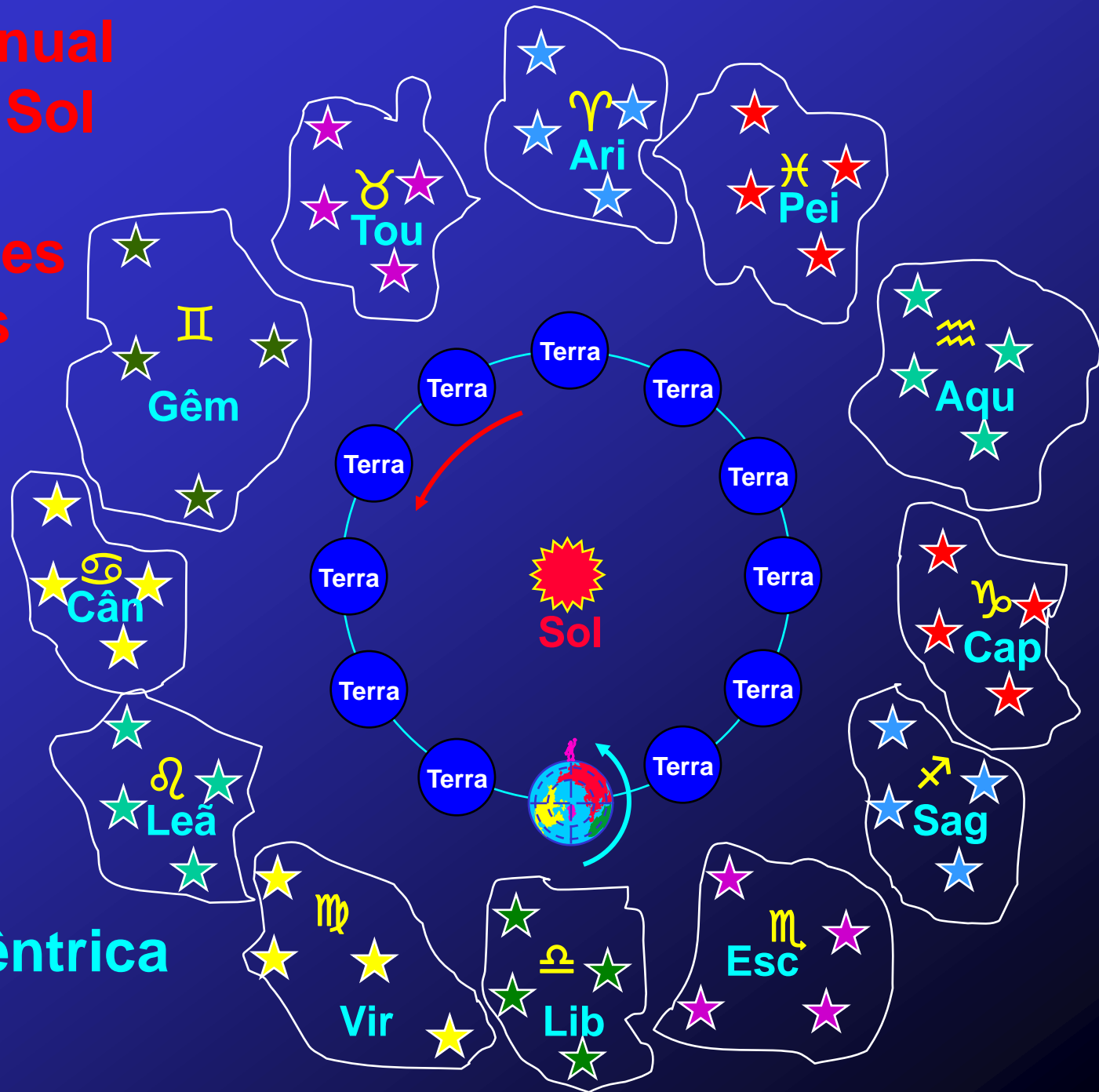
Constelações Zodiacais



**Trajetória
anual
aparente do
Sol por entre
as
constelações**



Movimento anual aparente do Sol pelas Constelações Zodiacais



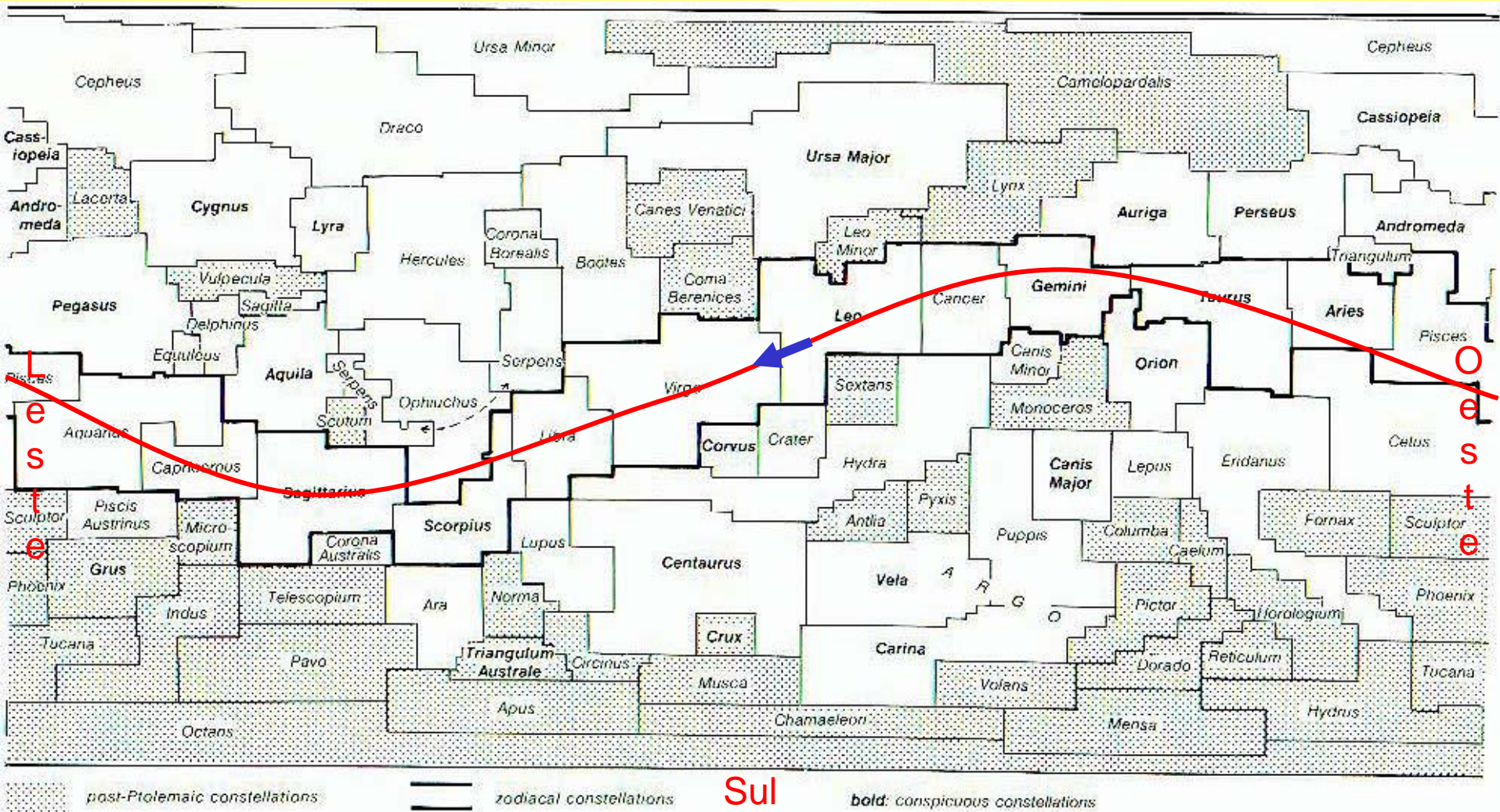
Visão heliocêntrica



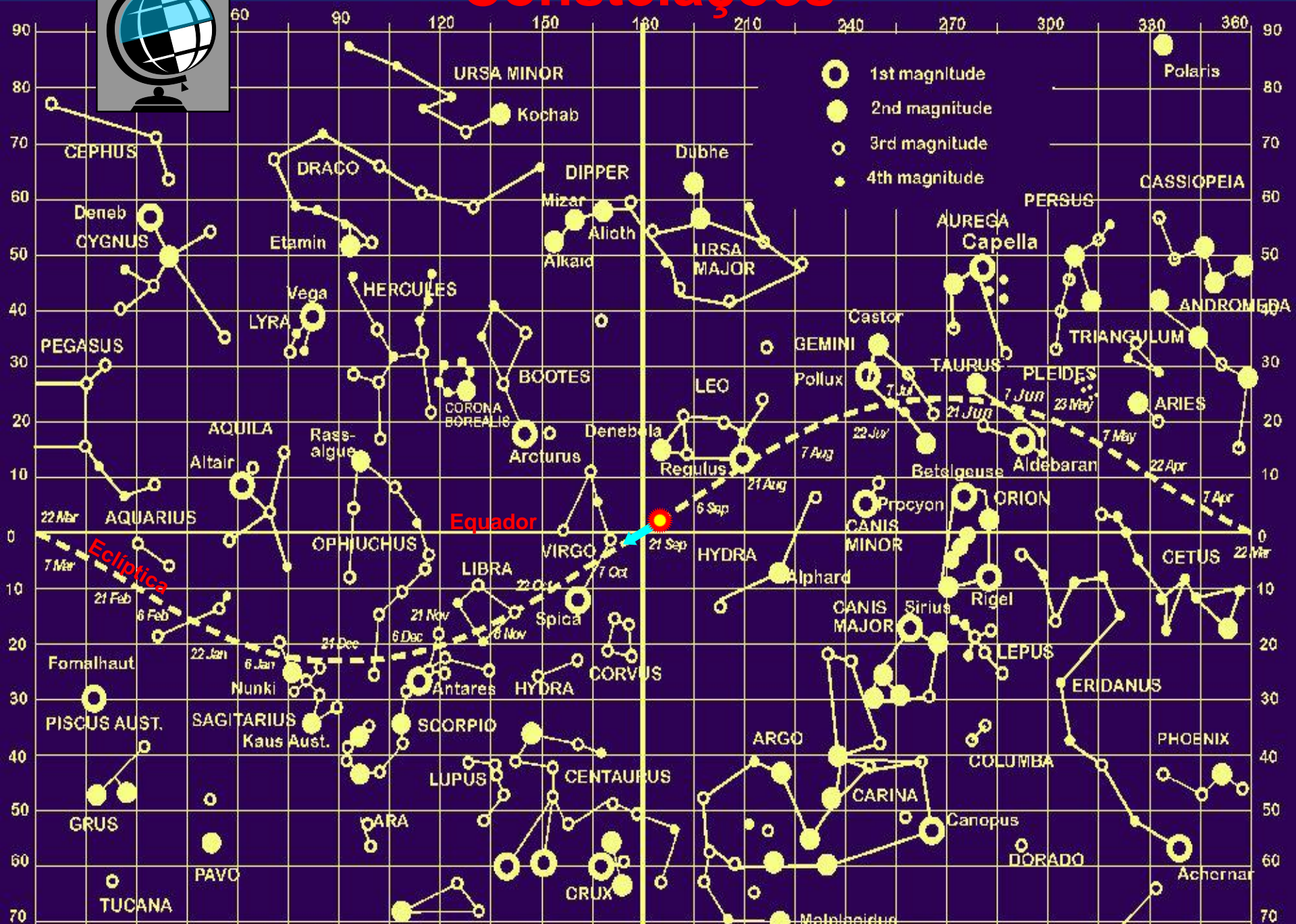
Constelações zodiacais observadas do Norte

Constelações percorridas pelo Sol

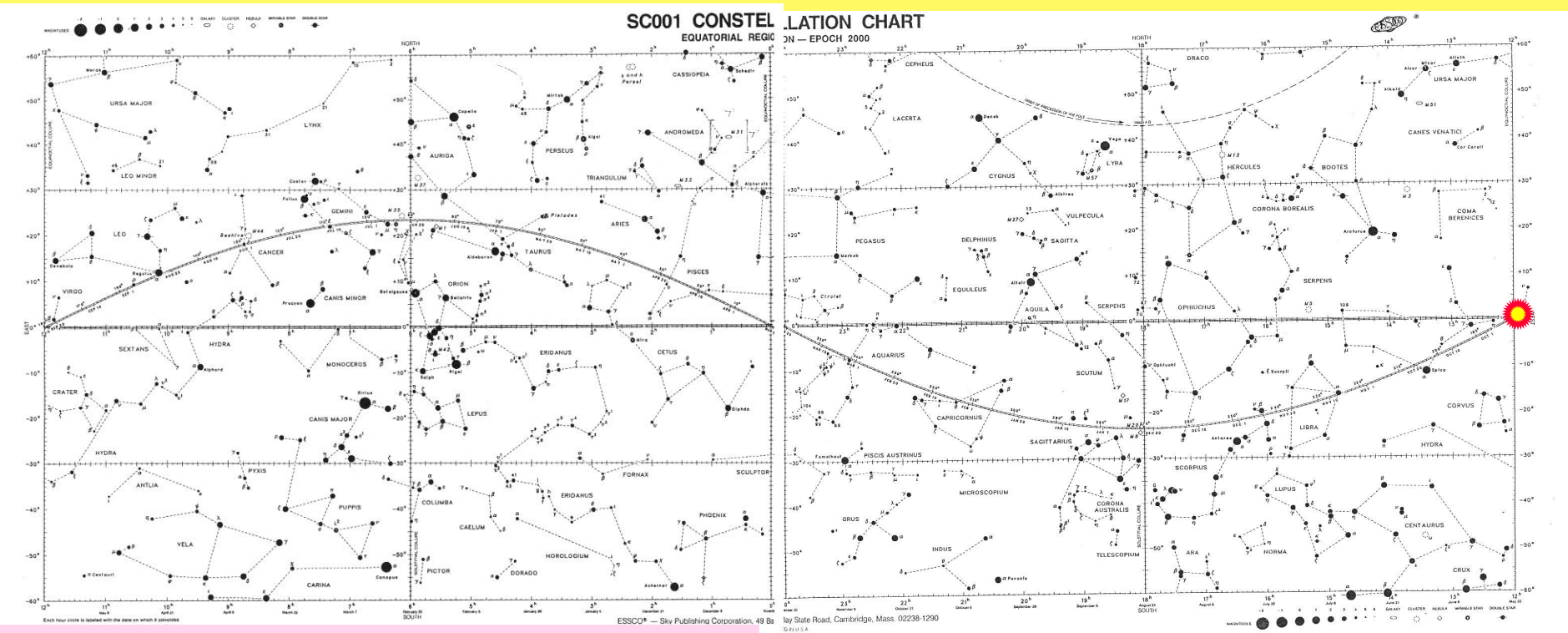
Norte



Constelações

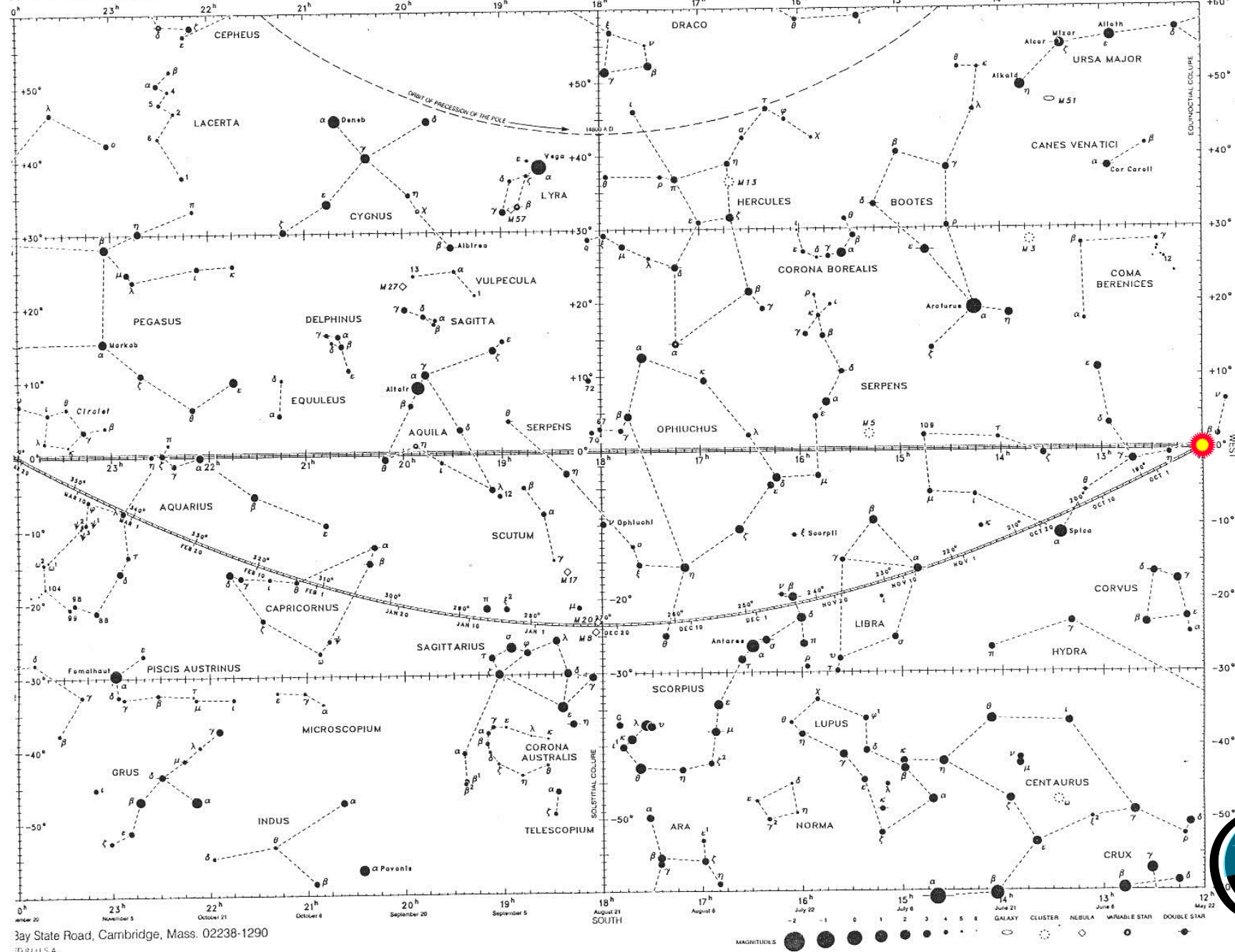


Constelações

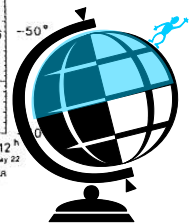


STELLATION CHART

ION — EPOCH 2000



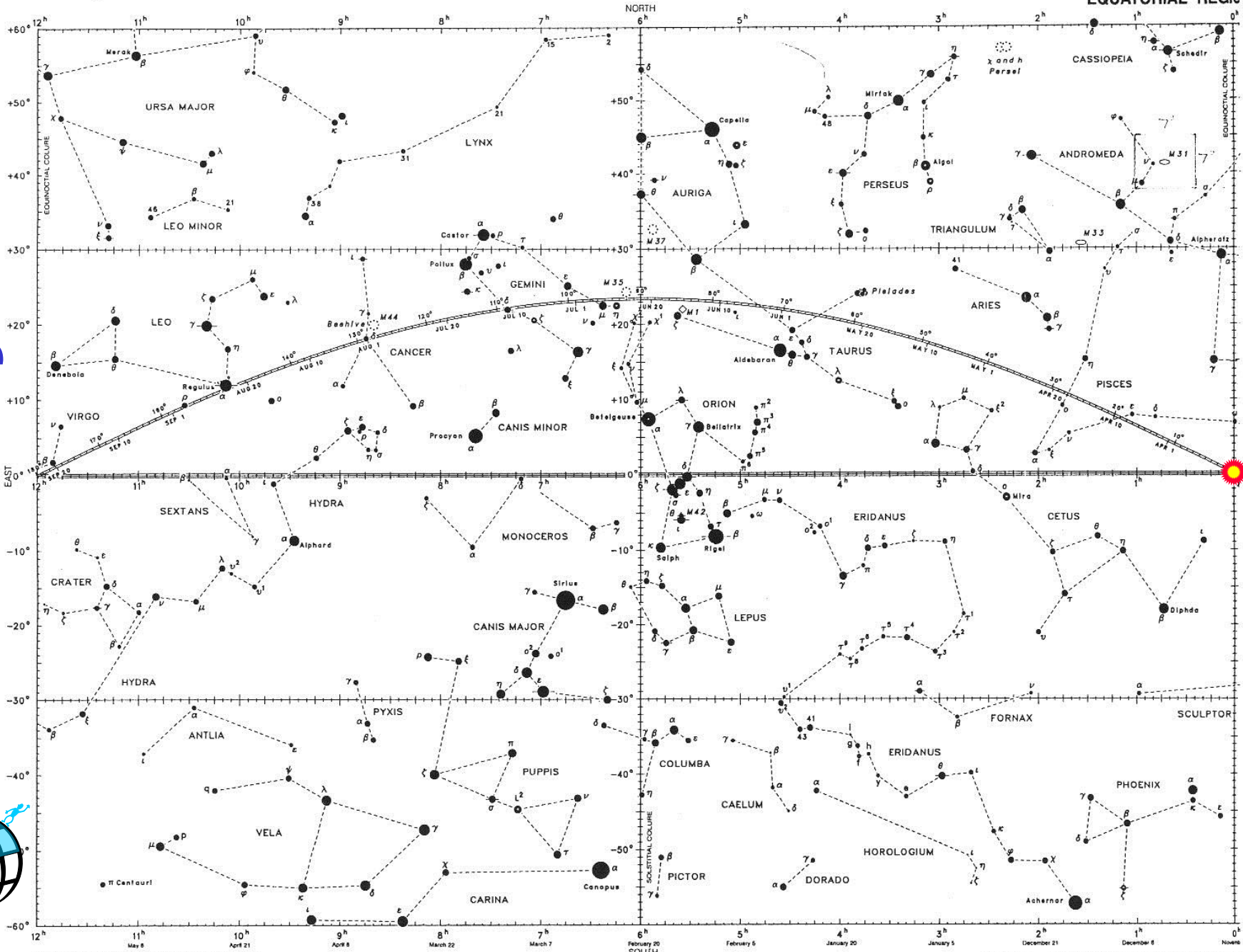
Constelações



SC001 CONSTEL EQUATORIAL REGIO

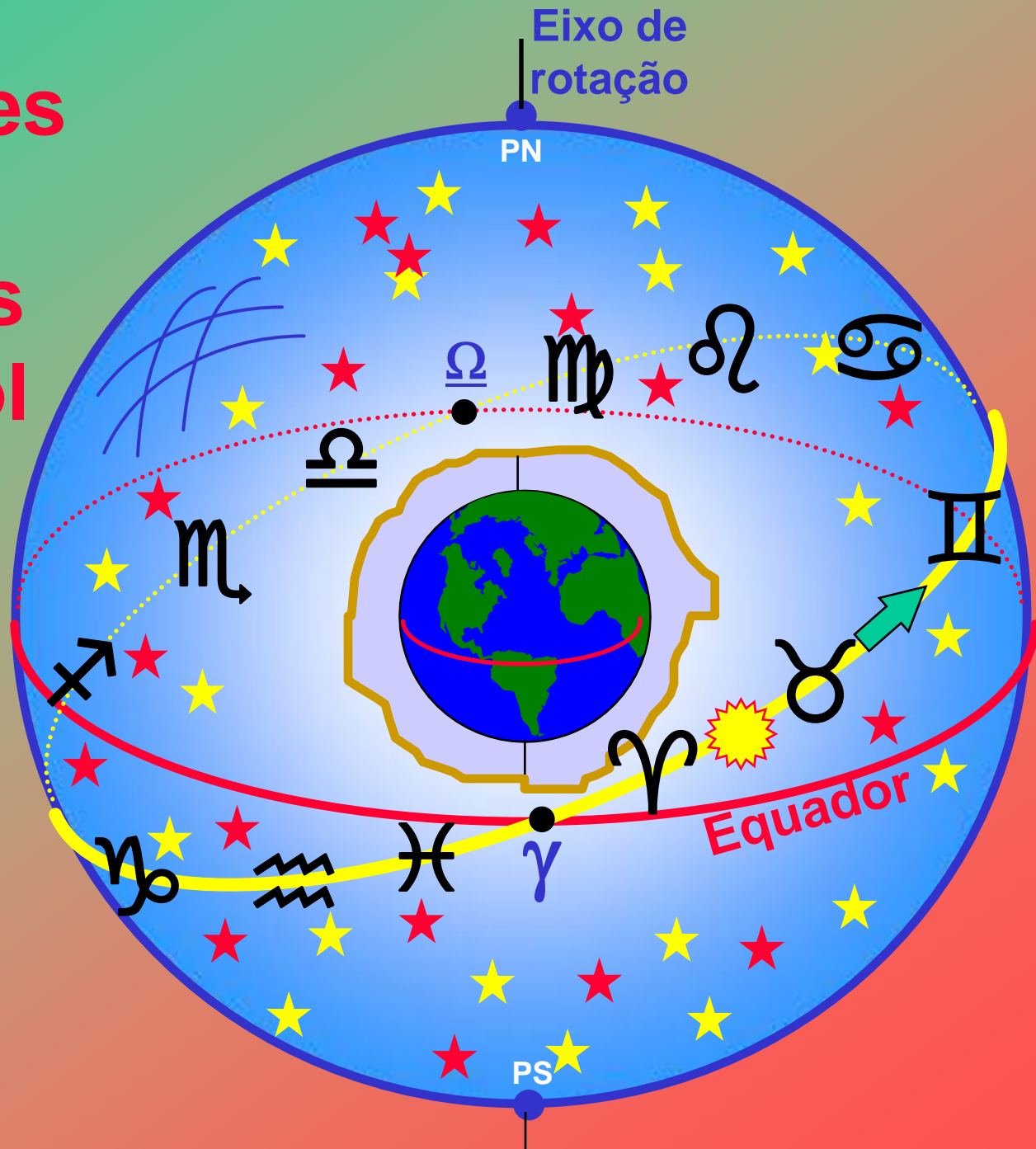
MAGNITUDES: -2, -1, 0, 1, 2, 3, 4, 5, 8
 GALAXY: ○
 CLUSTER: ⊙
 NEBULA: ⊕
 VARIABLE STAR: ●
 DOUBLE STAR: ⋄

Constelações



Each hour circle is labeled with the date on which it coincides

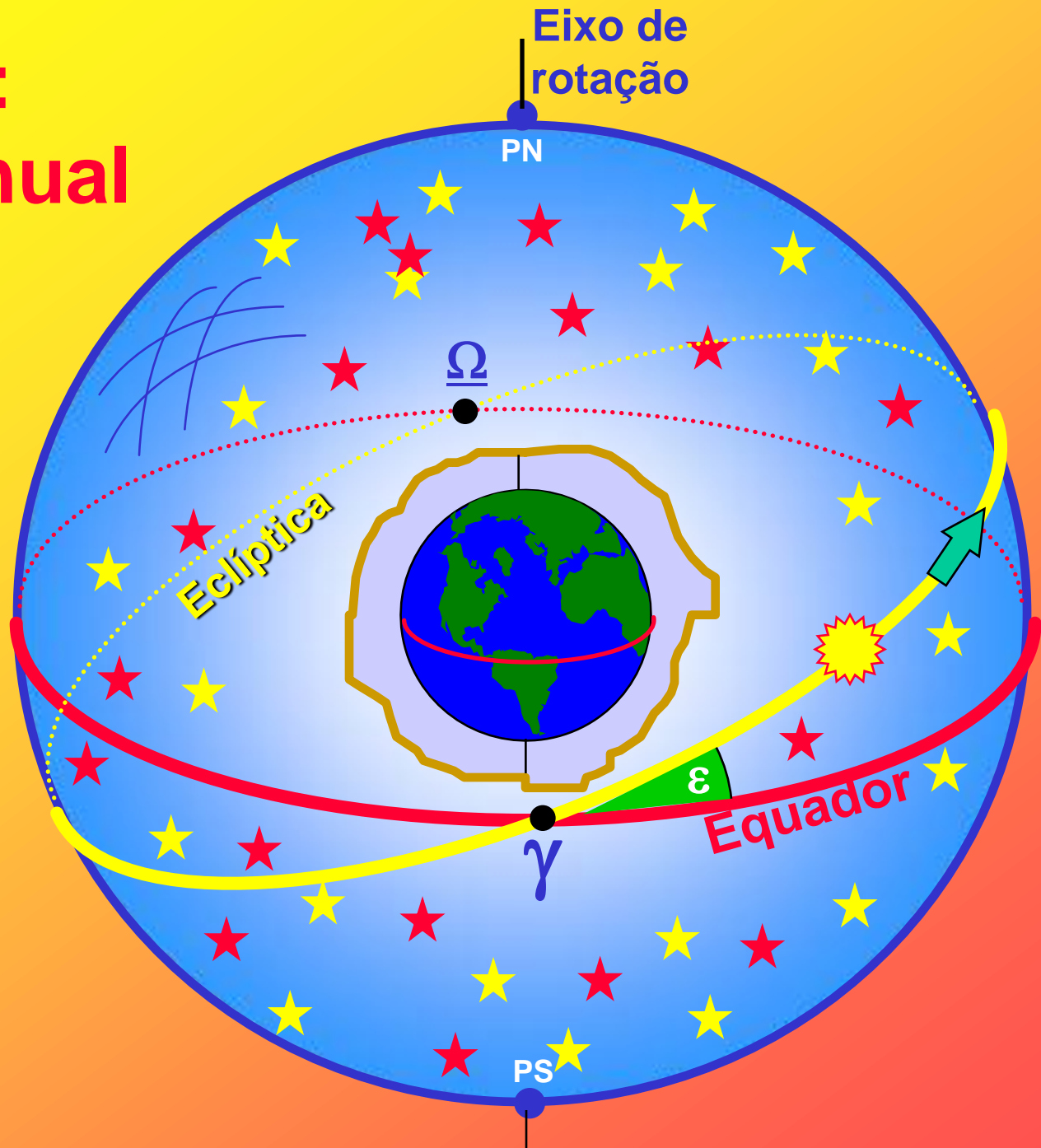
Constelações zodiacais pelas quais passa o Sol



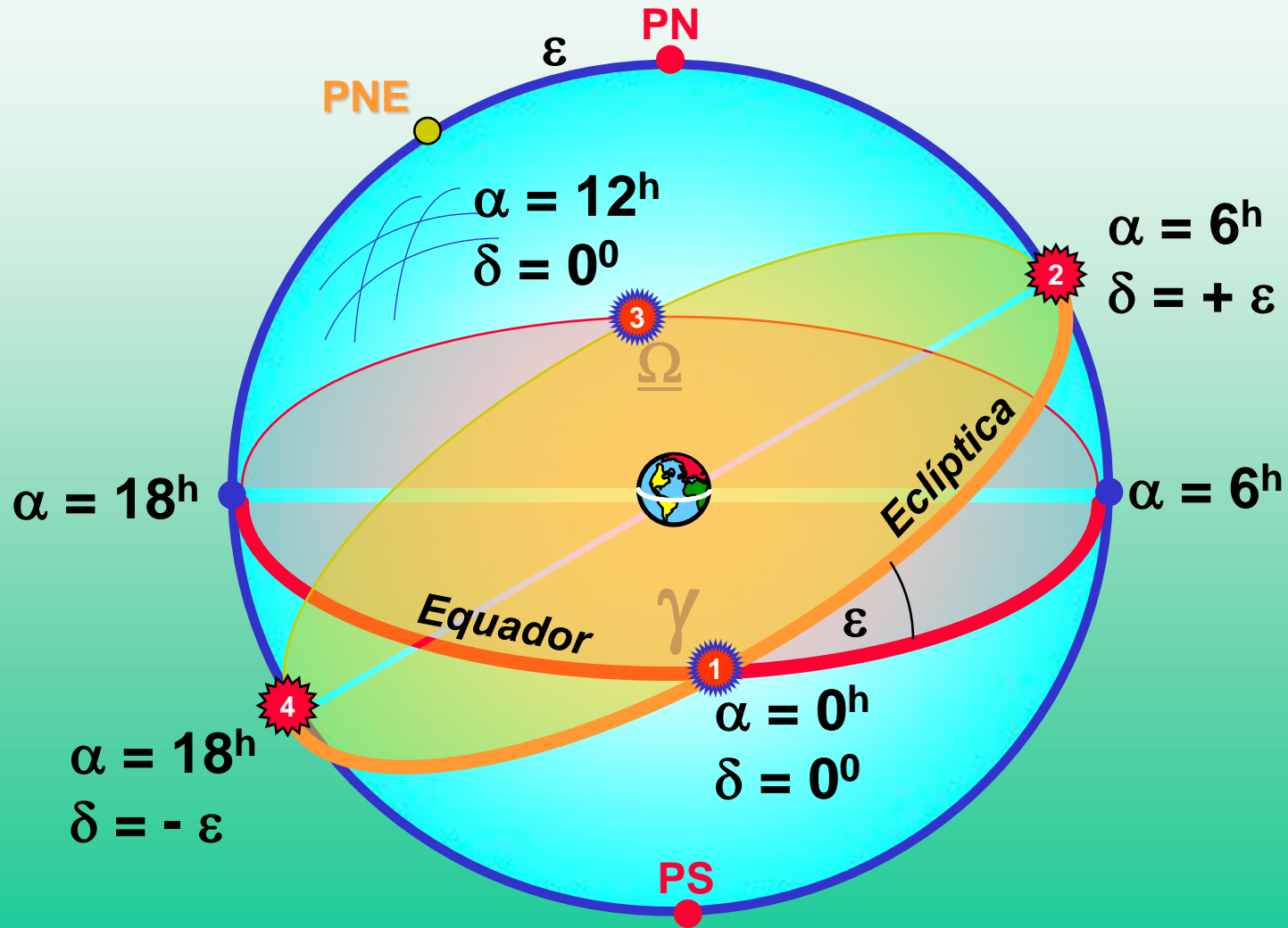
Eclíptica: Trajetória anual aparente do Sol

ε
Obliquidade da
eclíptica

$$\varepsilon \cong 23^\circ 27' 08''$$

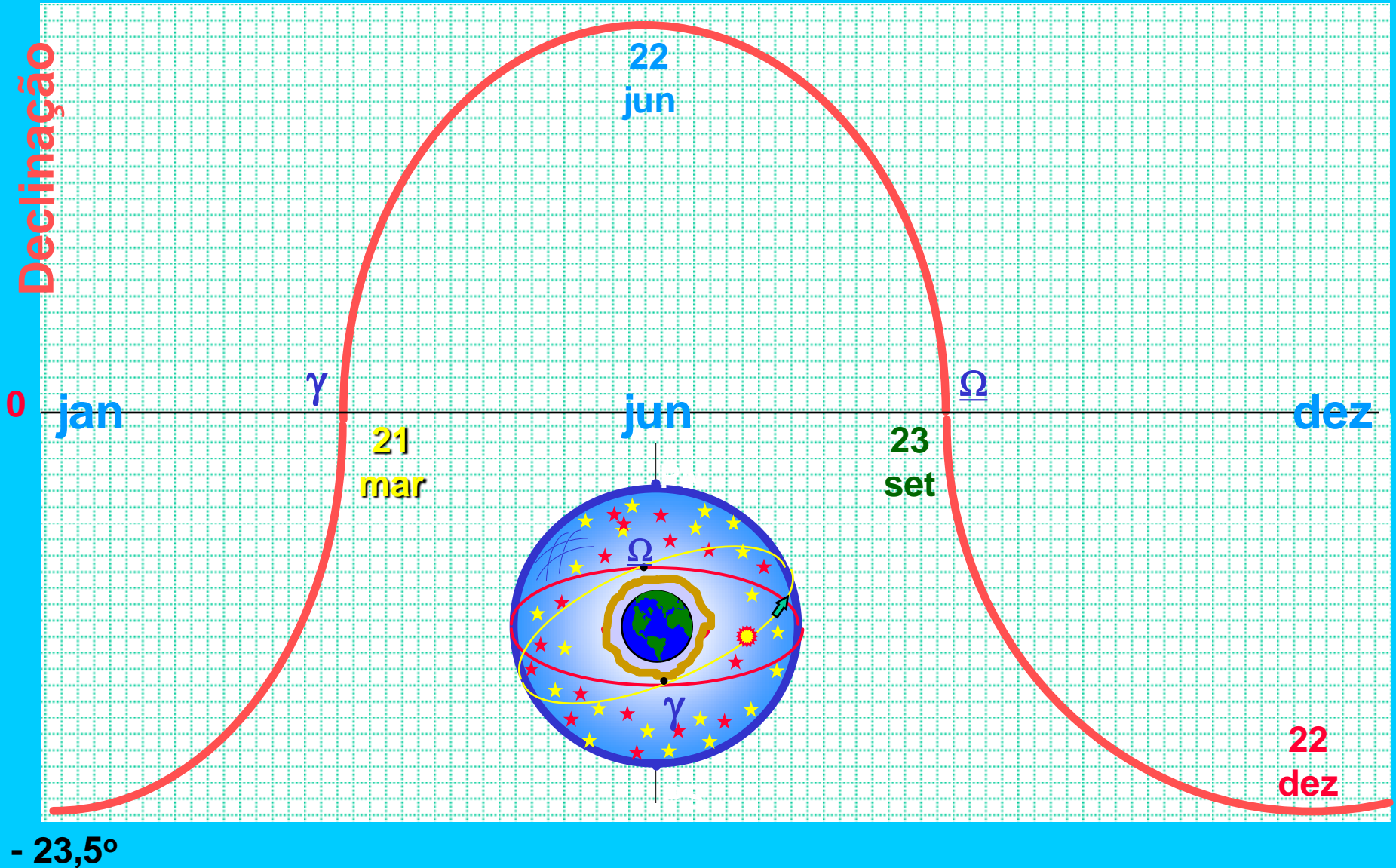


Coordenadas equatoriais particulares do Sol



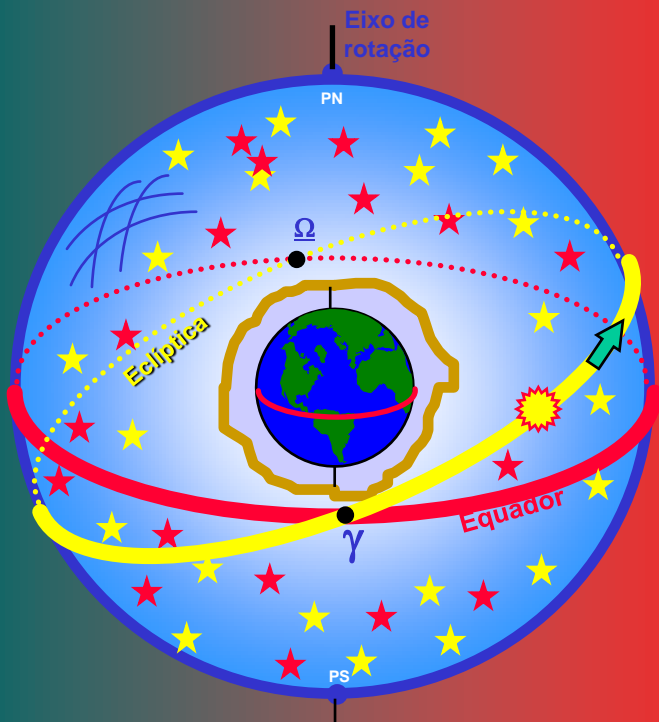
Declinação do Sol ao longo do ano

+ 23,5°

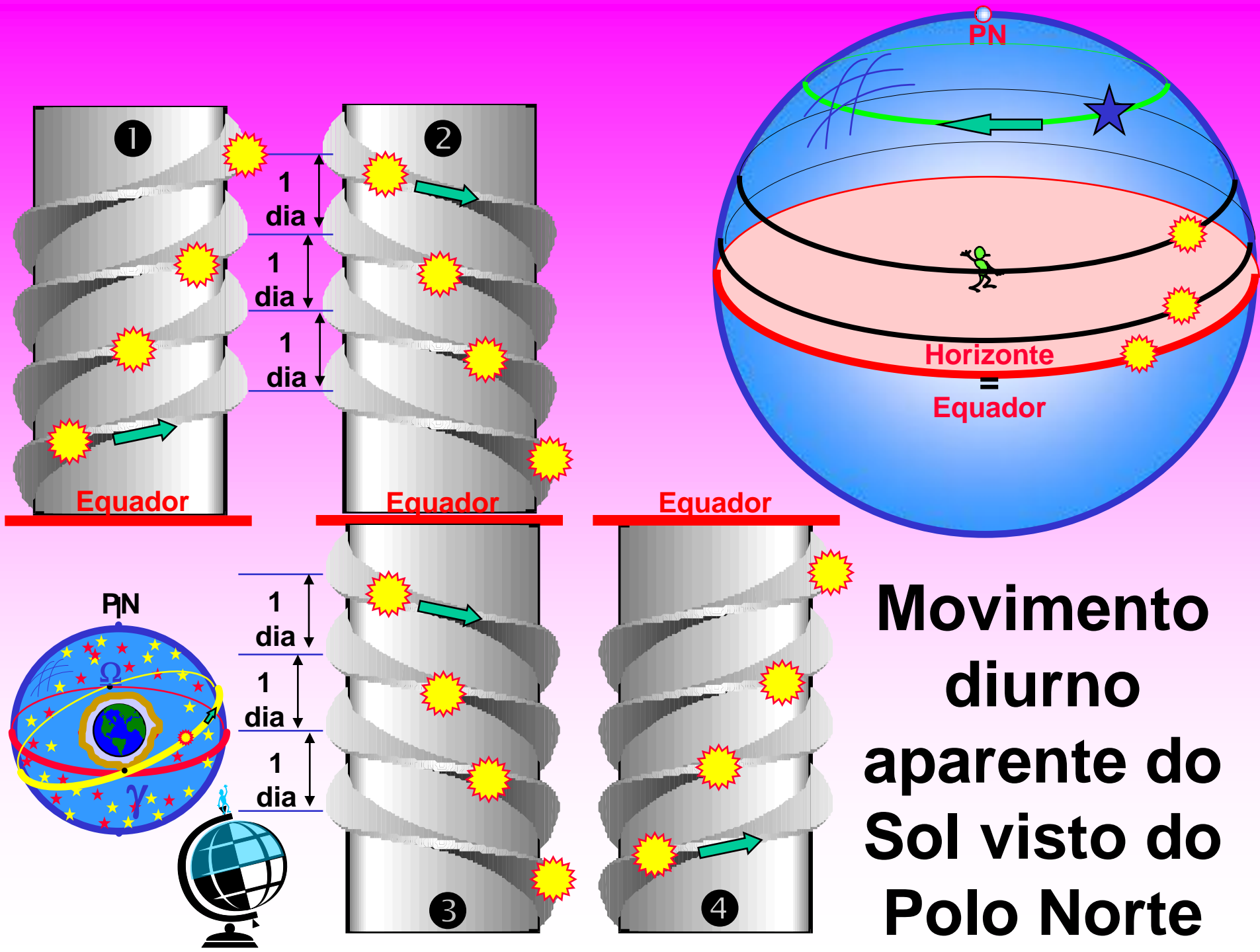


- 23,5°

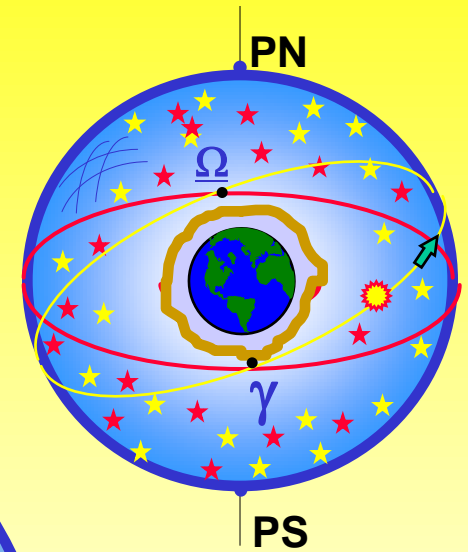
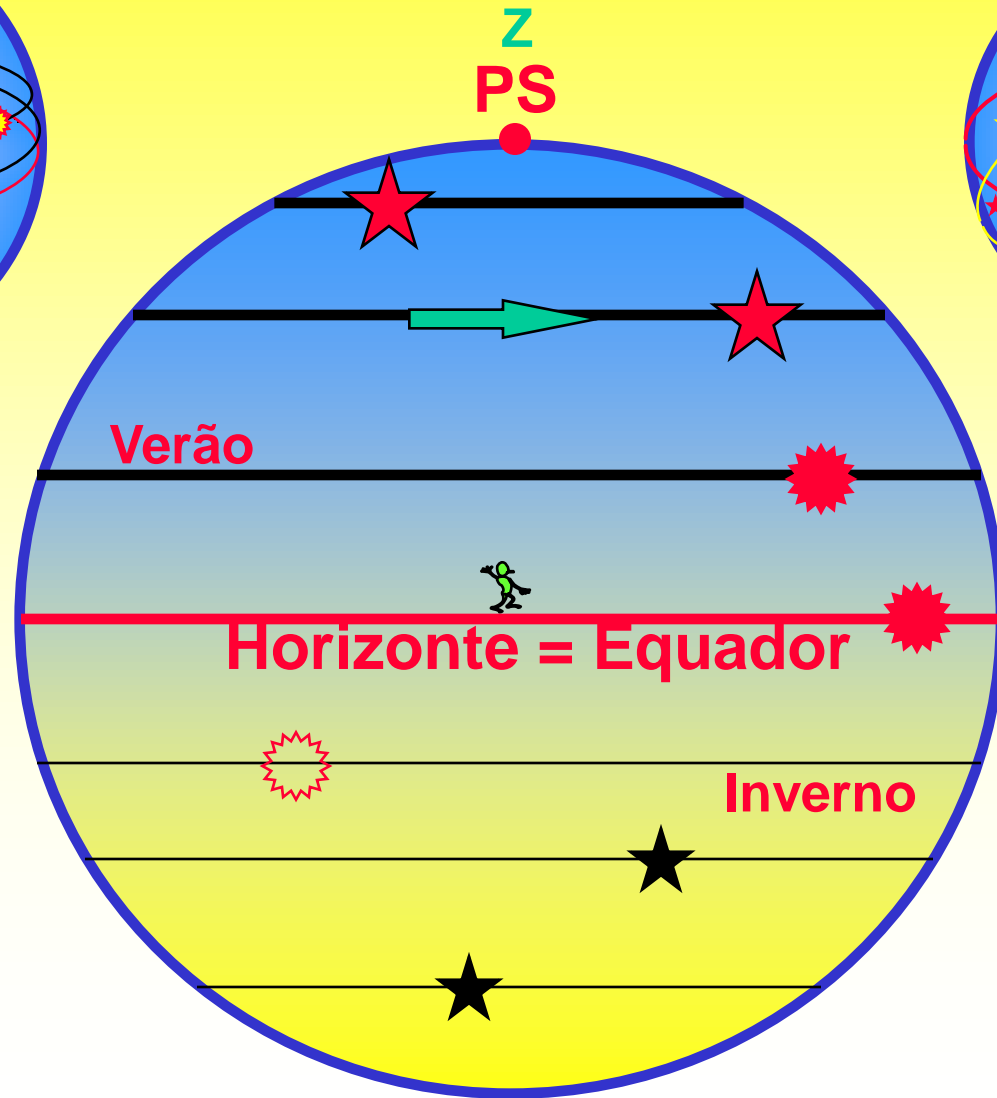
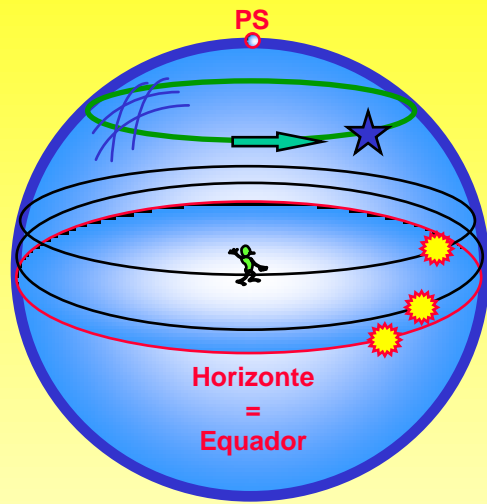
Terra "vista" do Sol ao longo do ano



**Movimento diurno
aparente do Sol
visto do polo**

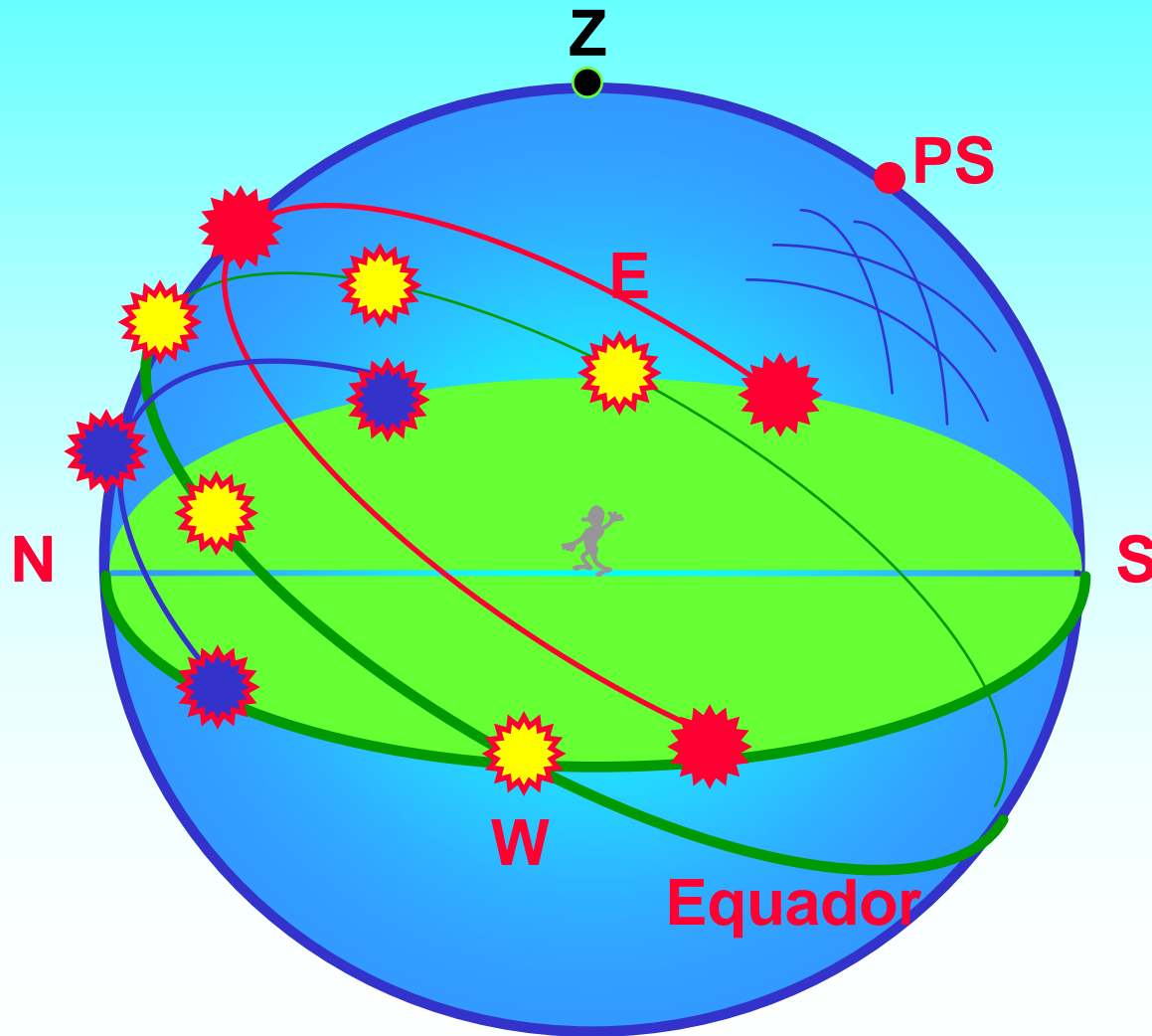


Movimento diurno aparente do Sol no Polo Sul

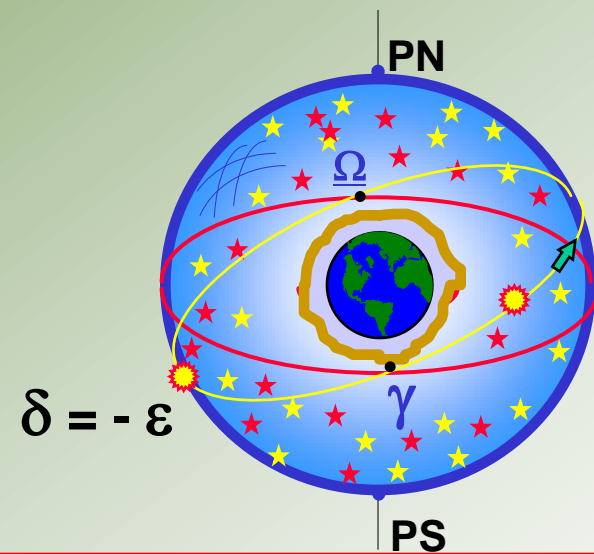
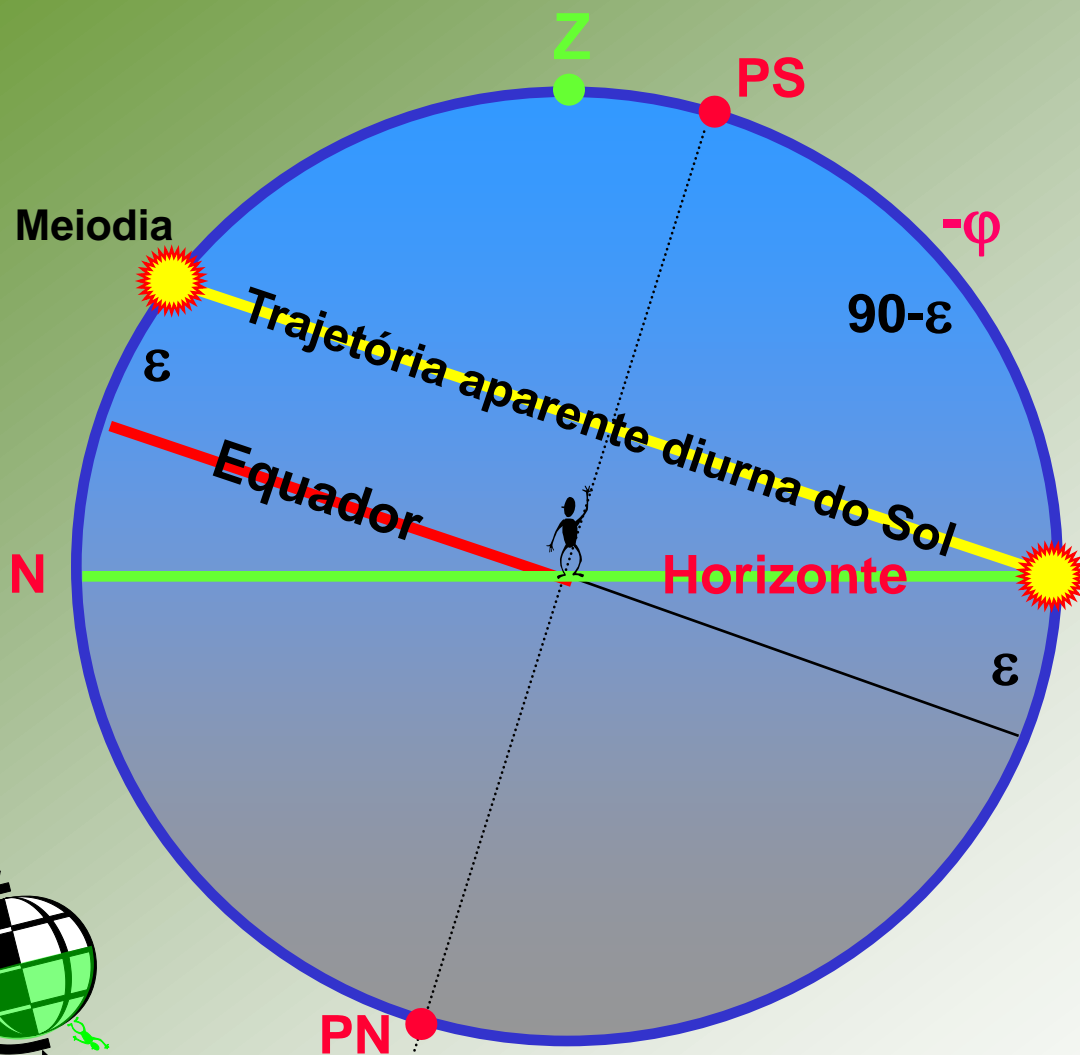


Sol da meia-noite

Movimento diurno aparente do Sol em diferentes dias do ano



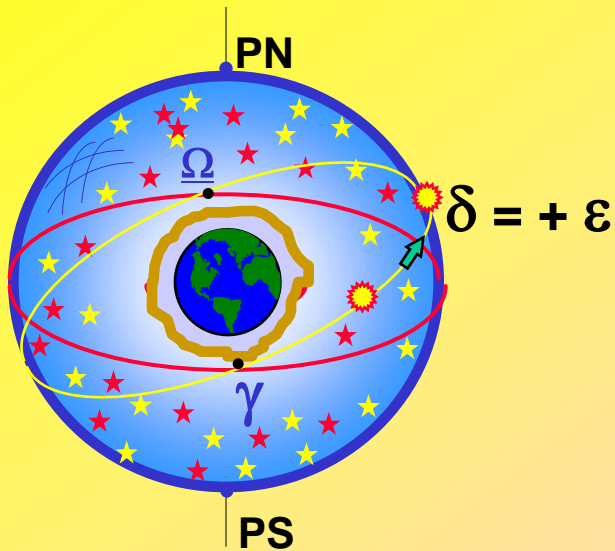
Sol da meia-noite no hemisfério Sul



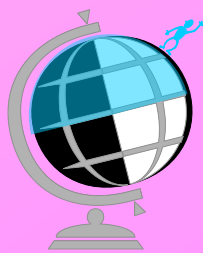
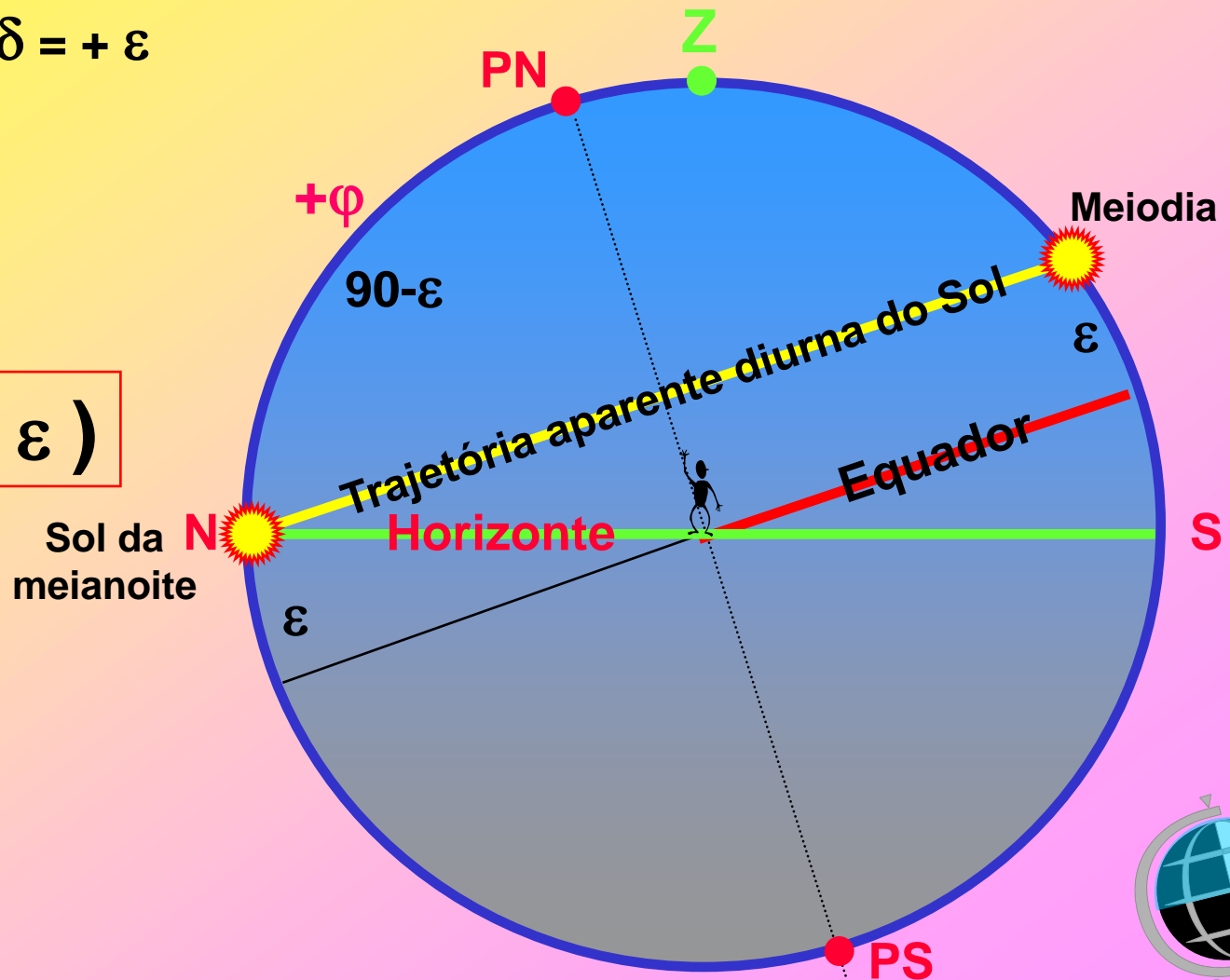
$$\varphi = - (90^\circ - \varepsilon)$$

S Sol da meianoite

Sol da meia-noite no hemisfério Norte



$$\varphi = + (90^{\circ} - \epsilon)$$



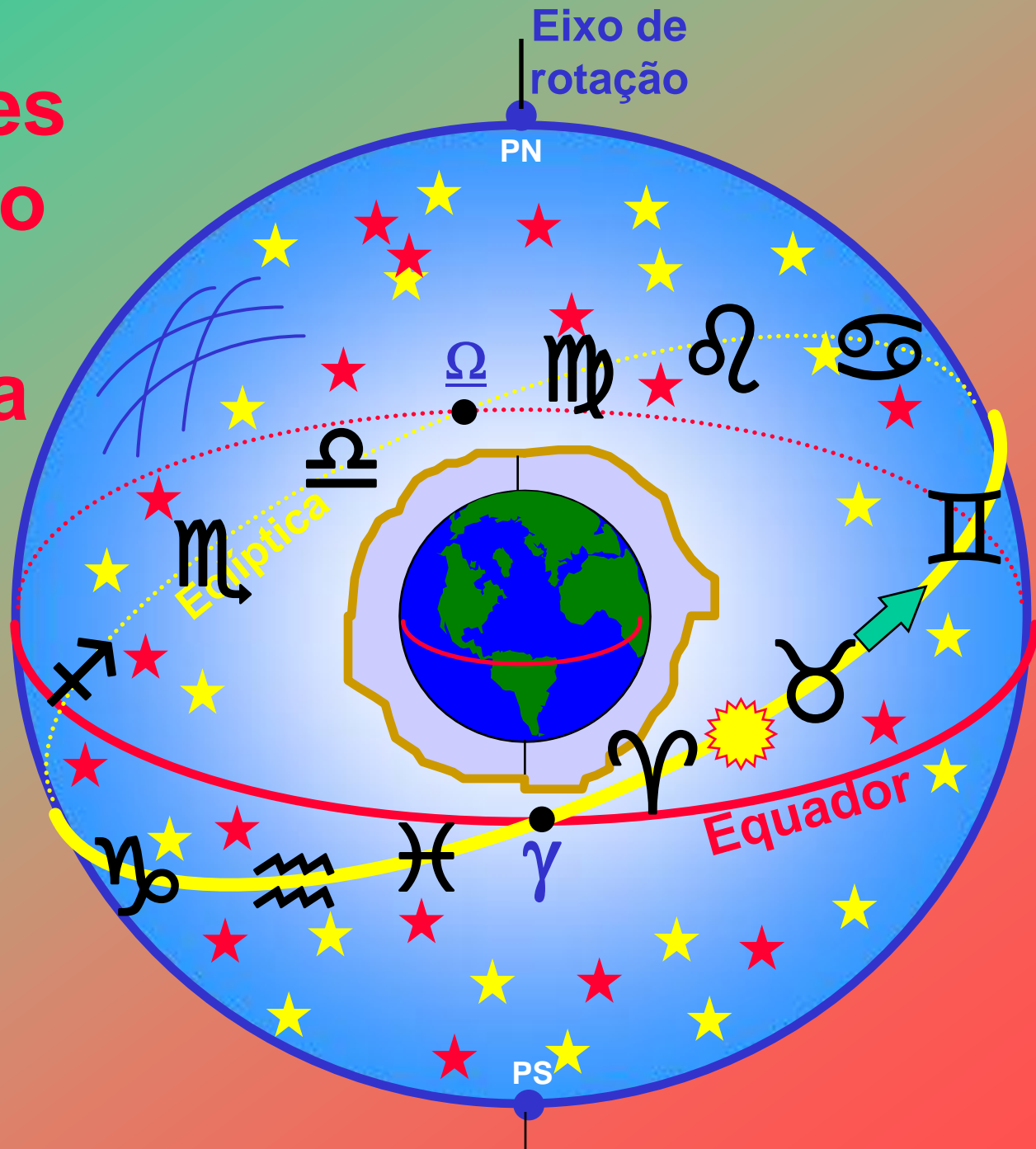


Sol da meia-noite

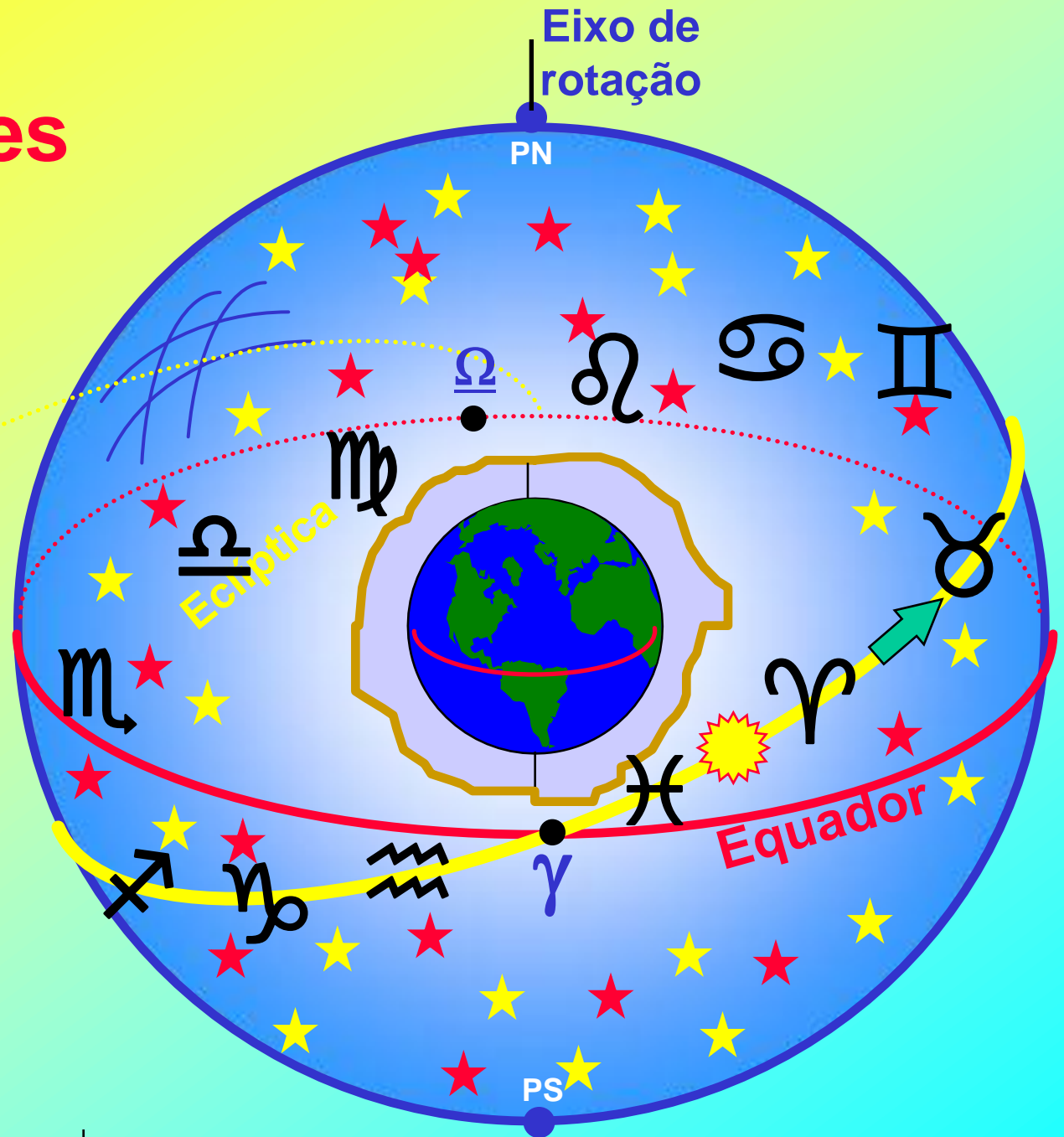


Mudanças milenares nas constelações zodiacais

Constelações zodiacais no início da Astronomia



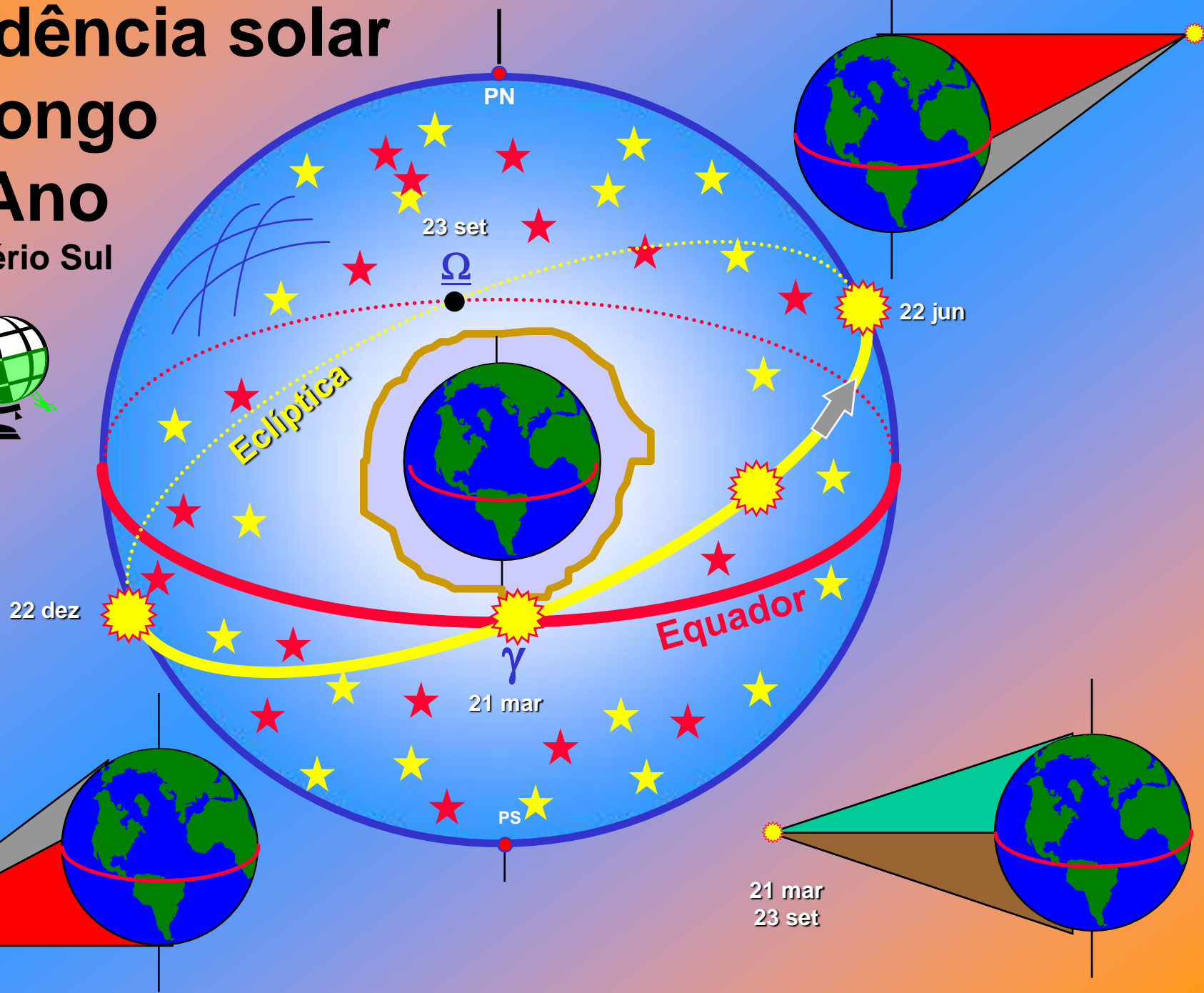
Constelações zodiacais atuais



**Qual o motivo das
estações do ano?**

Incidência solar ao longo do Ano

Hemisfério Sul



PN

23 set

Ω

22 jun

22 dez

Equador

Ecliptica

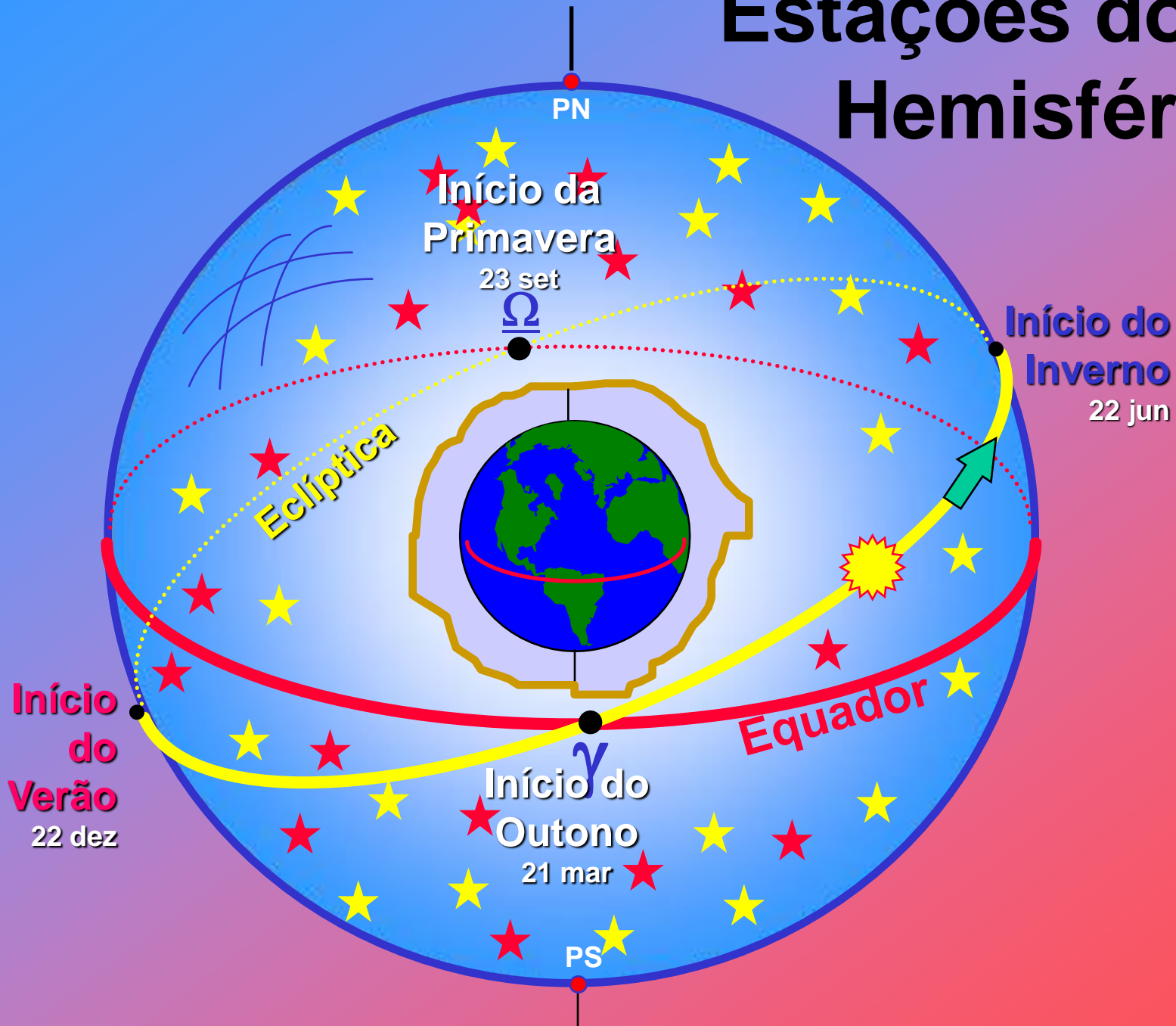
21 mar

γ

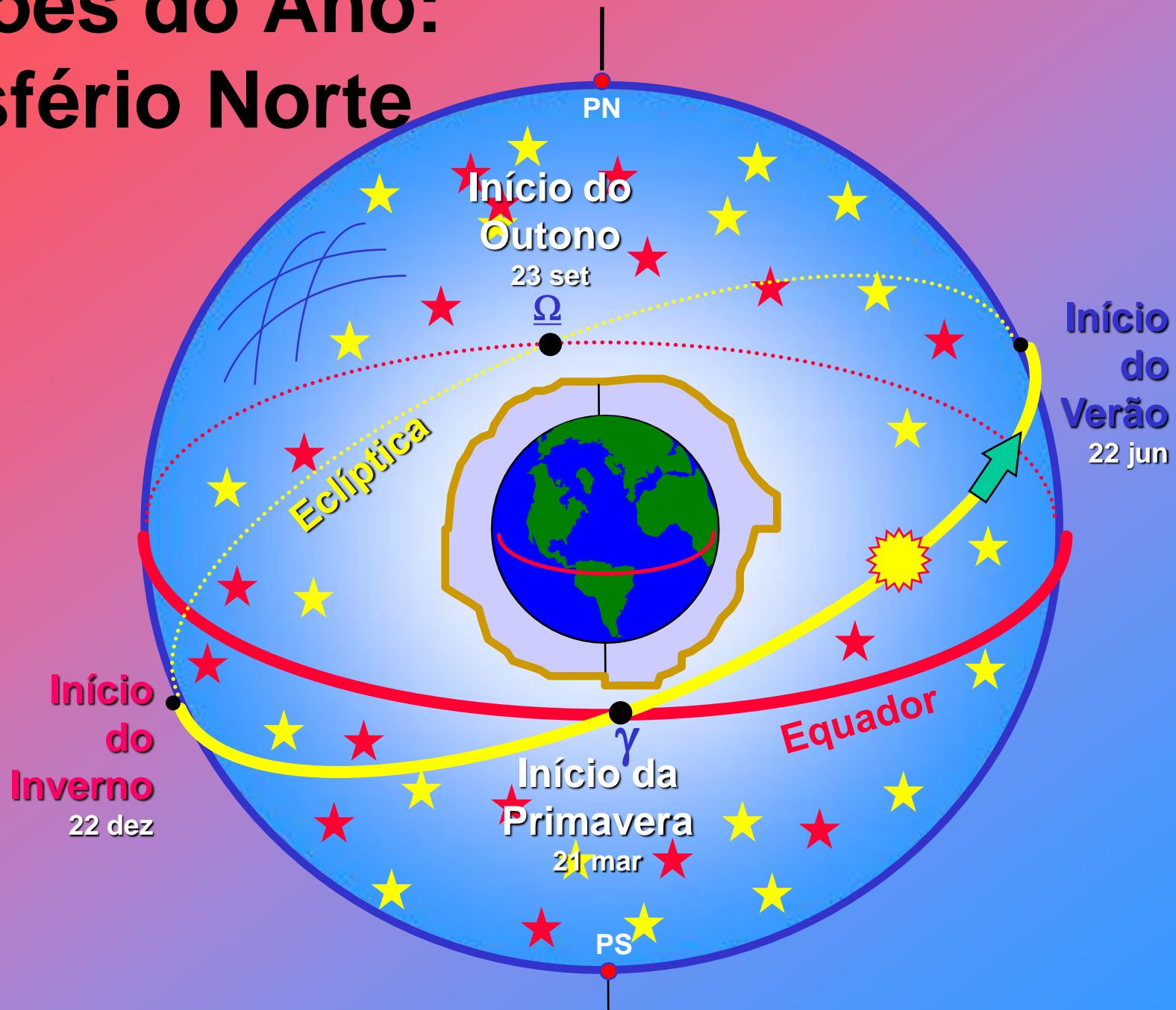
PS

21 mar
23 set

Estações do Ano: Hemisfério Sul



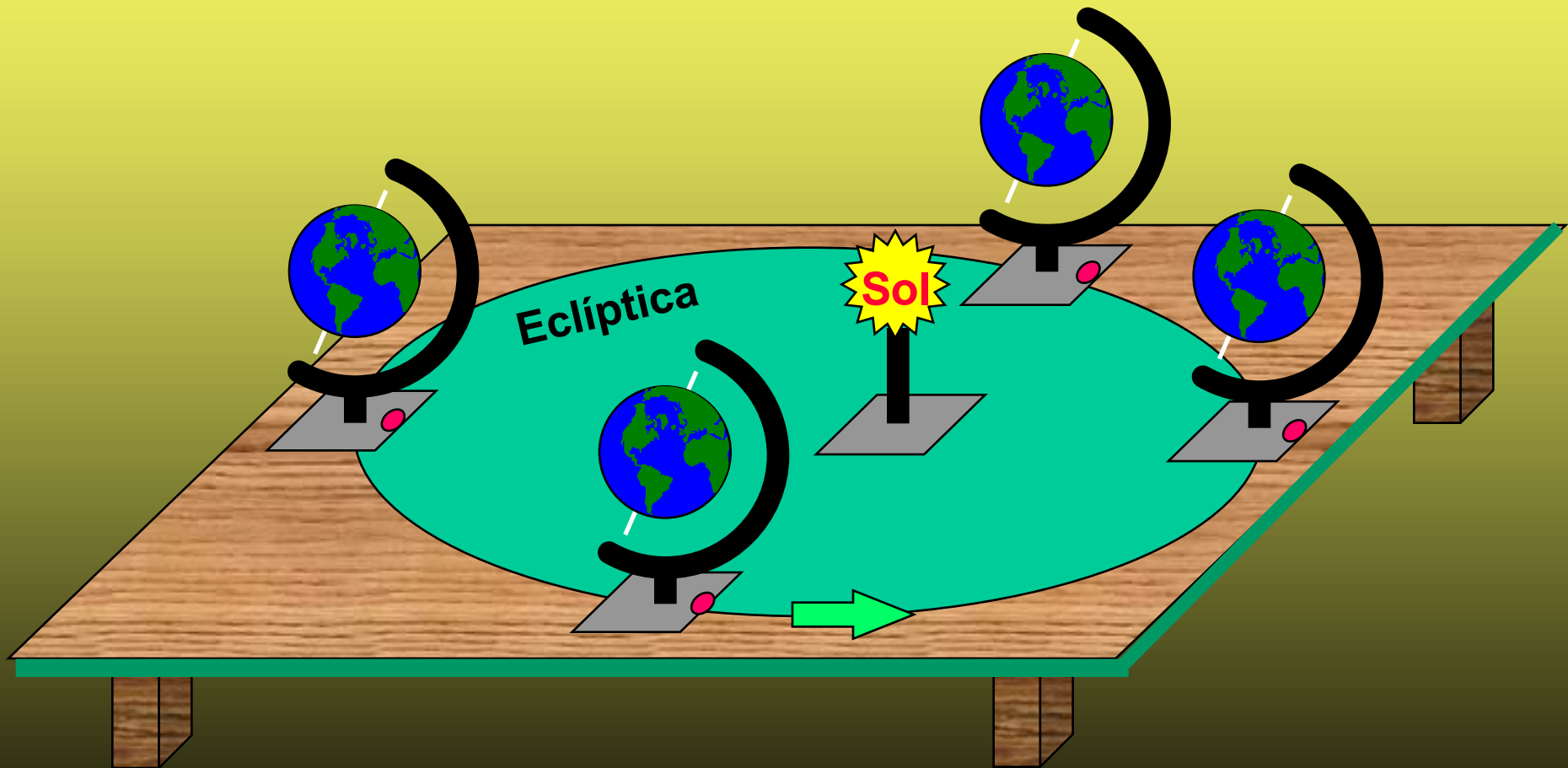
Estações do Ano: Hemisfério Norte



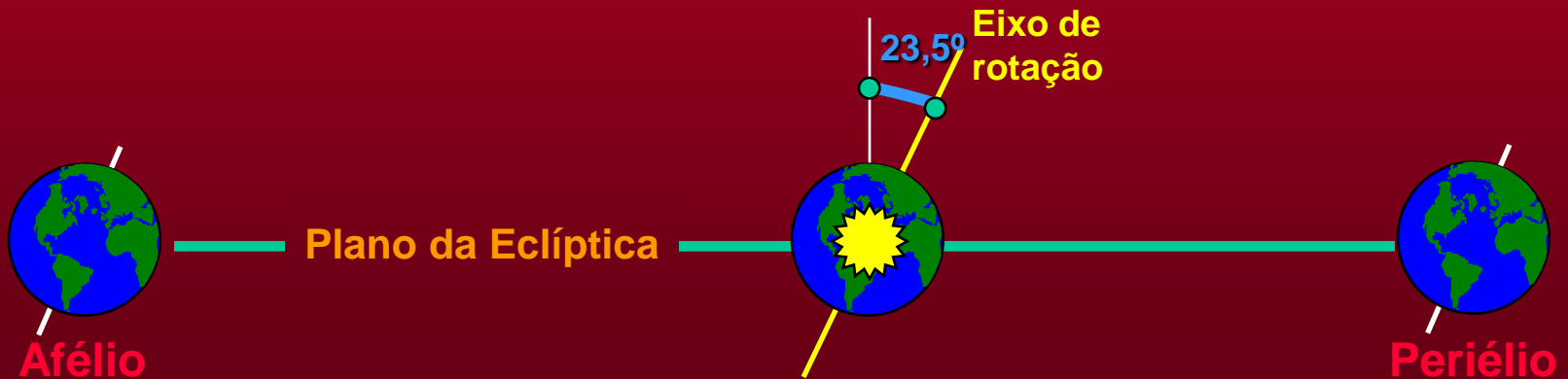
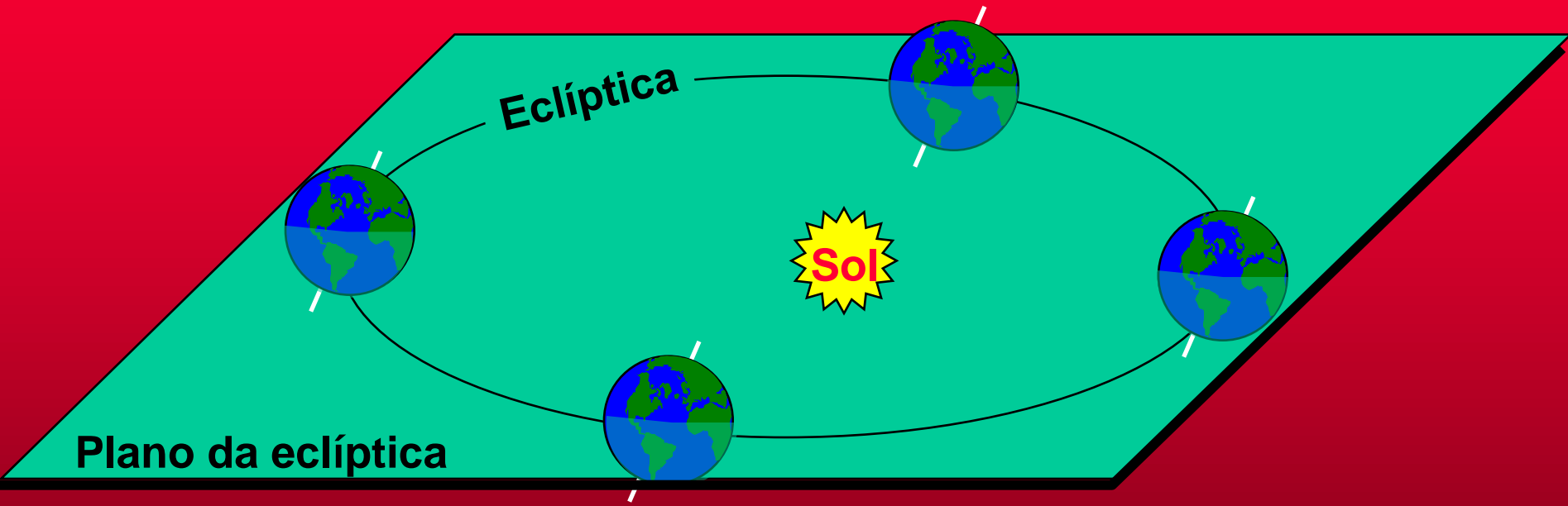
Estações versus Hemisférios



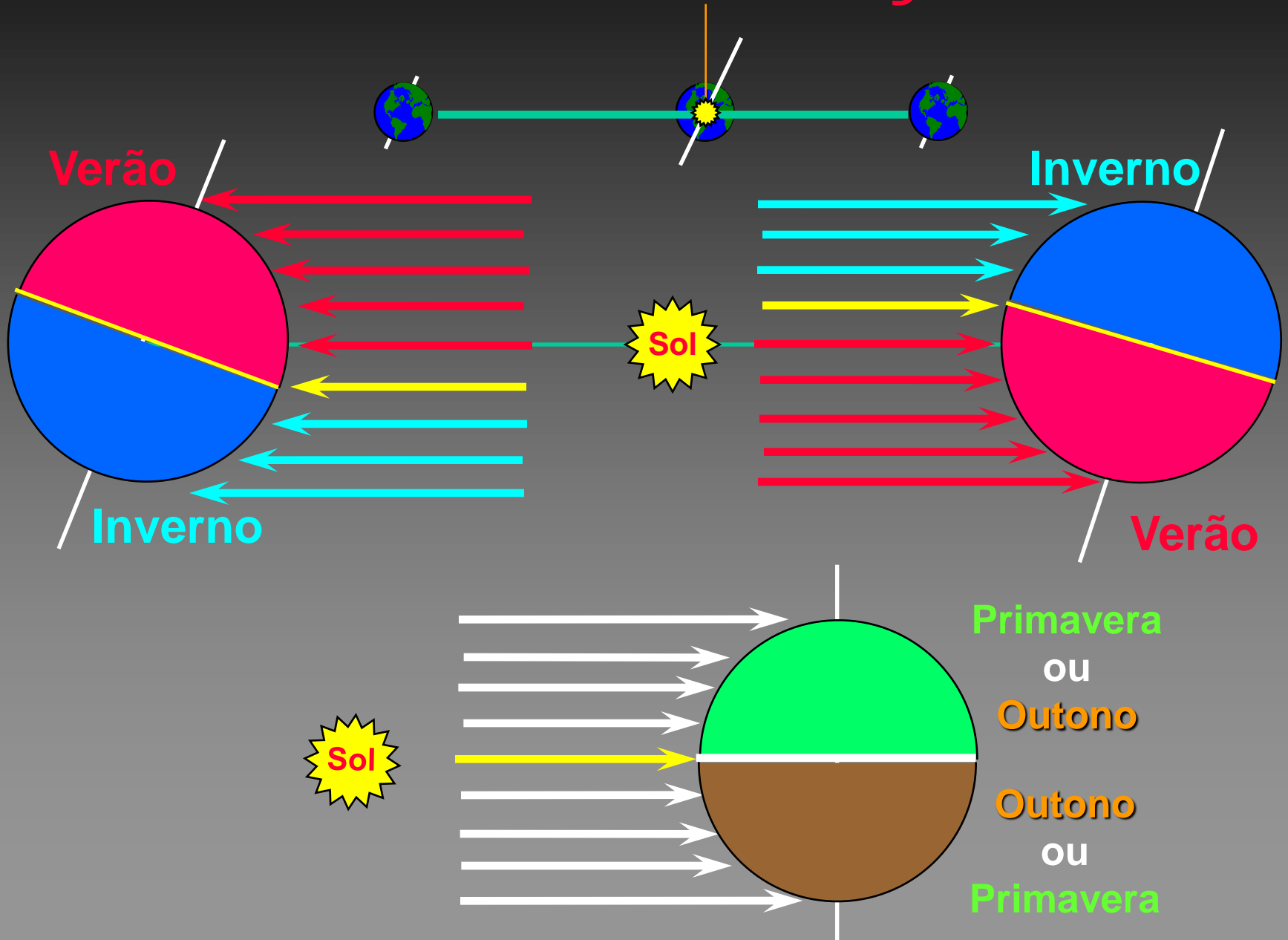
Esquema da Órbita da Terra em torno do Sol



Órbita da Terra em torno do Sol



Motivo das Estações



Paralelos especiais

**Tá cansado? Tá estressado? Venha para
UBATUBA**

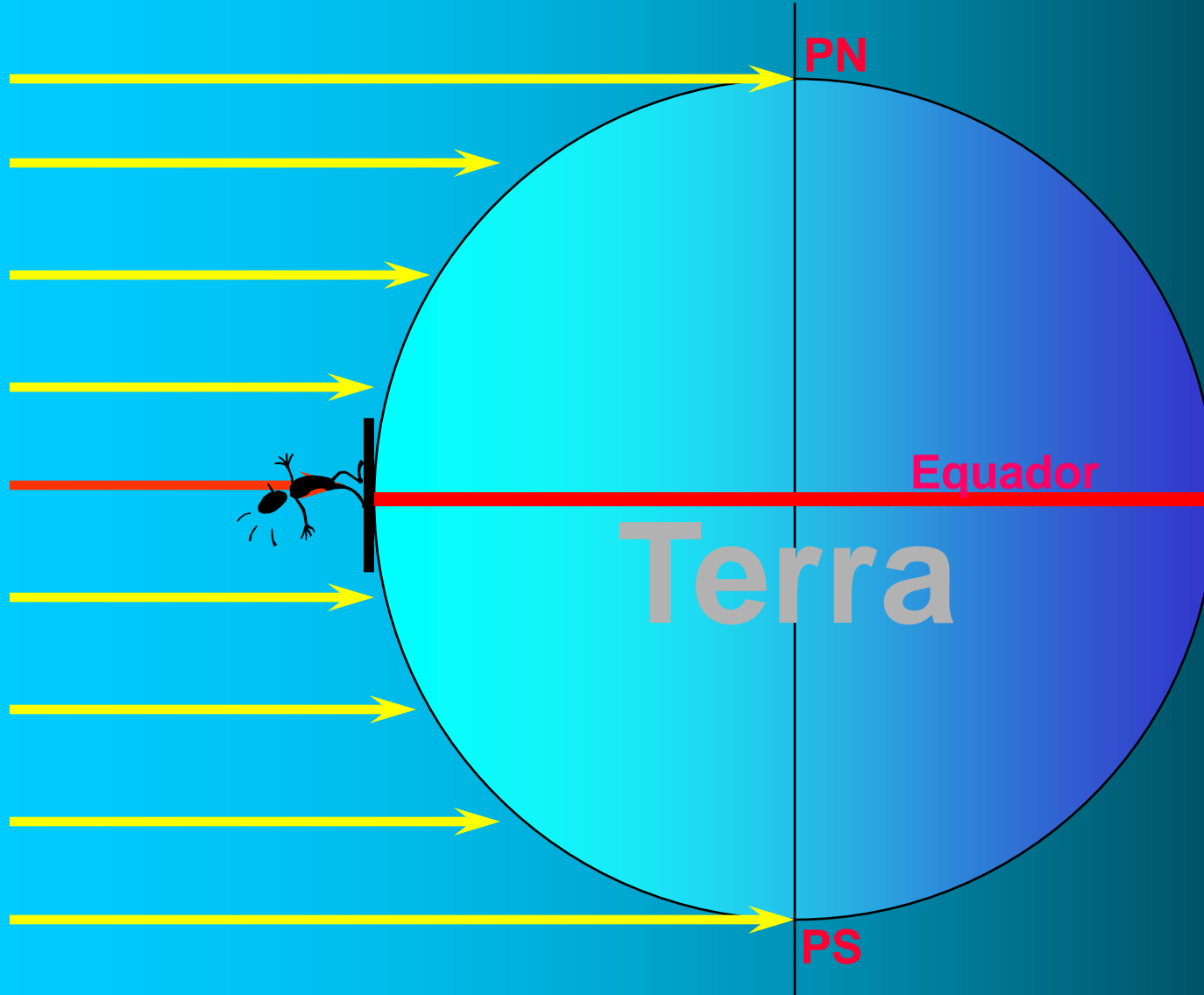
**Aqui passa o Trópico de Capricórnio,
sol e calor o ano inteiro ...**





Equinócio do Outono Austral

Sol no Equinócios do Outono Austral

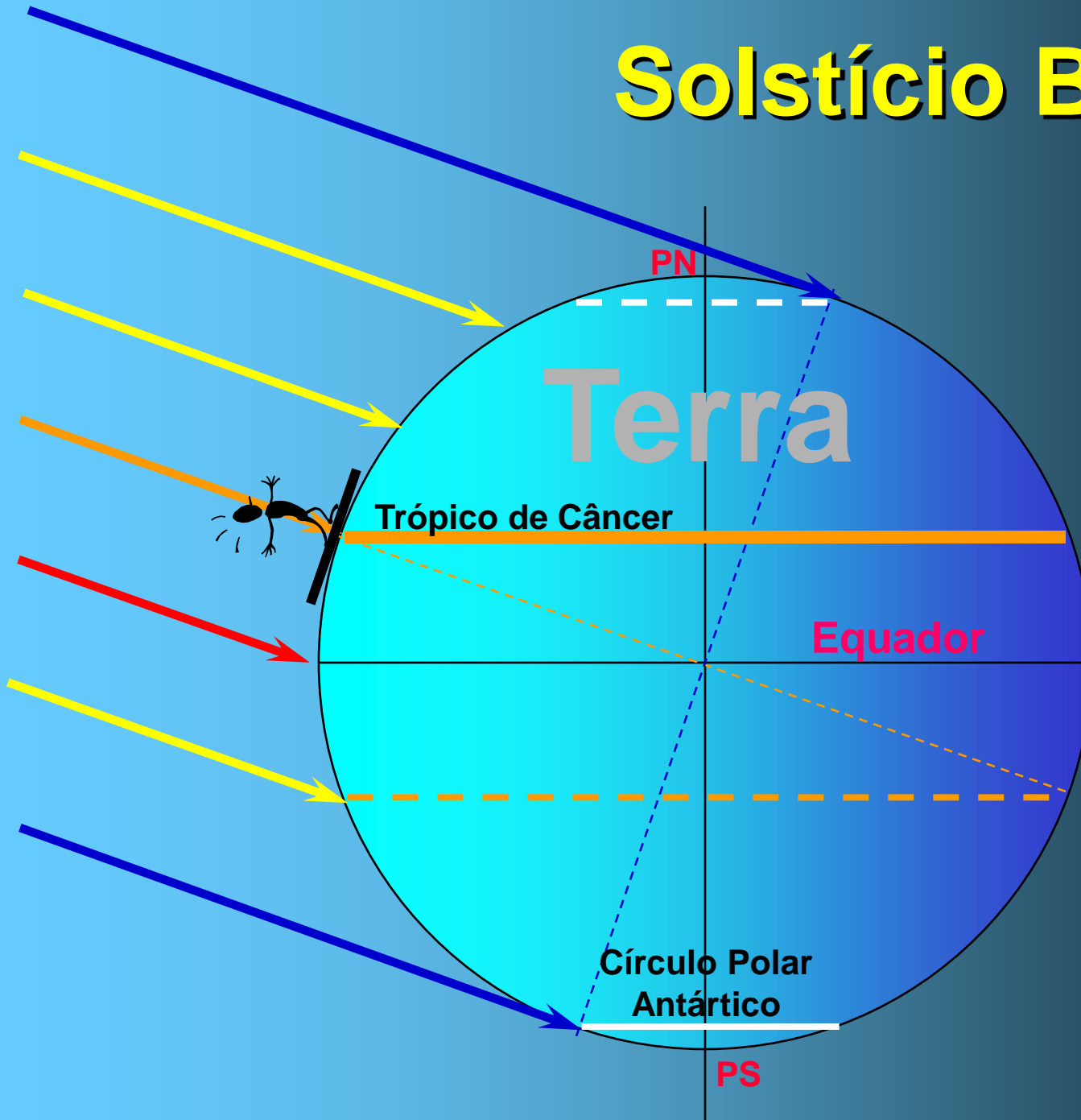


~21 mar

Solstício Boreal

Sol no Solstício do Inverno Austral

Verão Boreal

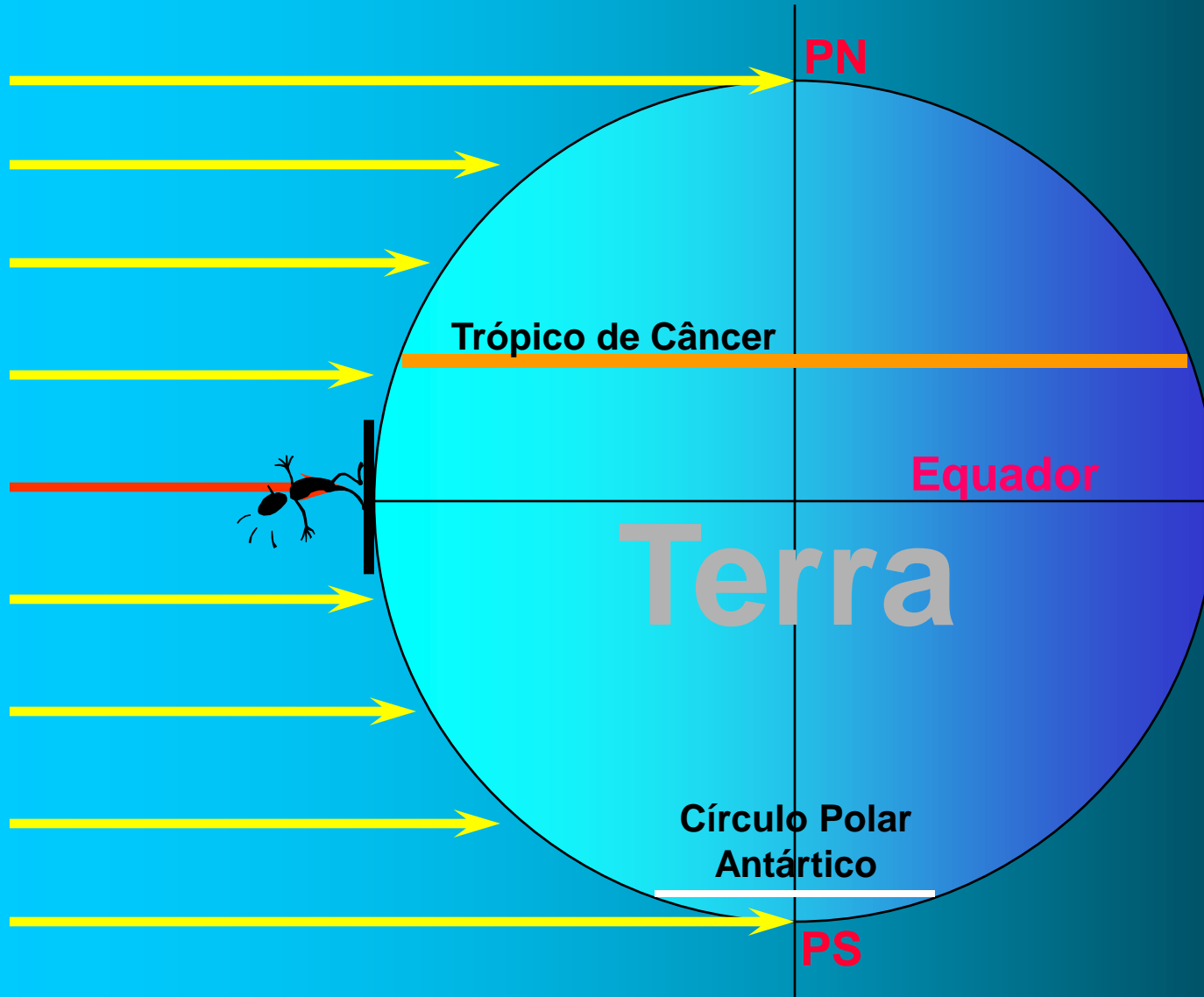


~22 jun



Equinócio da Primavera Austral

Sol no Equinócios da Primavera Austral



~23 set



PN

Círculo Polar Ártico

Terra

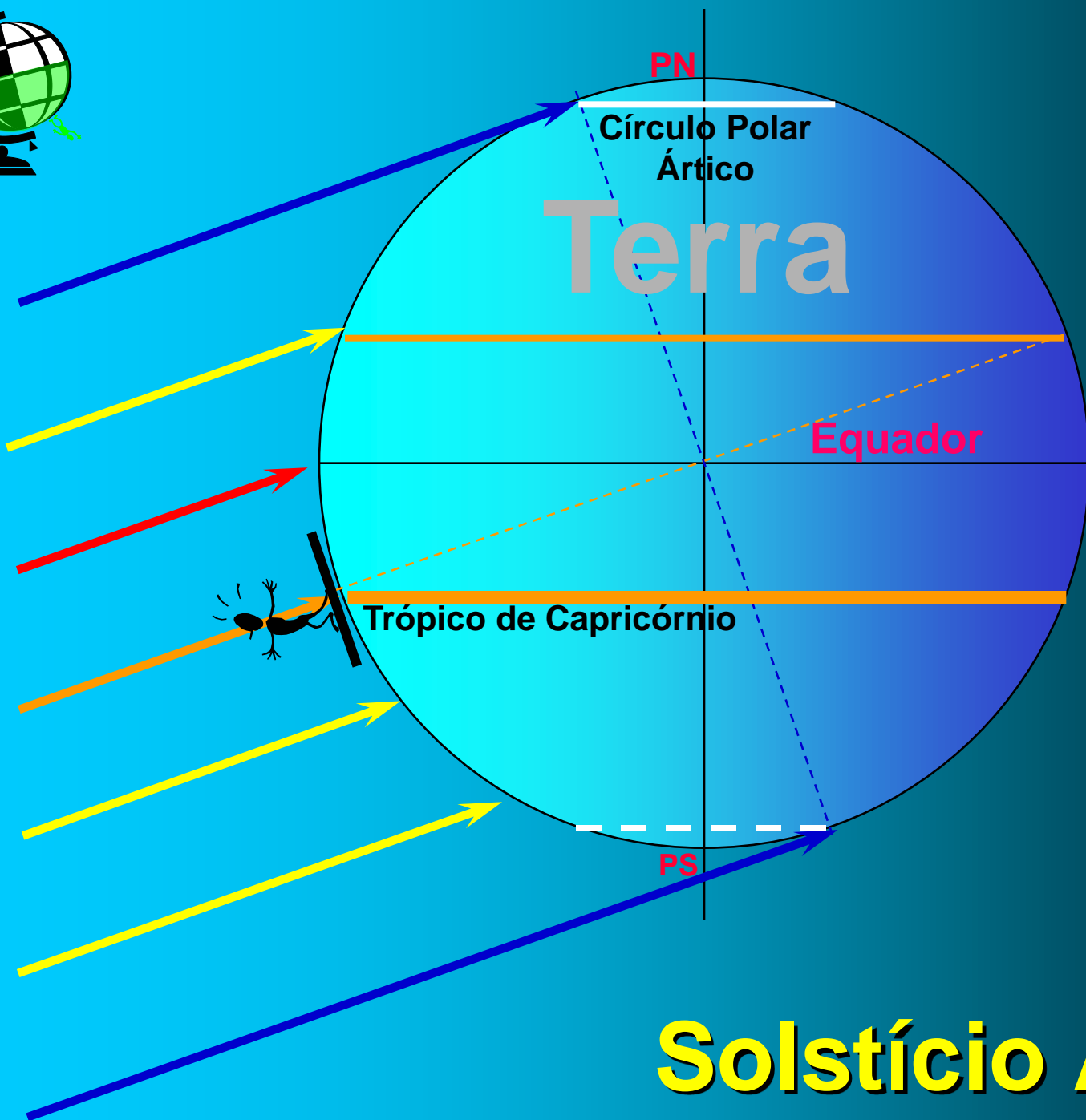
Equador

Trópico de Capricórnio

PS

Sol no Solstício do Verão Austral

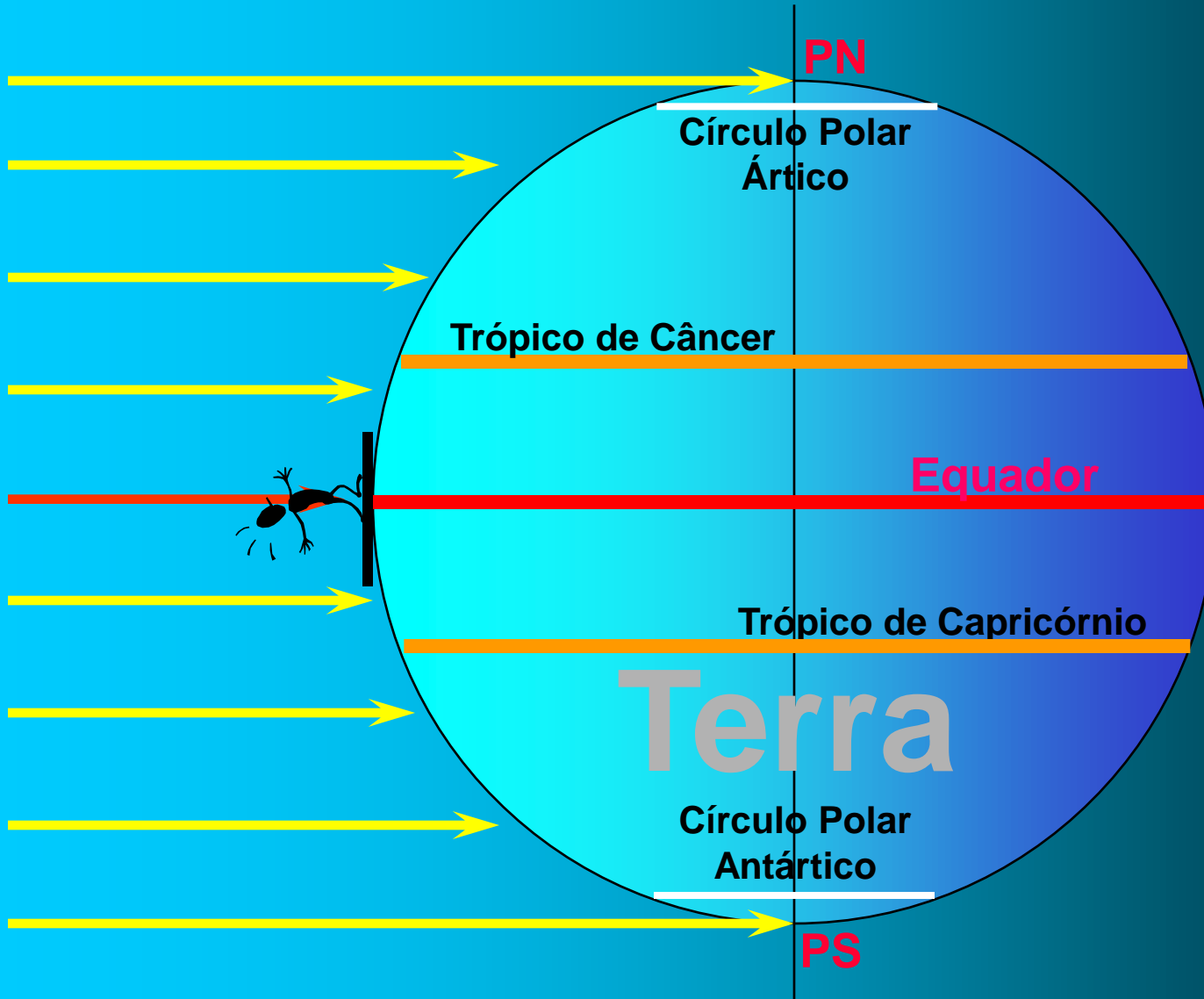
Solstício Austral





Equinócio do Outono Austral

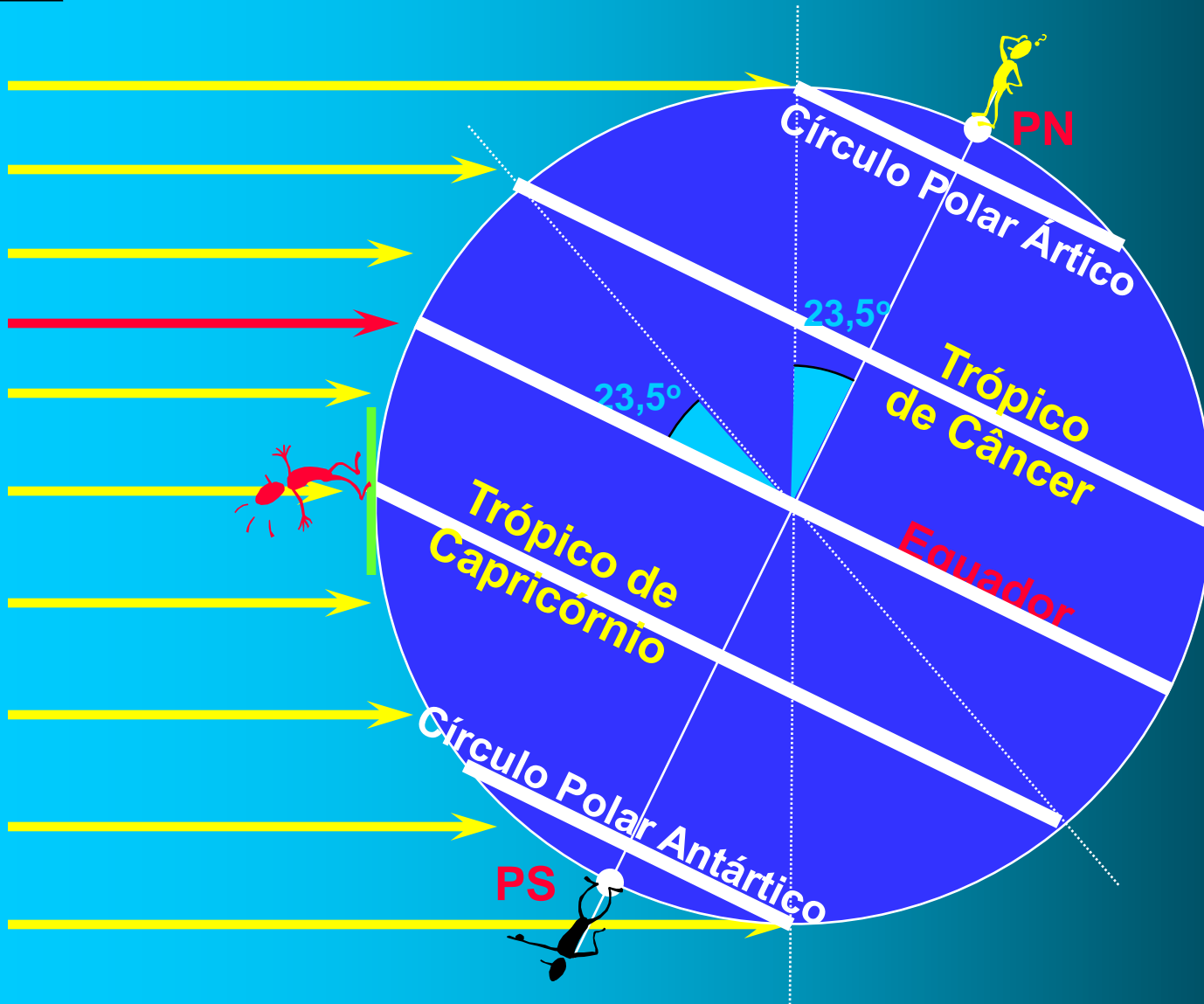
Sol no Equinócios do Outono Austral

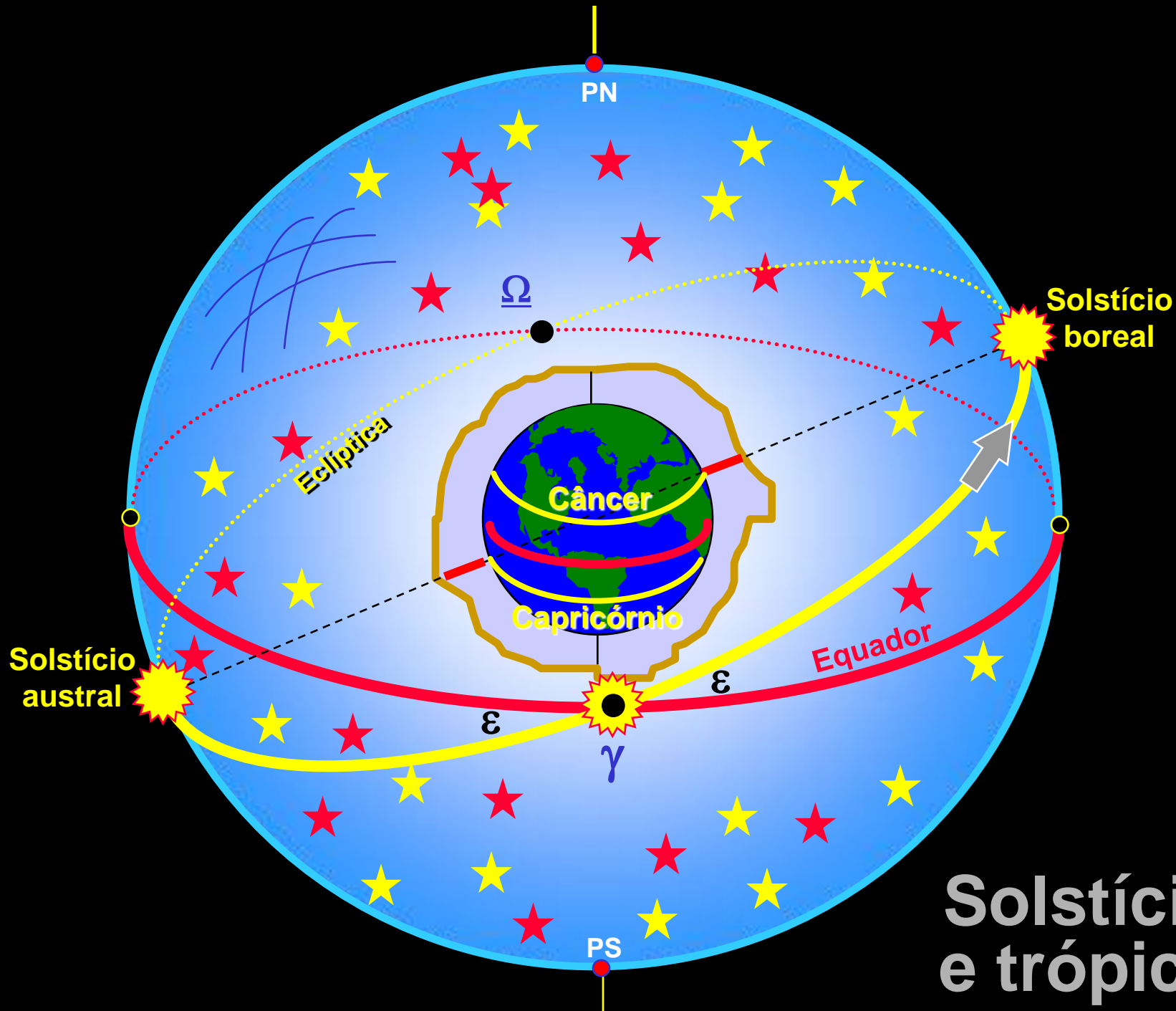




Paralelos Importantes

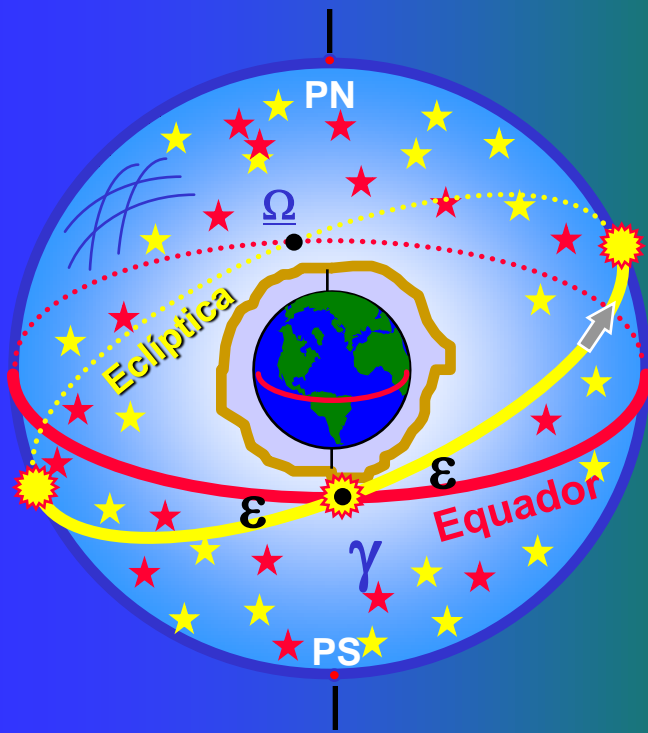
Sol no Solstício Austral





Solstícios e trópicos

Paralelos particulares na Terra



Eixo de rotação

PN

Círculo Polar Ártico

Trópico de Câncer

Equador

Trópico de Capricórnio

Círculo Polar Antártico

PS

Solstício boreal



Equinócio



Equinócio

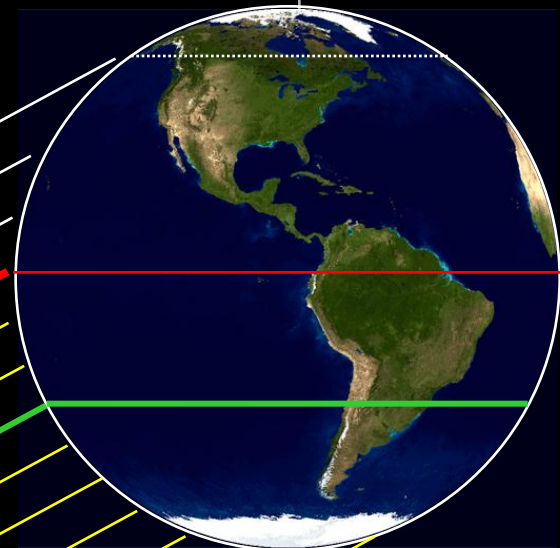


Solstício austral

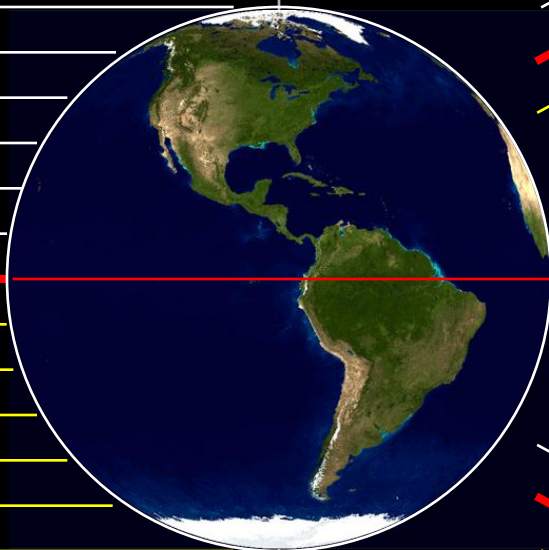


Sol e Terra nas diferentes estações

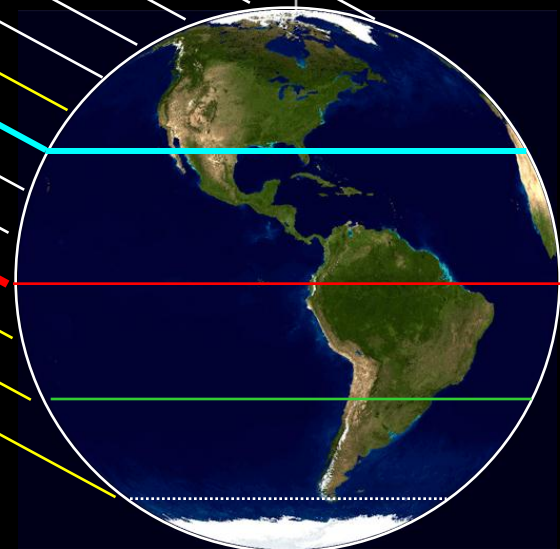
Sol no solstício austral



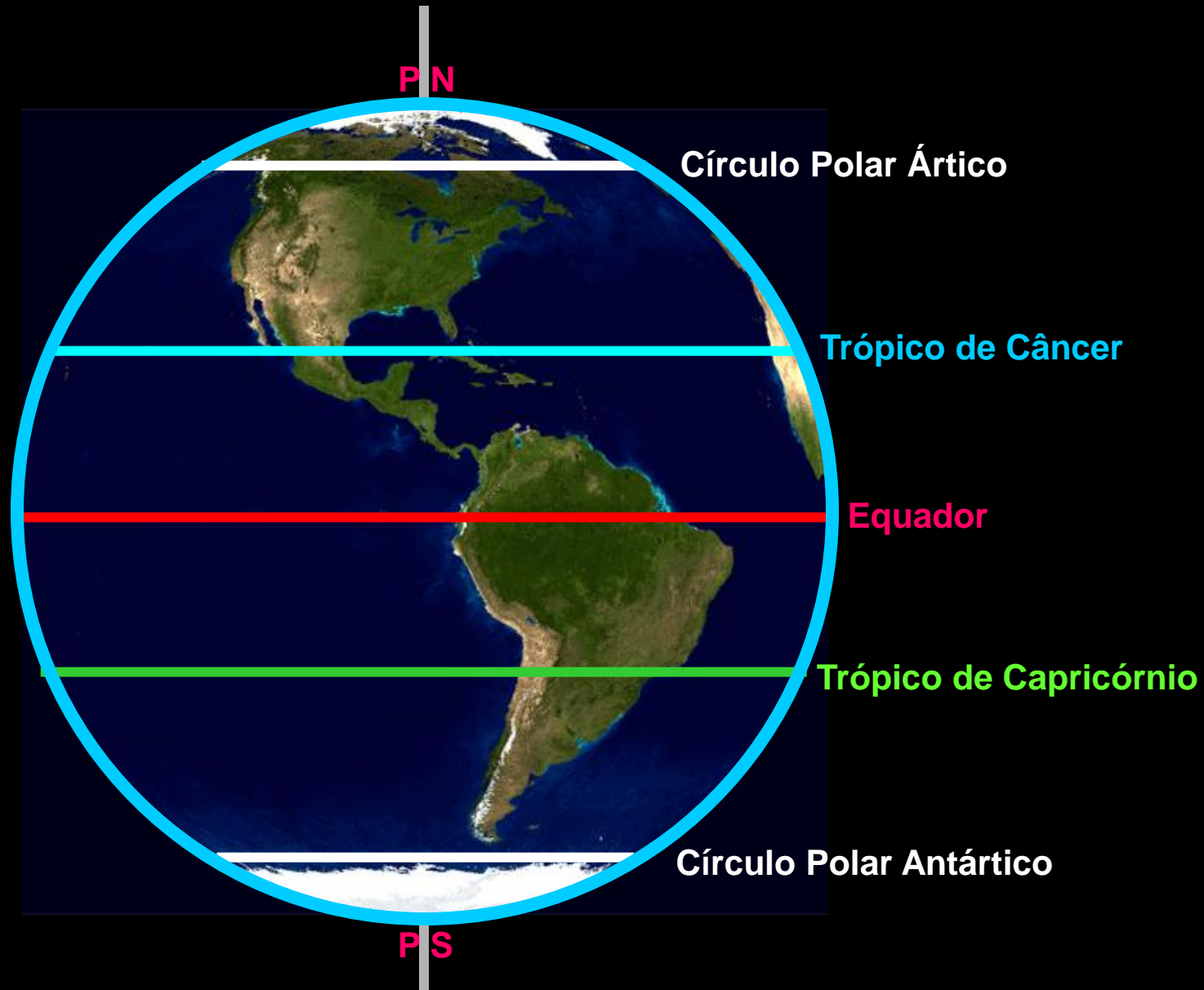
Sol no equinócio



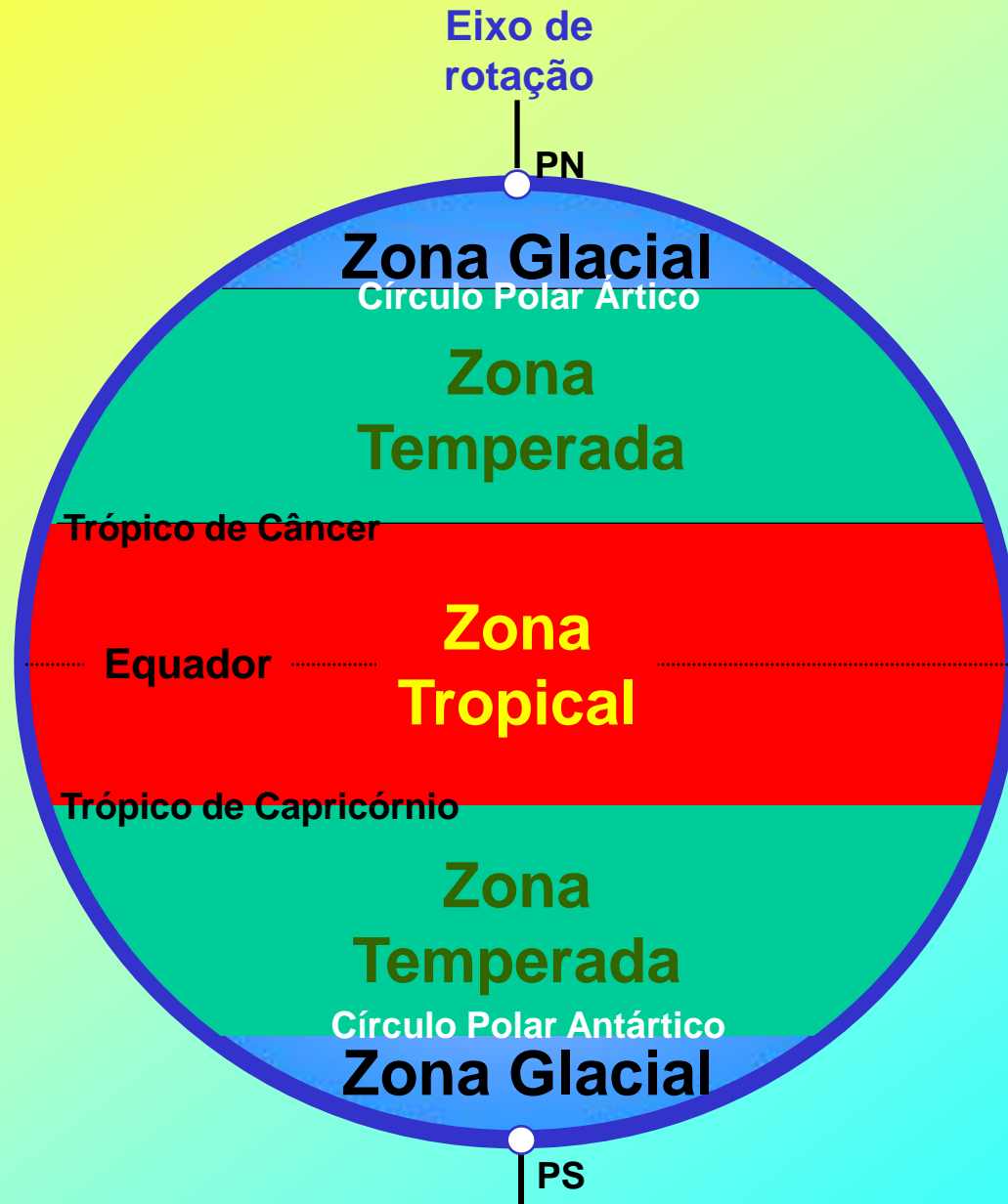
Sol no solstício boreal



Paralelos importantes



Zonas climáticas



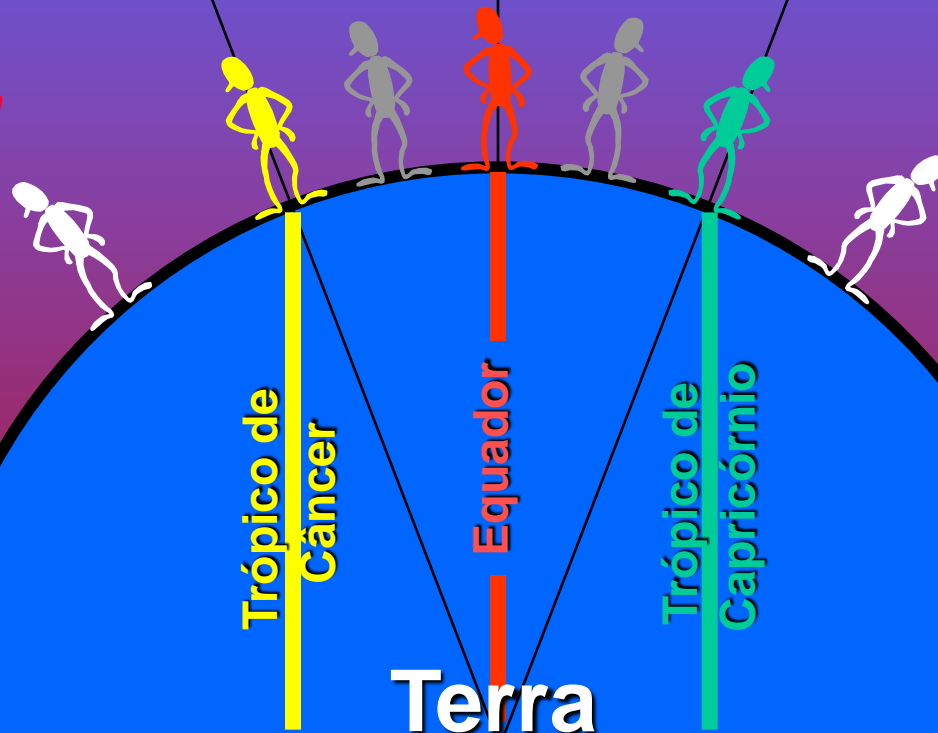
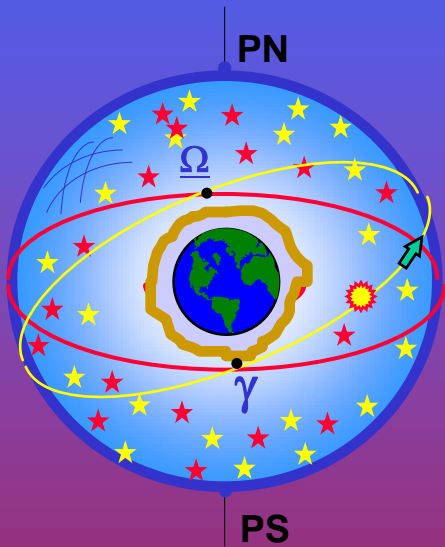
**Sombra ao
meio dia**

Solstício boreal

Equinócios

Solstício austral

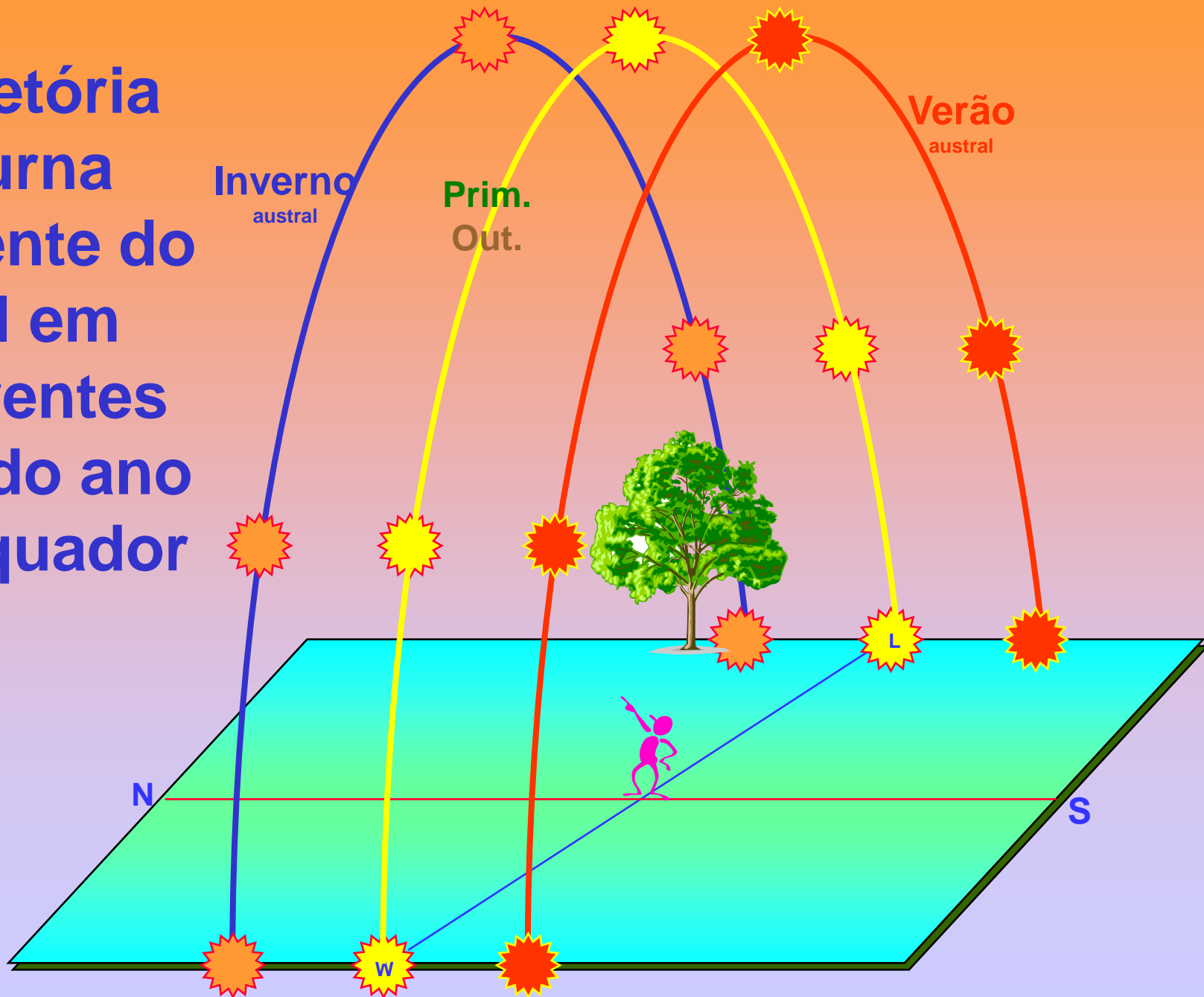
Sombras em diferentes locais e em diferentes datas

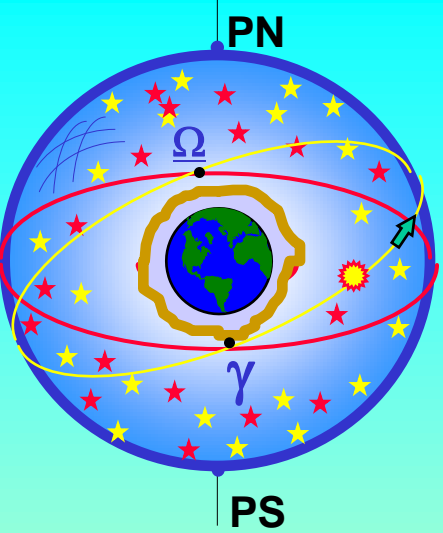


PN

PS

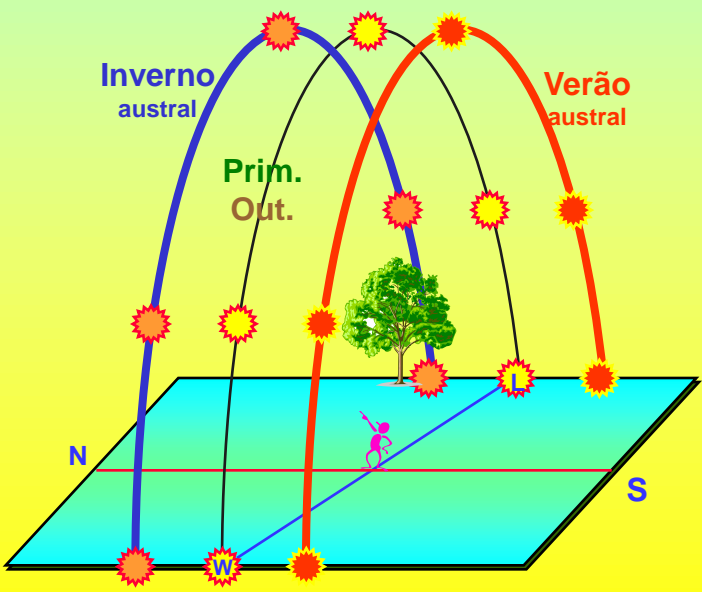
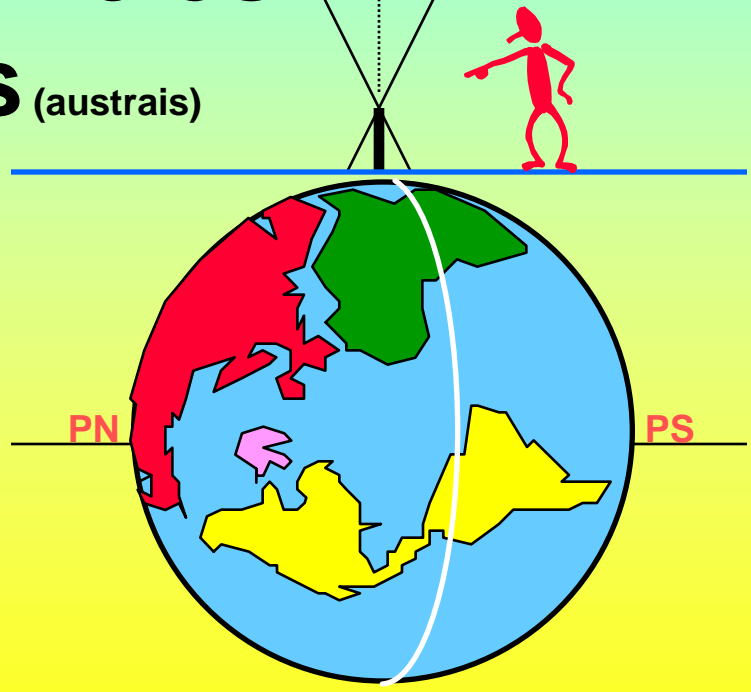
Trajetoória diurna aparente do Sol em diferentes dias do ano no equador





Inverno 22/jun 
 Primavera 23/set 
 Outono 21/mar 
 Verão 22/dez 

Sombras, no equador, nos inícios das estações (austrais)



Definição dos trópicos

Verão Boreal
22/jun



Primavera

23/set



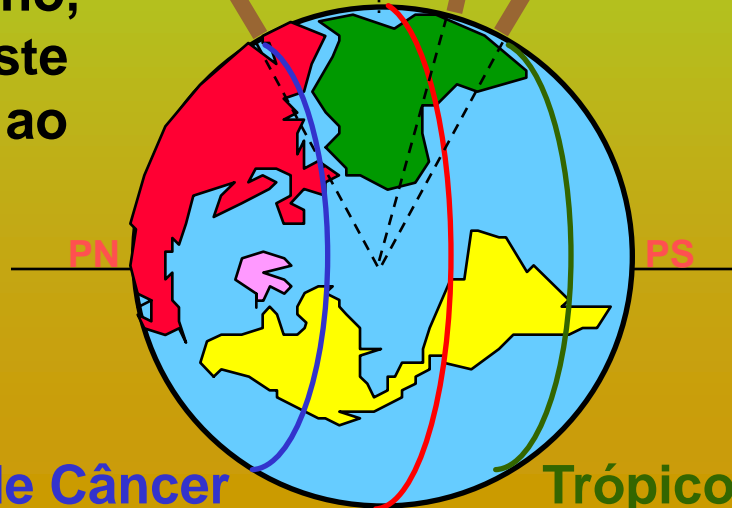
Outono
21/mar

Verão Austral
22/dez



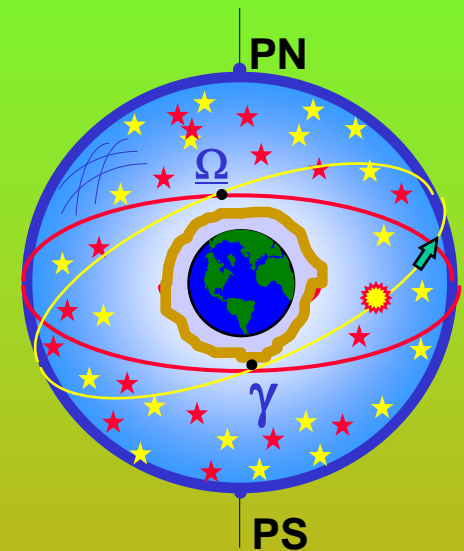
Trópicos:

Locais da Terra onde,
uma única vez por ano,
a sombra de um poste
vertical é um ponto ao
meiodia.

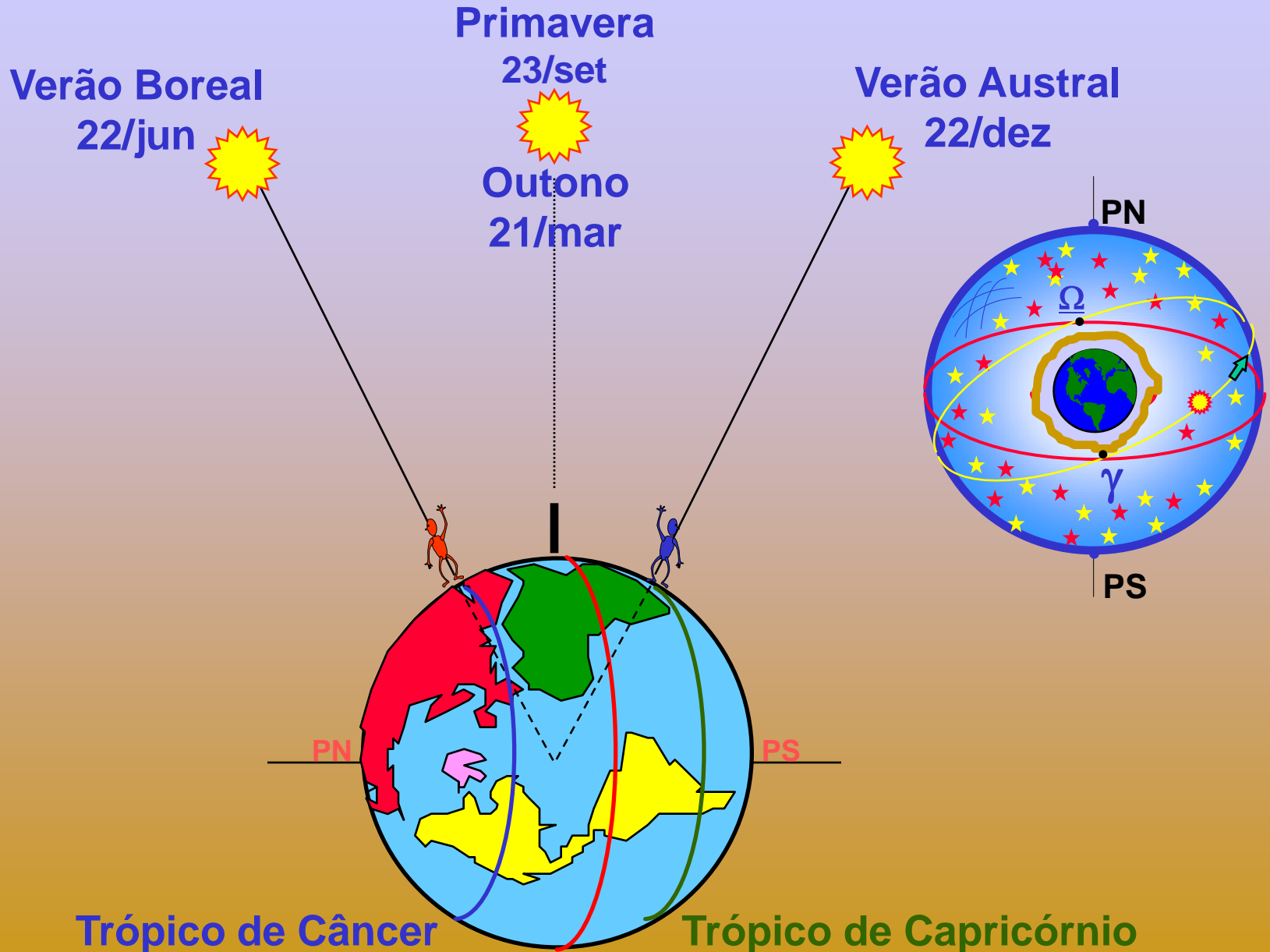


Trópico de Câncer

Trópico de Capricórnio



Sombras nos verões dos trópicos

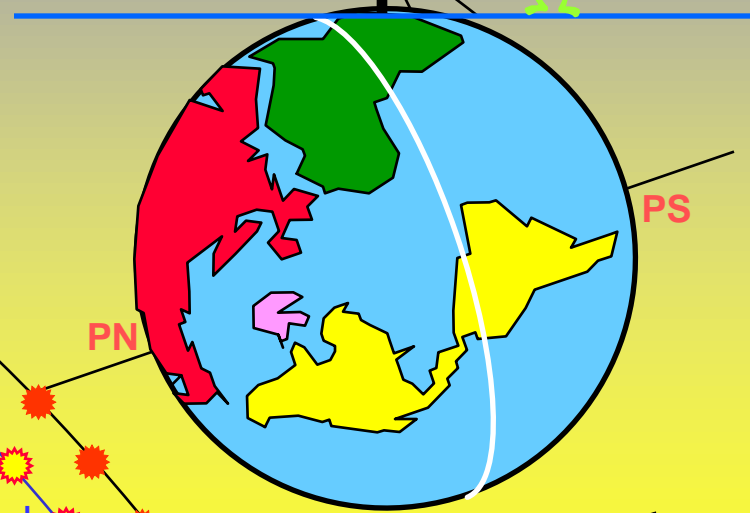
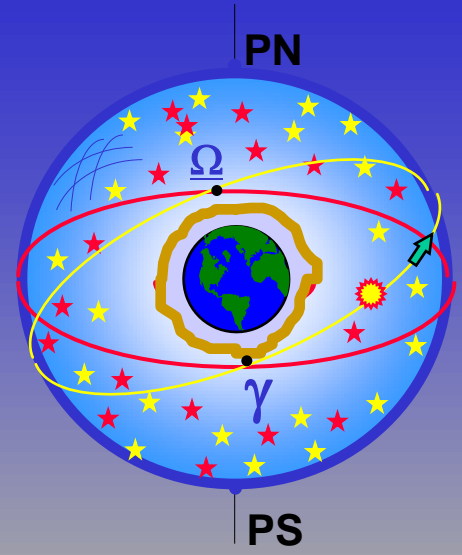


Inverno
22/jun

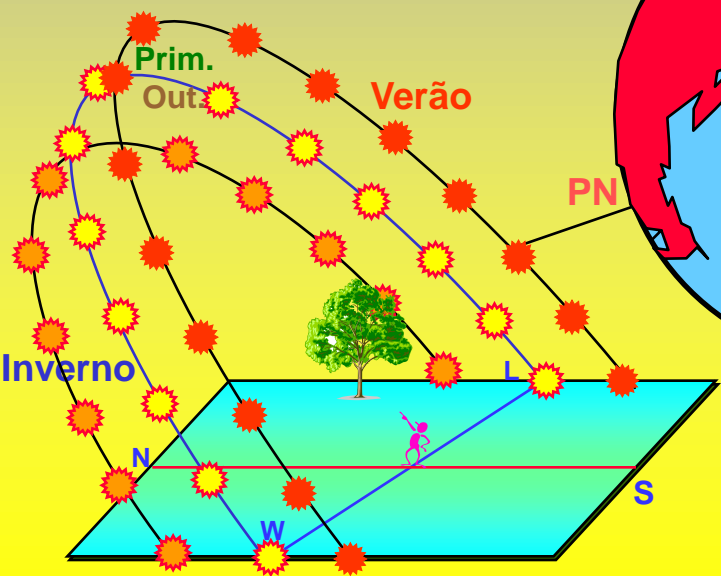
Primavera
23/set

Outono
21/mar

Verão
22/dez

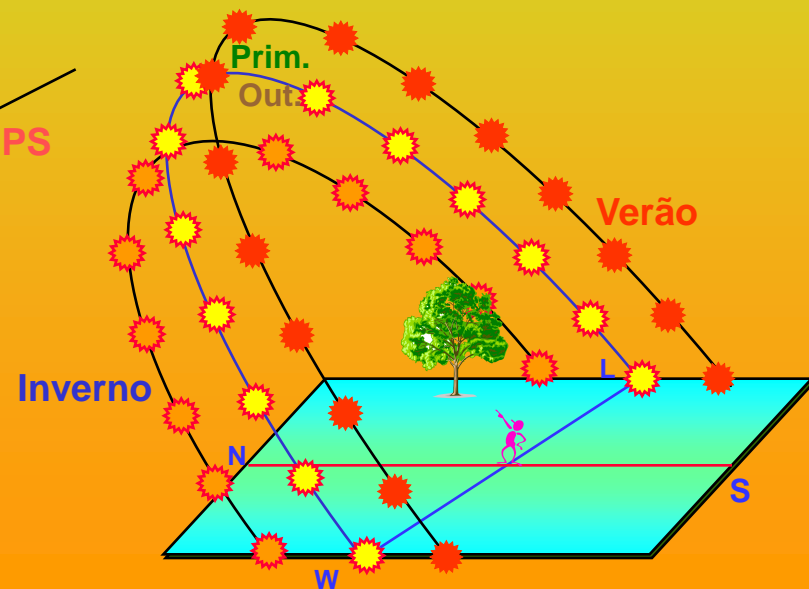
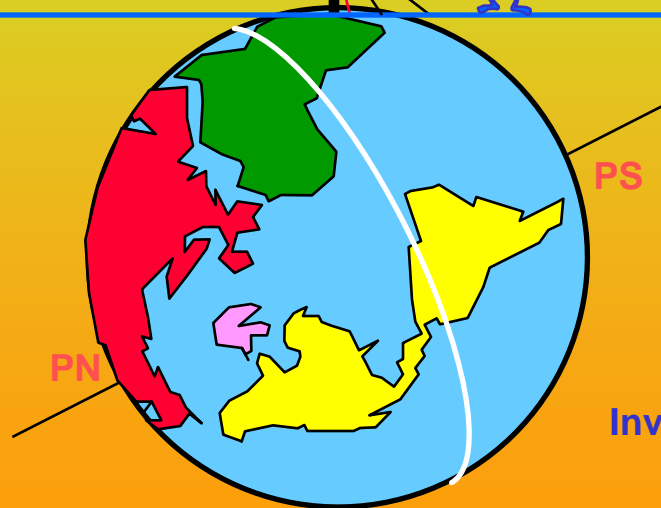
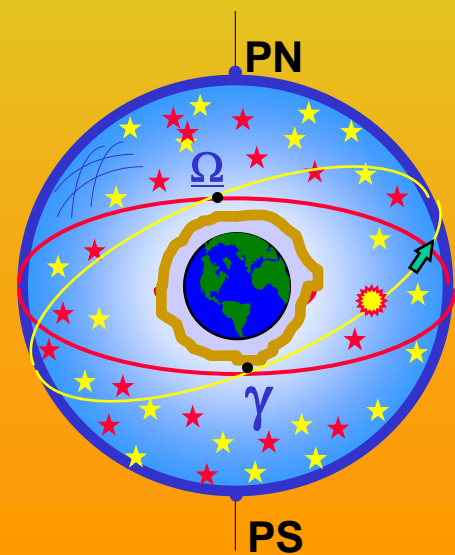
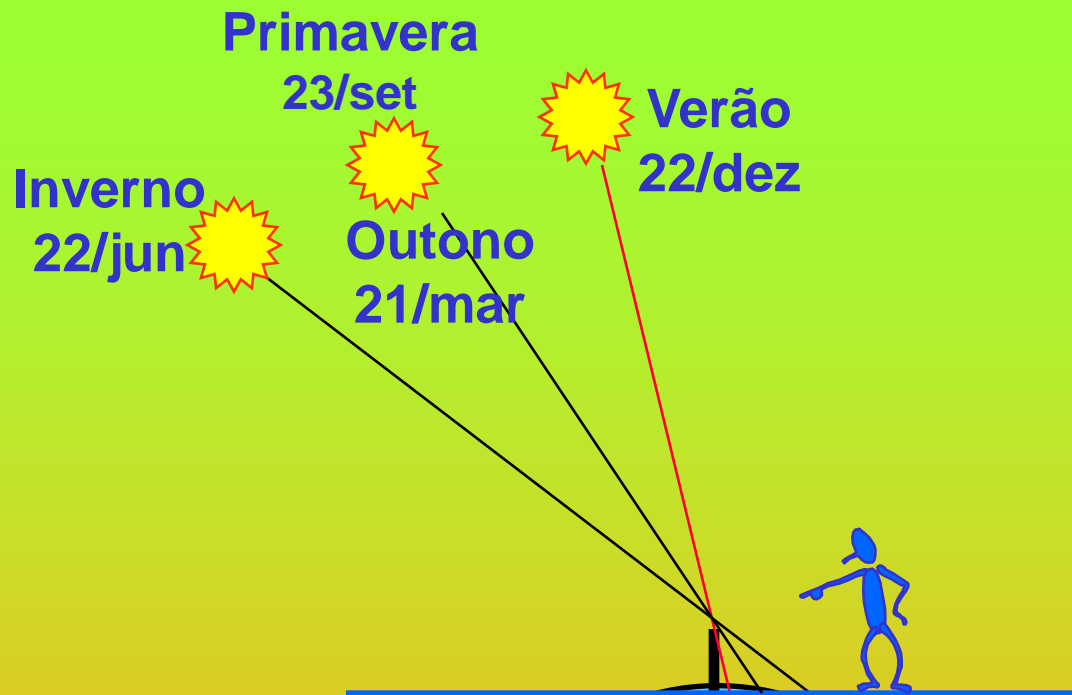


**Sombra nos
trópicos nos
inícios das
diferentes
estações**





Sombras além dos trópicos



Definição dos Círculos Polares

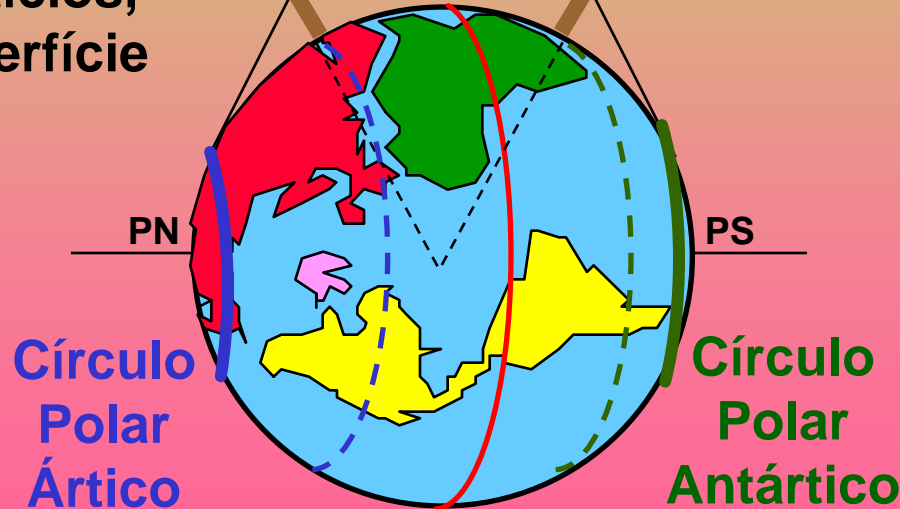
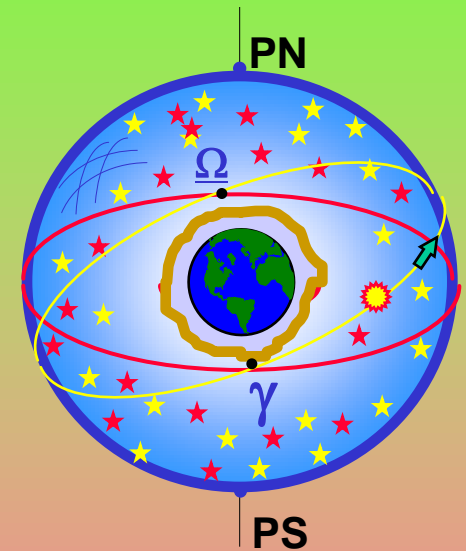
Verão Boreal
22/jun

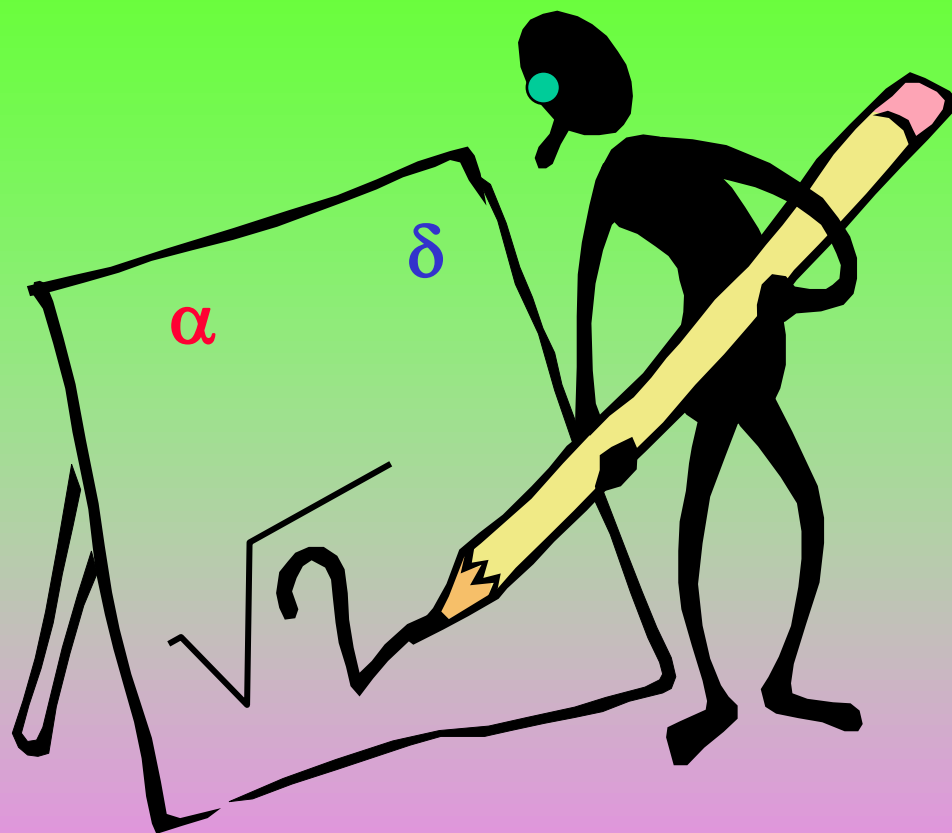


Verão Austral
22/dez



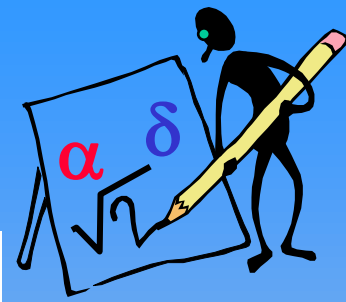
São os locais da Terra onde os raios solares, ao meiodia dos solstícios, tangenciam a superfície da Terra.





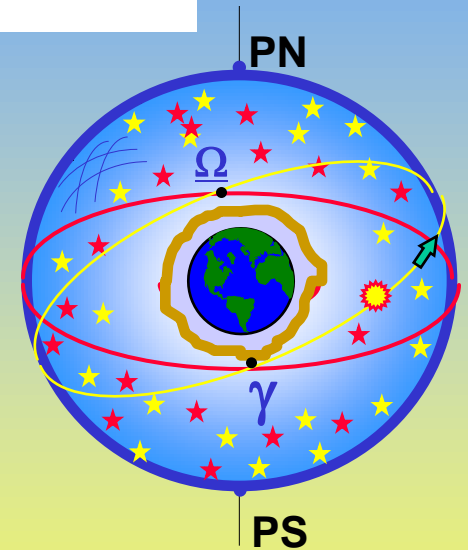
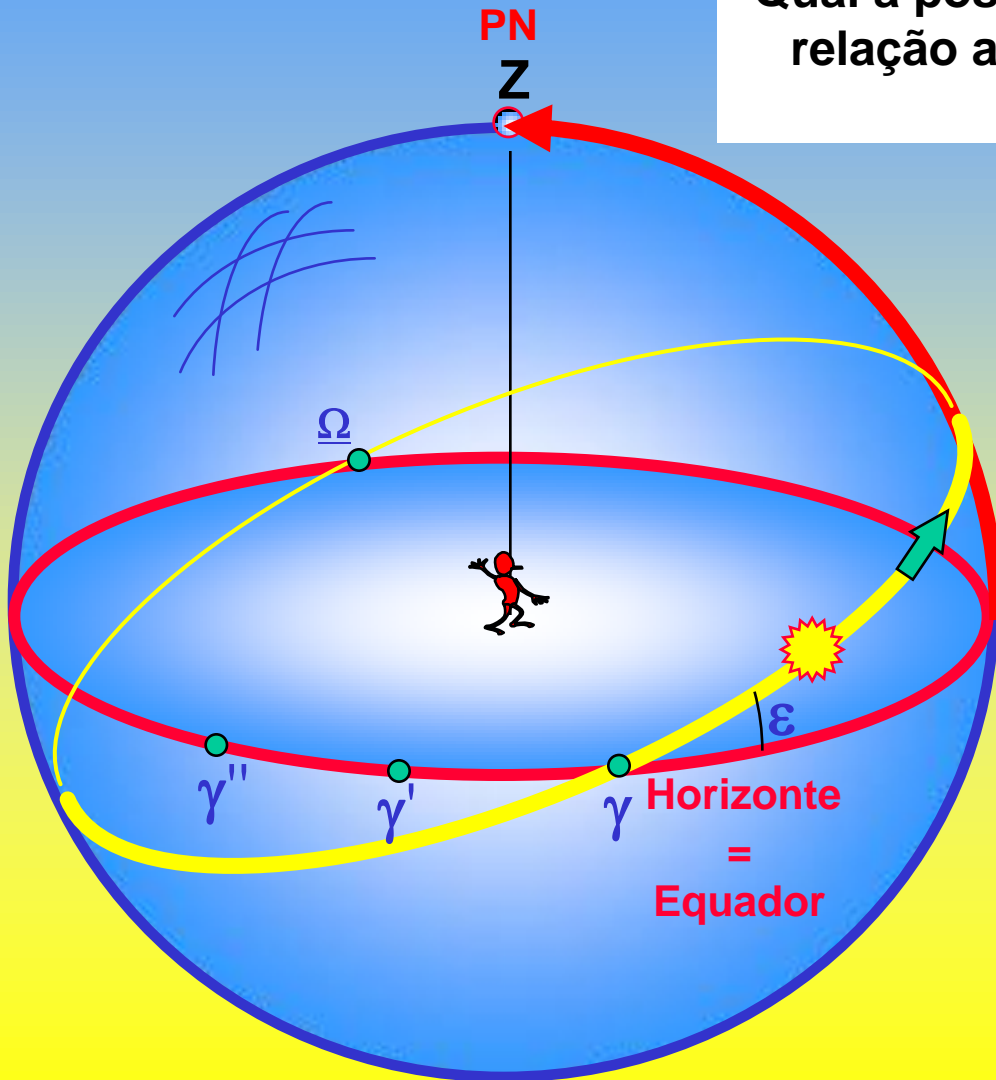
Aplicações

Posição da eclíptica



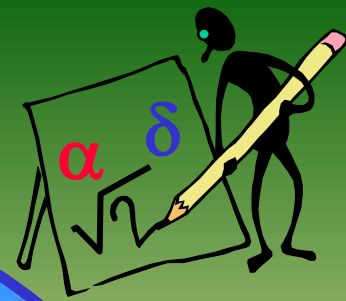
Enunciado:

Qual a posição da eclíptica com relação ao horizonte no polo Norte?

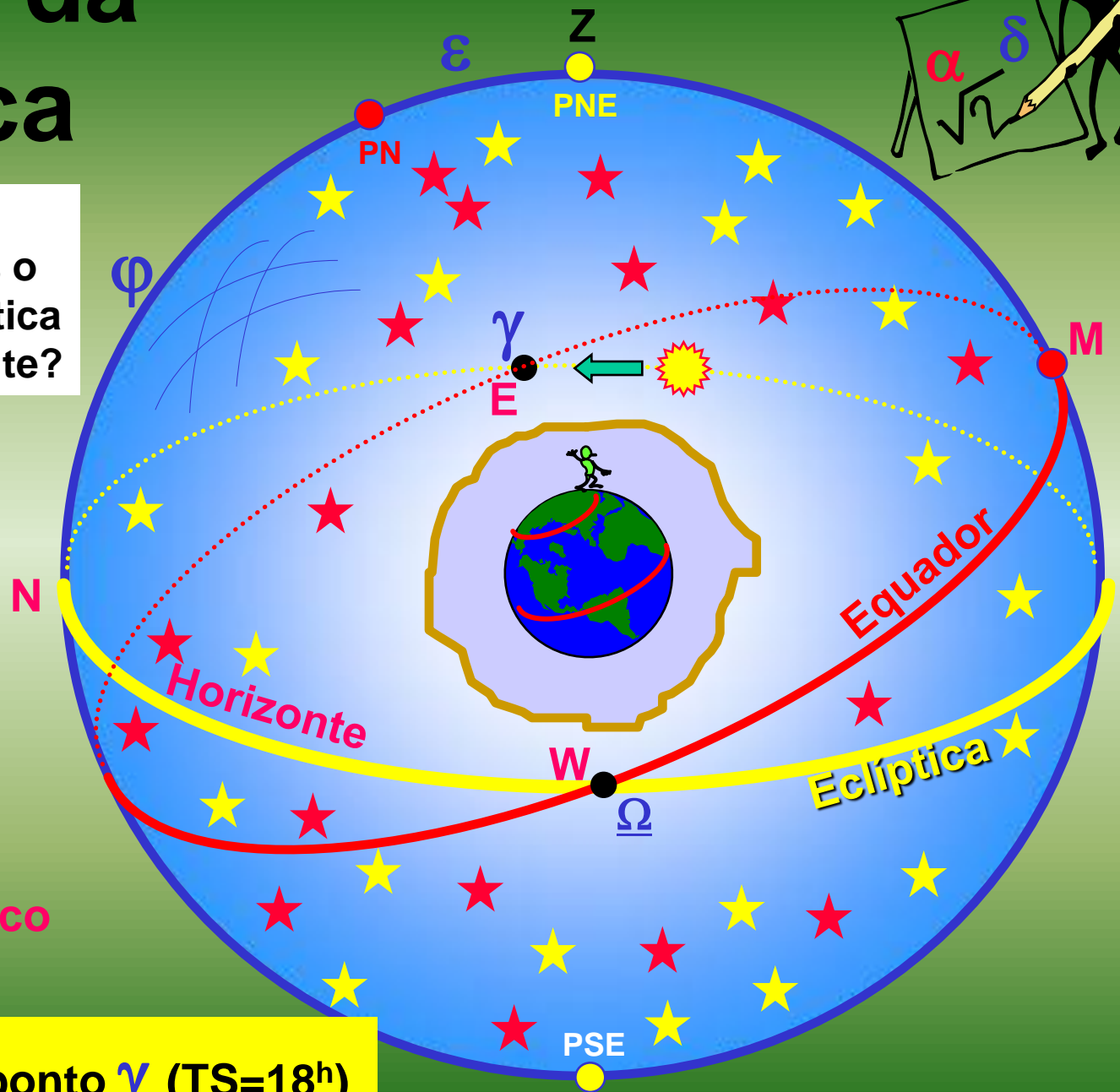


Como a eclíptica parece presa ao céu, e como a Terra gira em torno de seu eixo, a eclíptica parece se deslocar de leste para oeste, mantendo o ângulo com o horizonte constante.

Posição da eclíptica



Enunciado:
Em que condições o Polo Norte da Eclíptica coincide com o zênite?



$$\varphi = 90^\circ - \varepsilon$$

Círculo Polar Ártico
e

$$\gamma = E \text{ Nascer do ponto } \gamma \text{ (TS=18h)}$$

Enunciado:

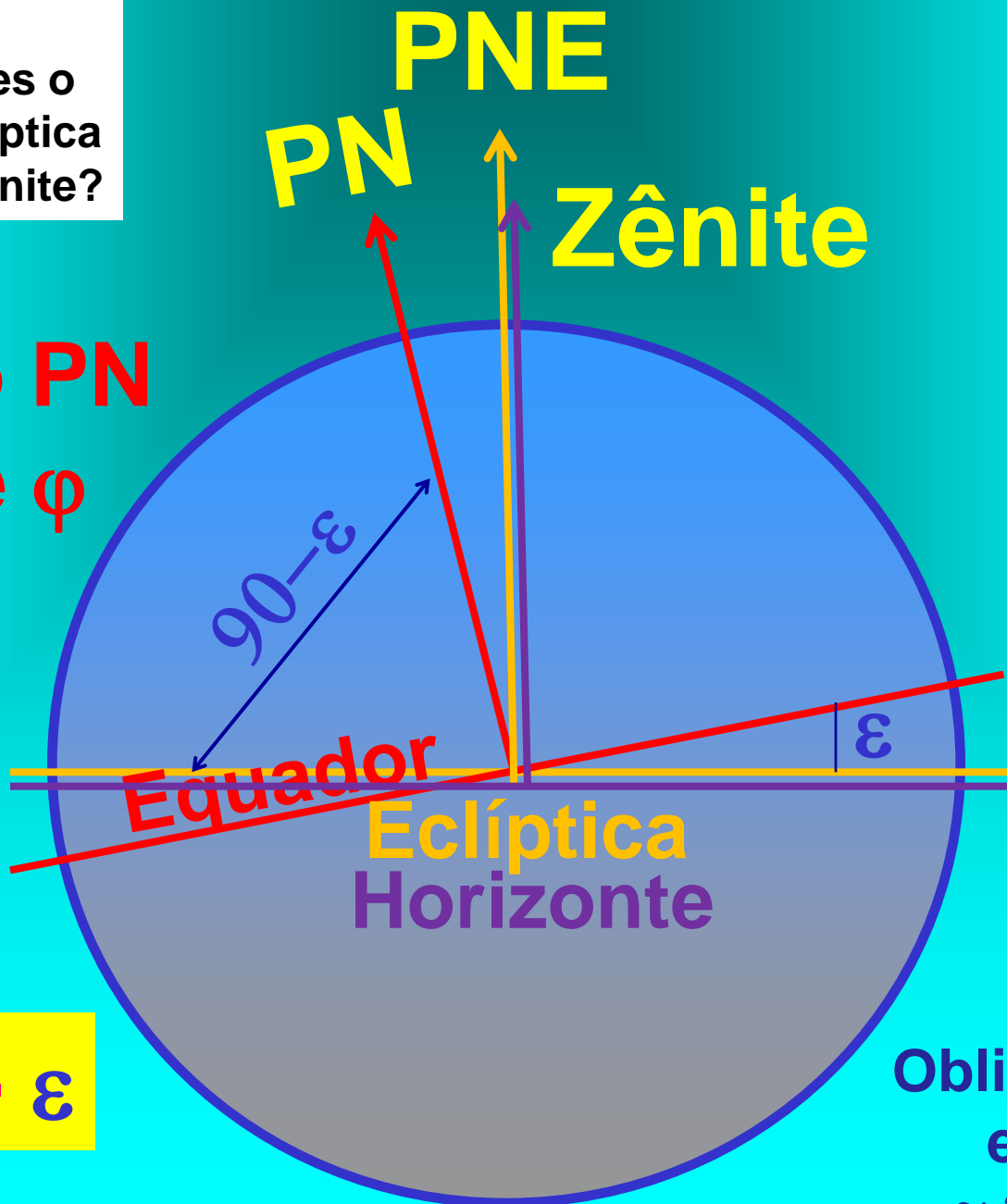
Em que condições o Polo Norte da Eclíptica coincide com o zênite?



Enunciado:

Em que condições o Polo Norte da Eclíptica coincide com o zênite?

**Altura do PN
= latitude φ**

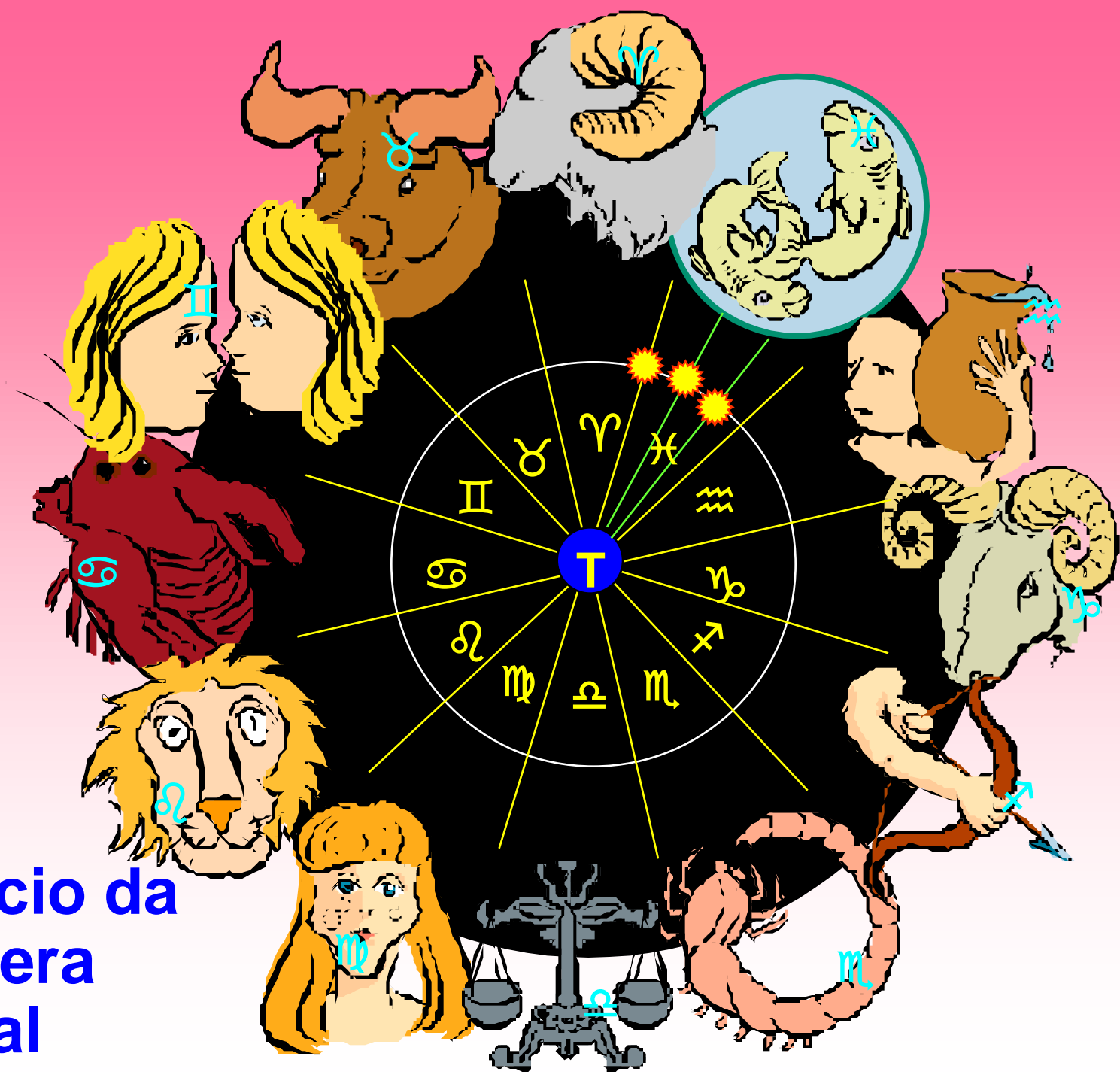


$$\varphi = 90^\circ - \varepsilon$$

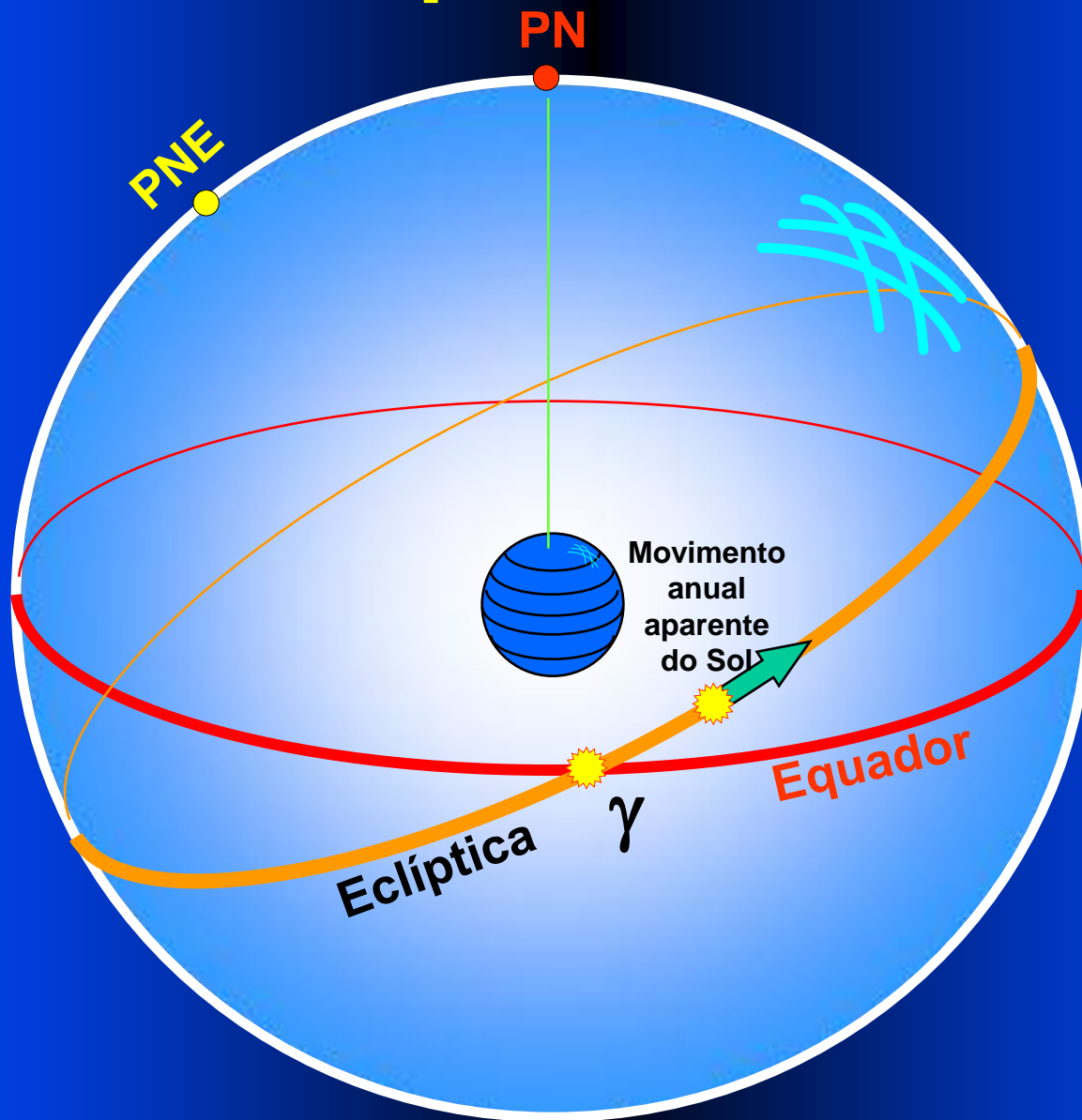
Obliquidade da eclíptica
 $\varepsilon \approx 23^\circ 27' 08''$

Precessão

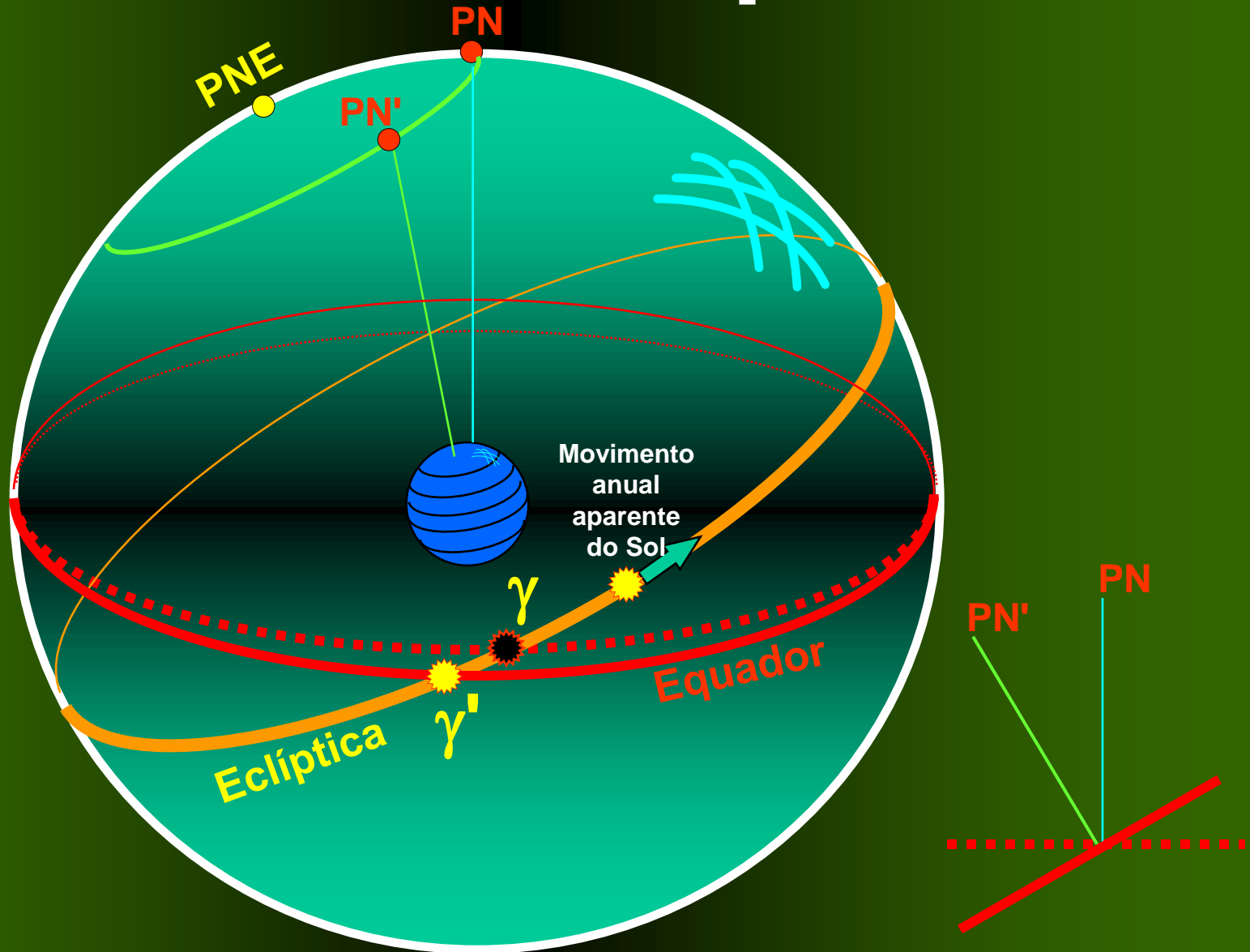
**Sol no início da
primavera
Boreal**



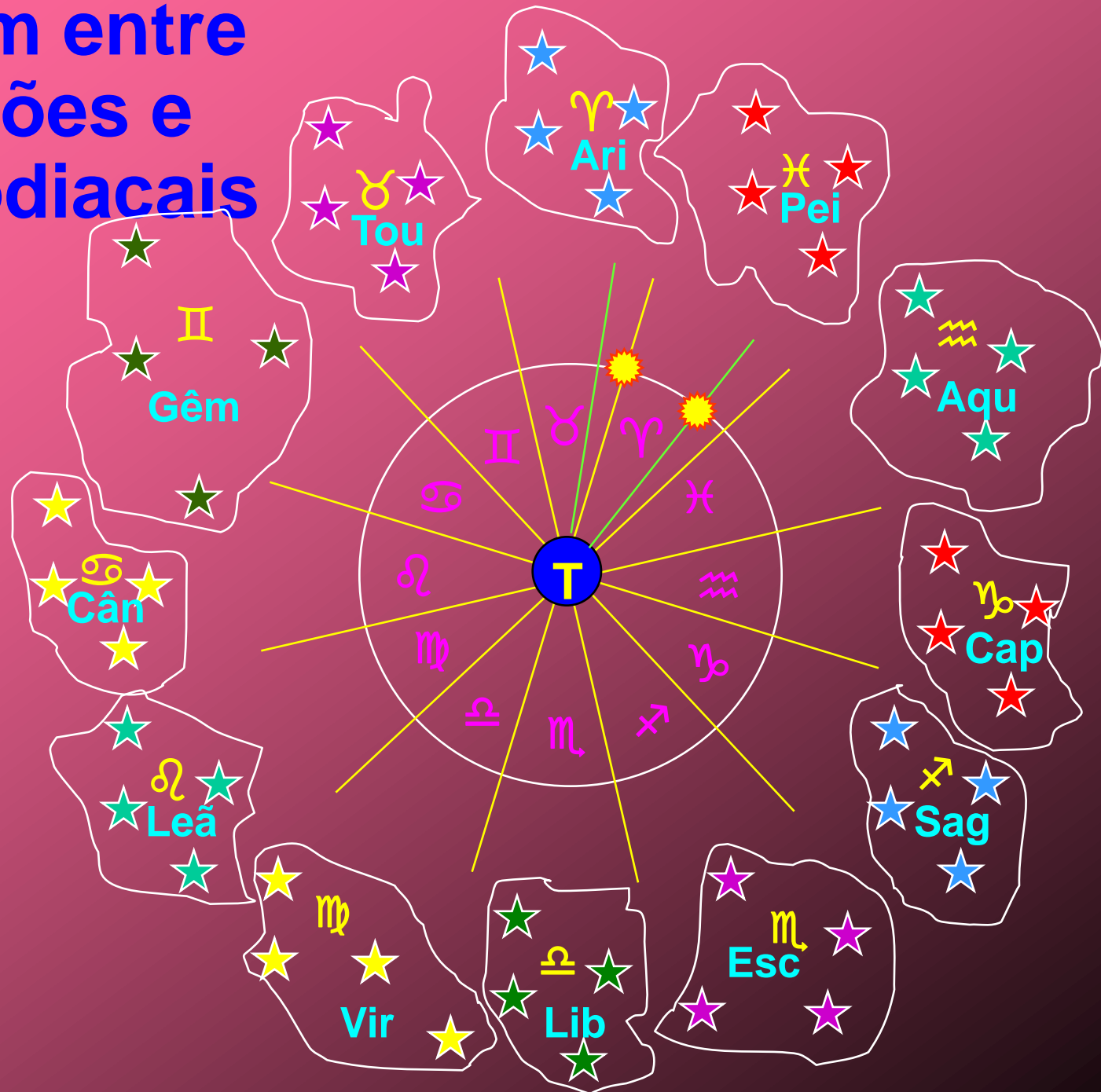
Equinócio da primavera boreal (γ)



Precessão dos equinócios



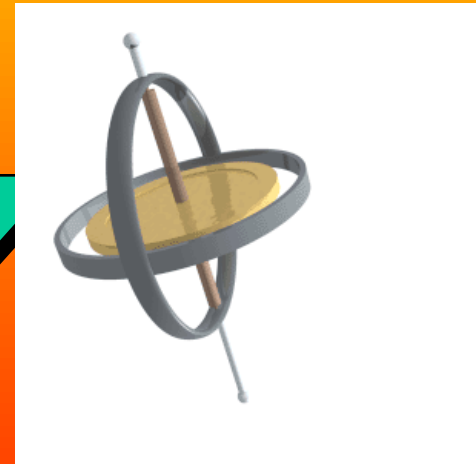
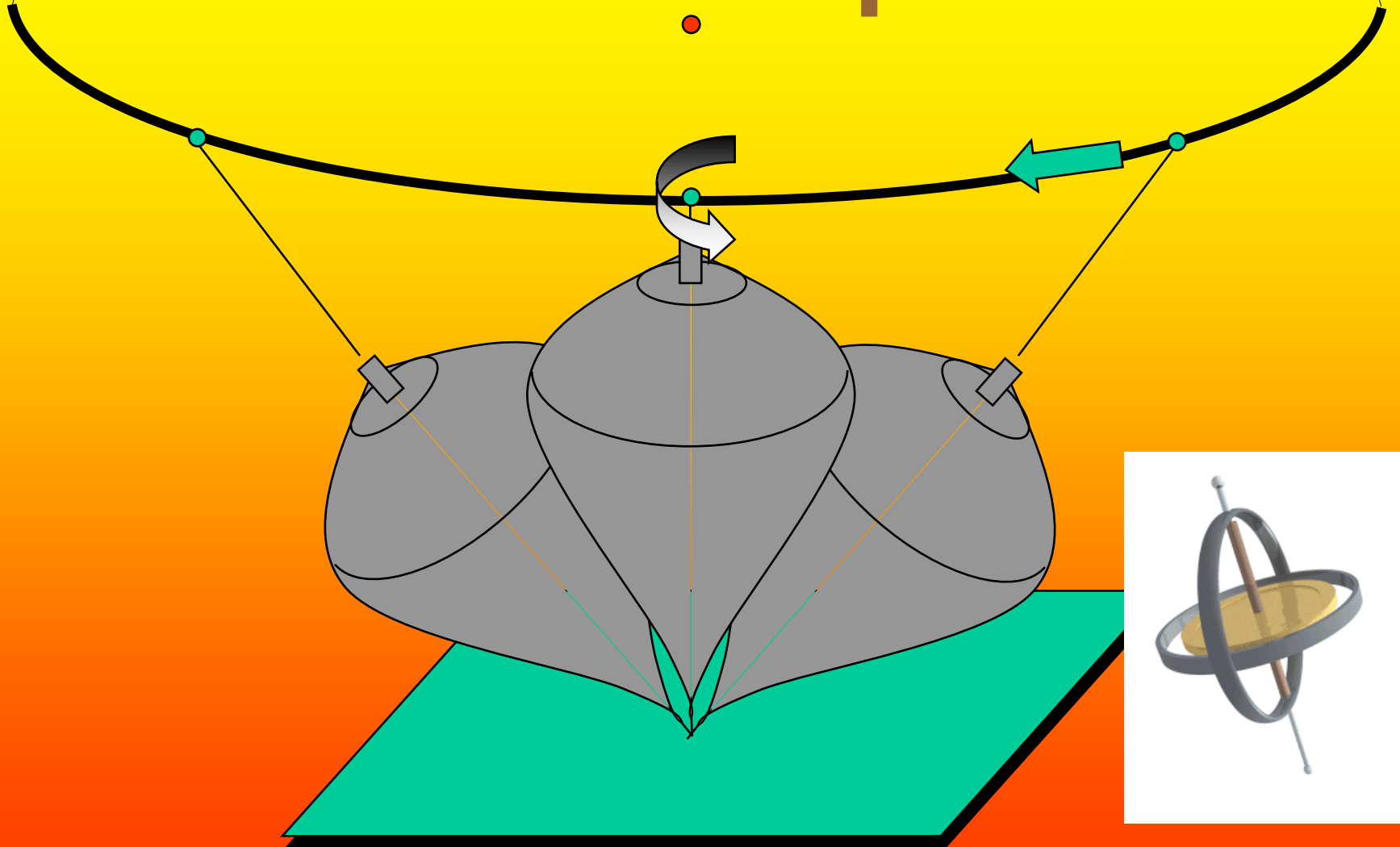
Defasagem entre Constelações e Signos Zodiacais



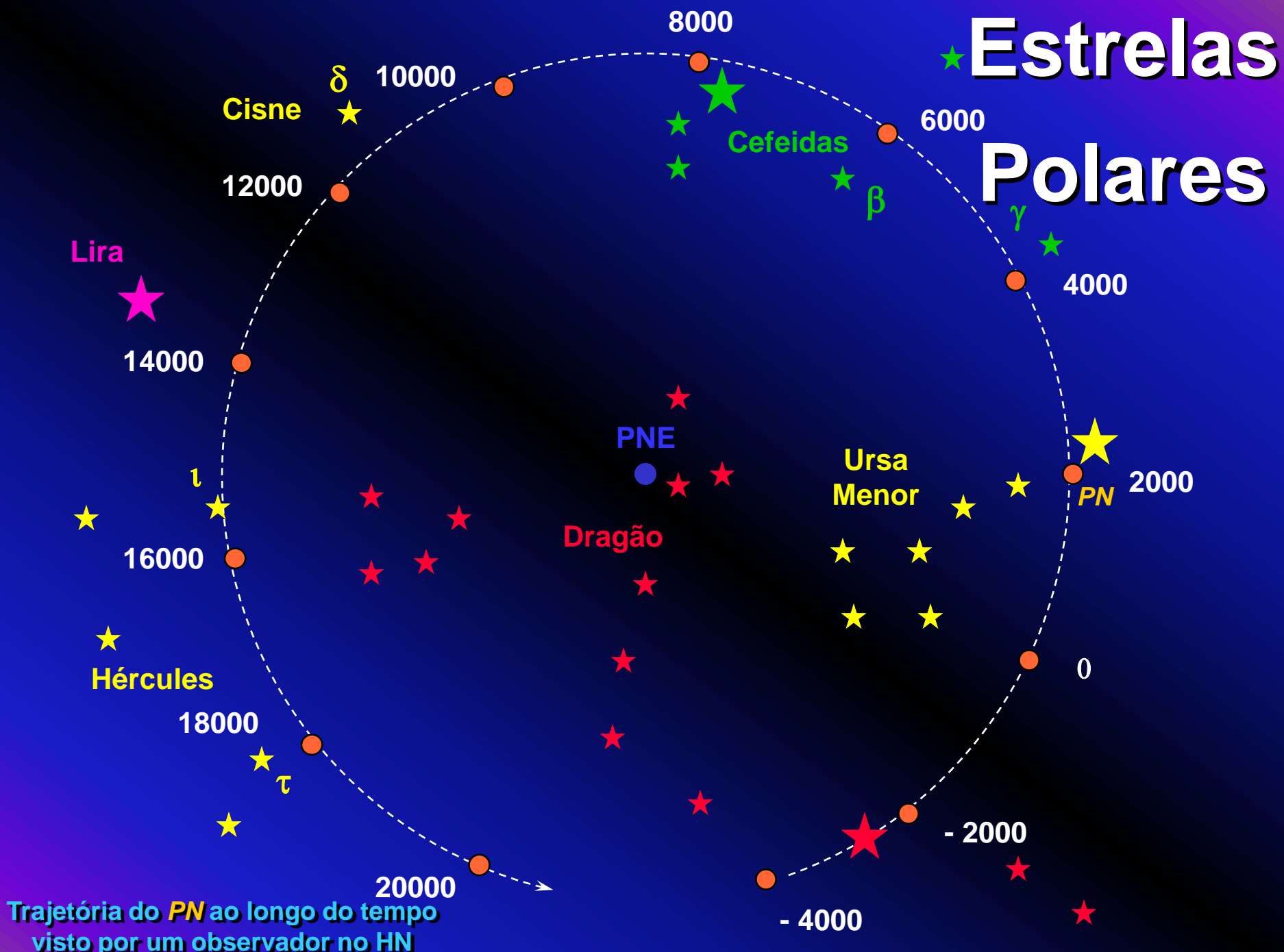
Precessão



Giroscópio



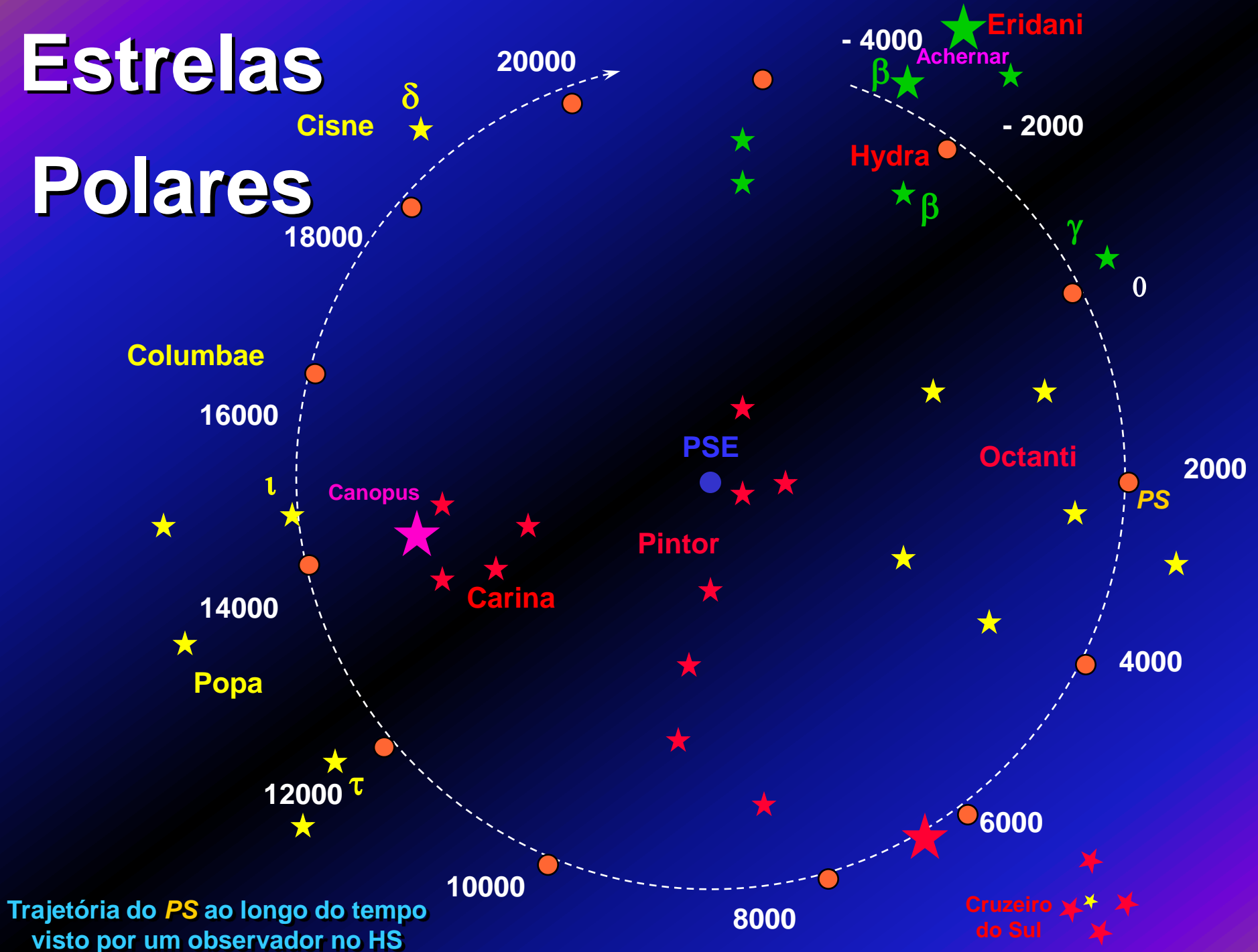
Estrelas Polares



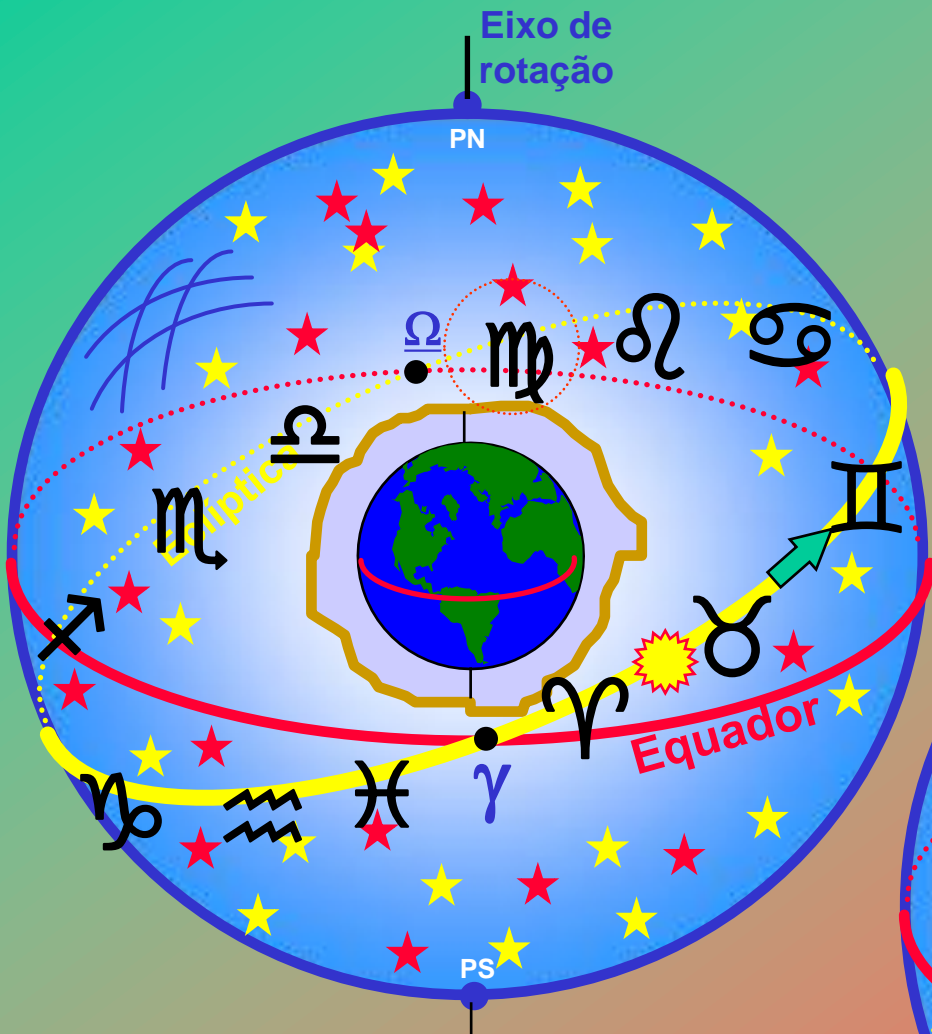
Trajétória do PN ao longo do tempo visto por um observador no HN

Estrelas

Polares

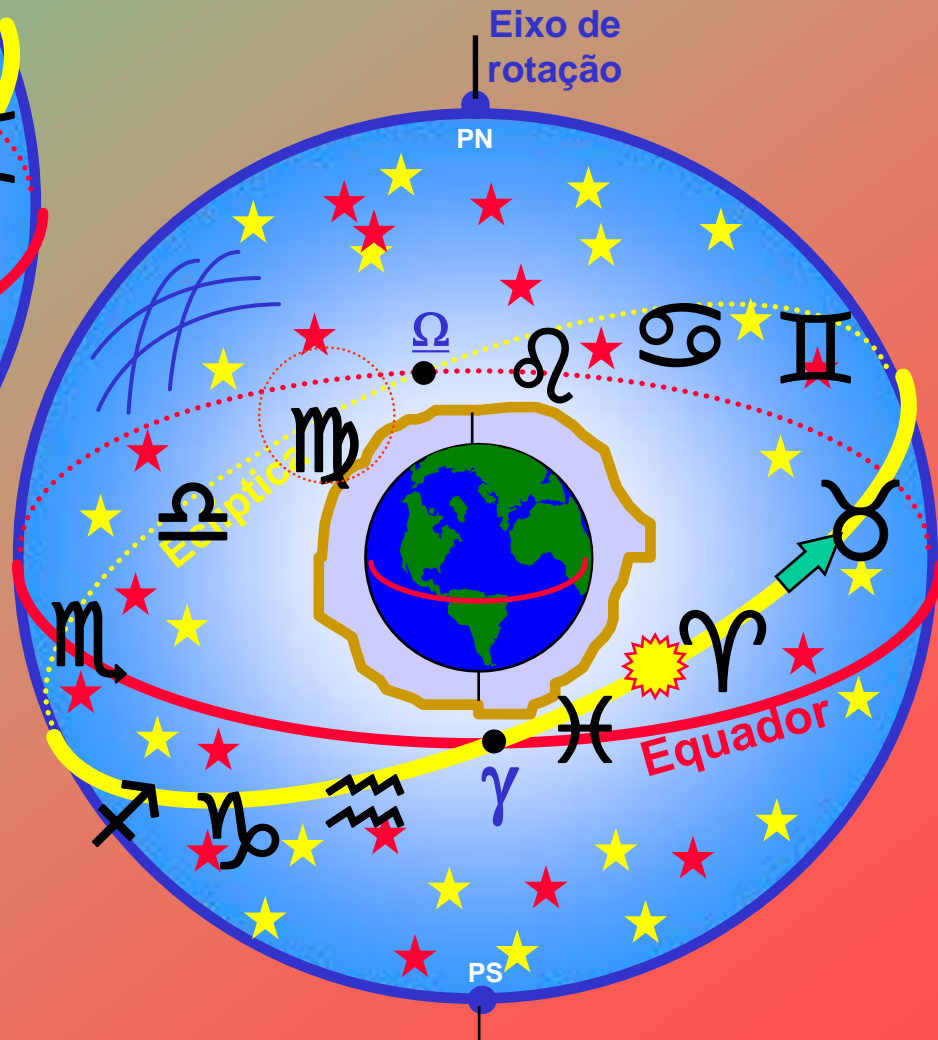


Trajetória do PS ao longo do tempo visto por um observador no HS



Constelações zodiacais no início da Astronomia

Constelações zodiacais atuais



Film