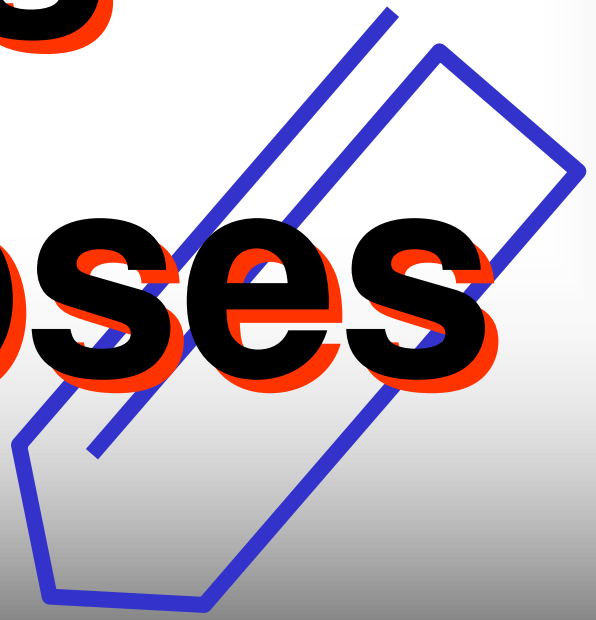
Os Eclipses



R. Boczko

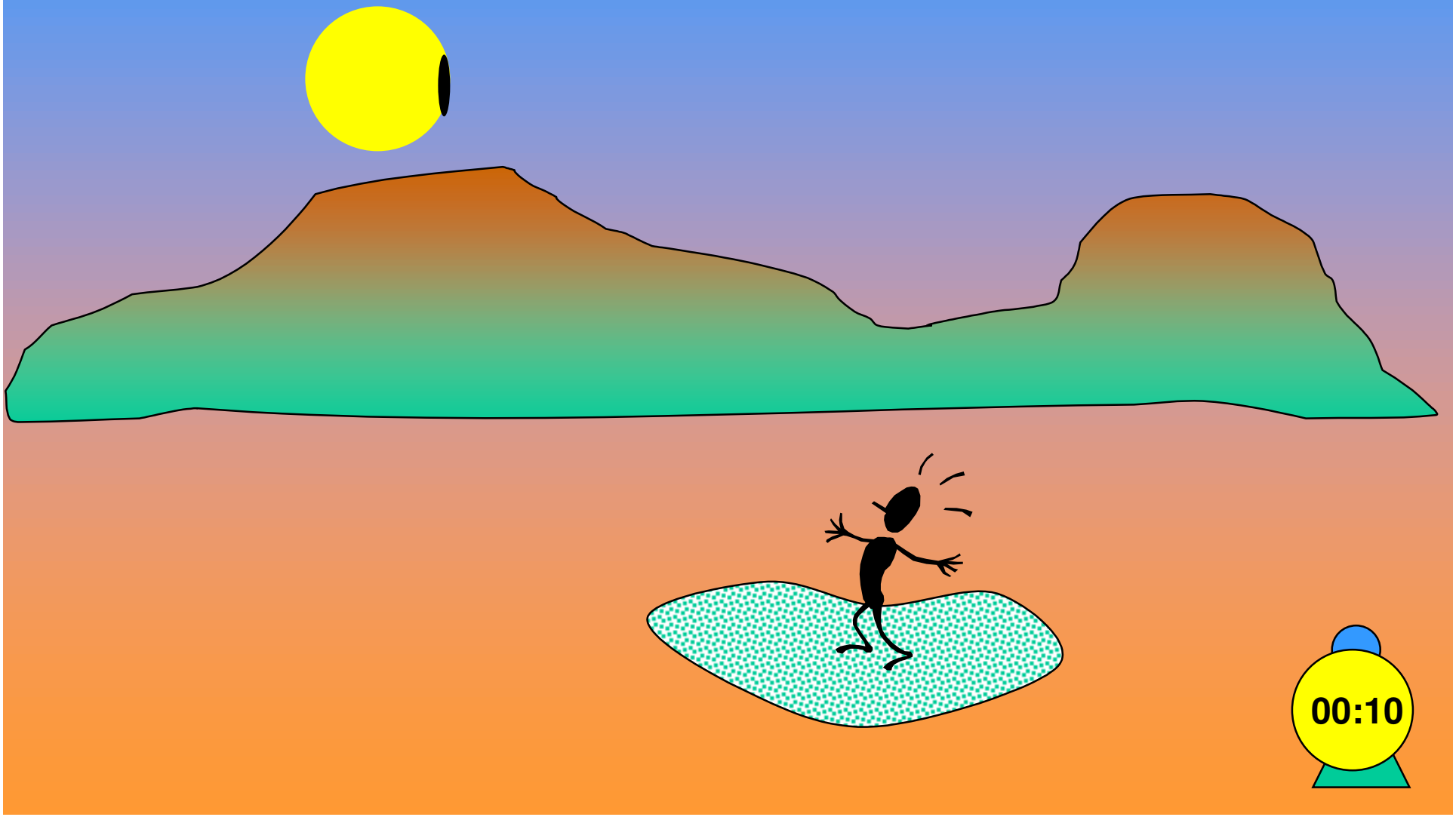
IAG-USP

11
01
04

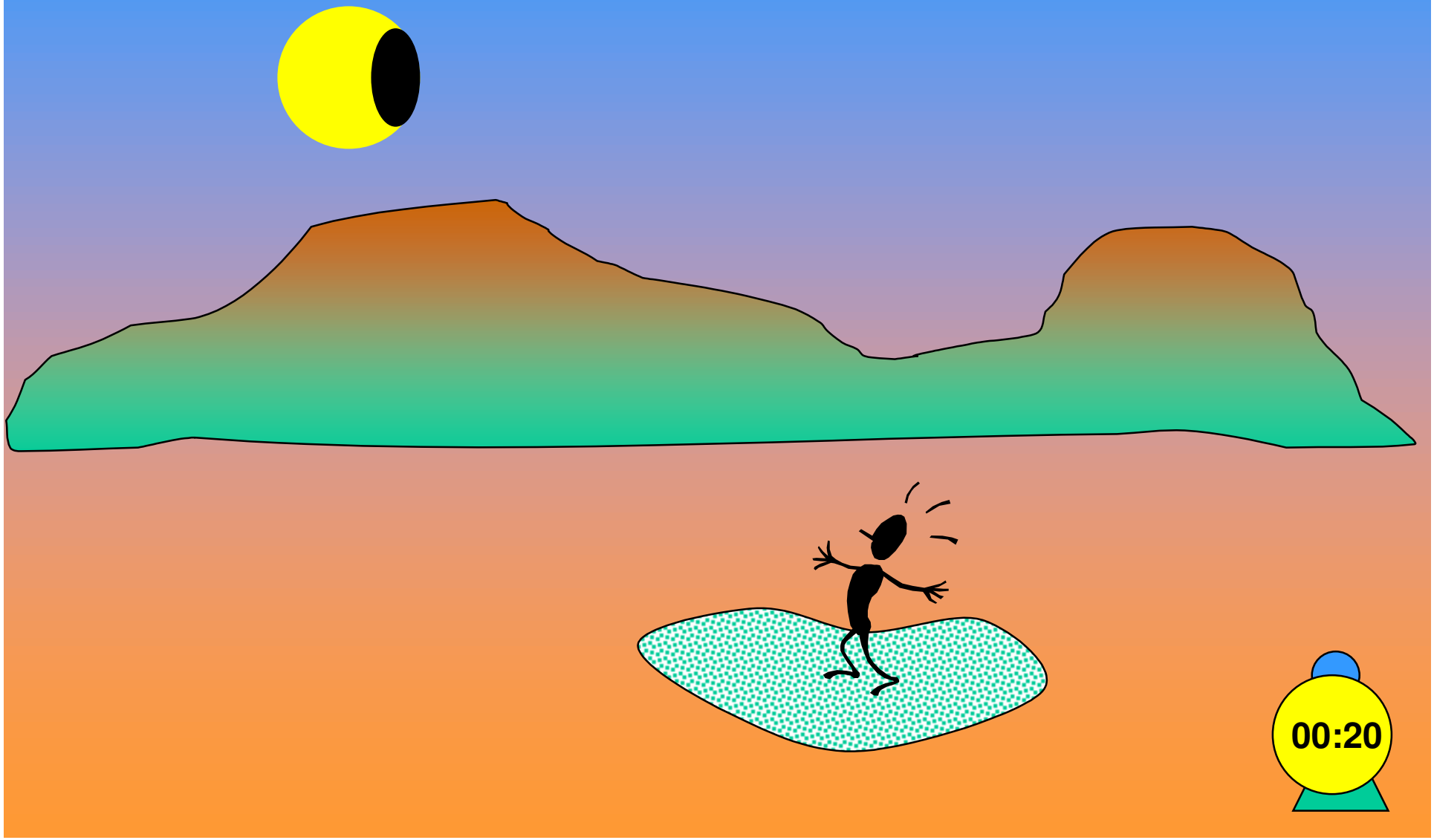
Seqüência de um Eclipse Solar

Sol visto no céu

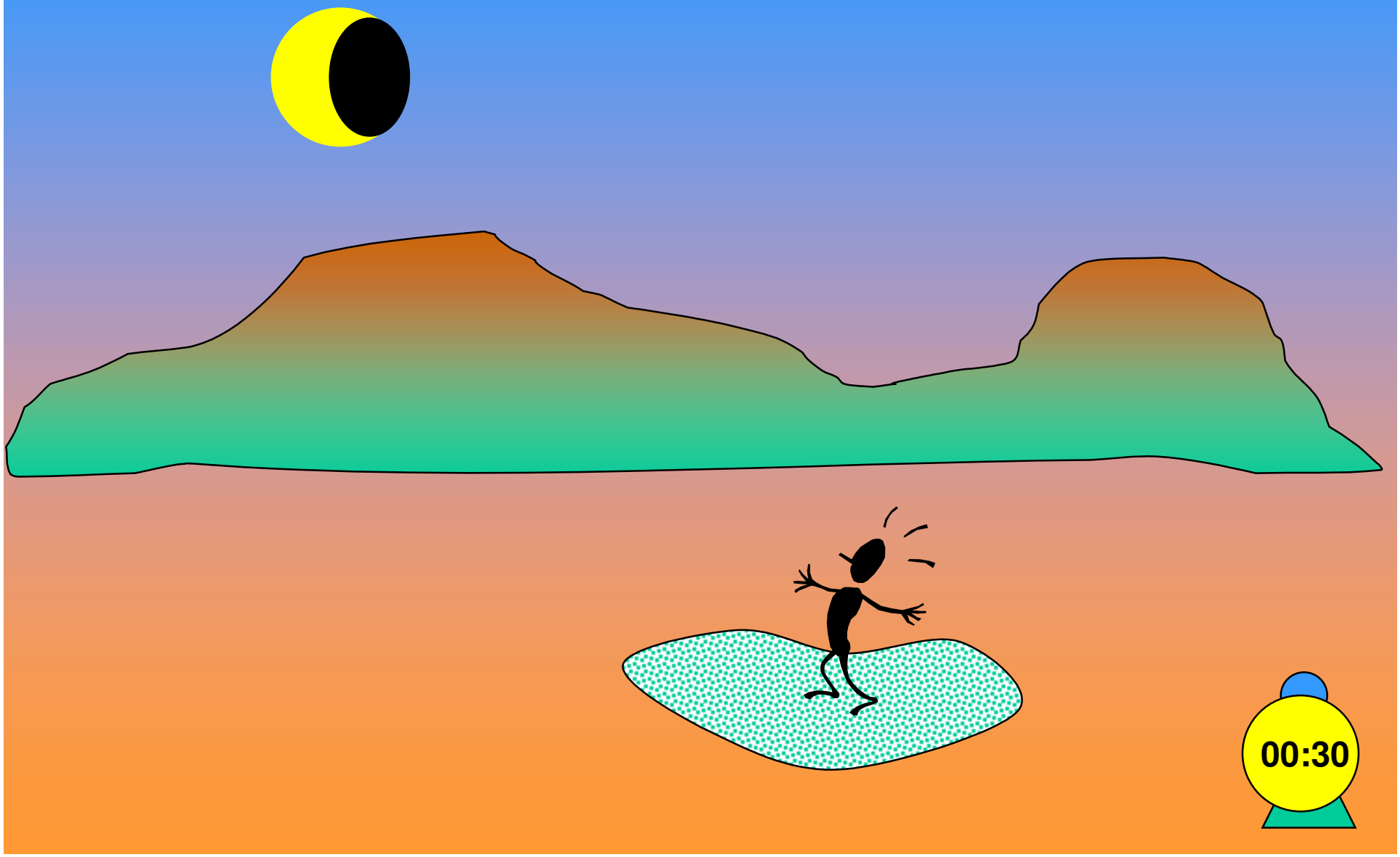
Início do Eclipse Solar Parcial



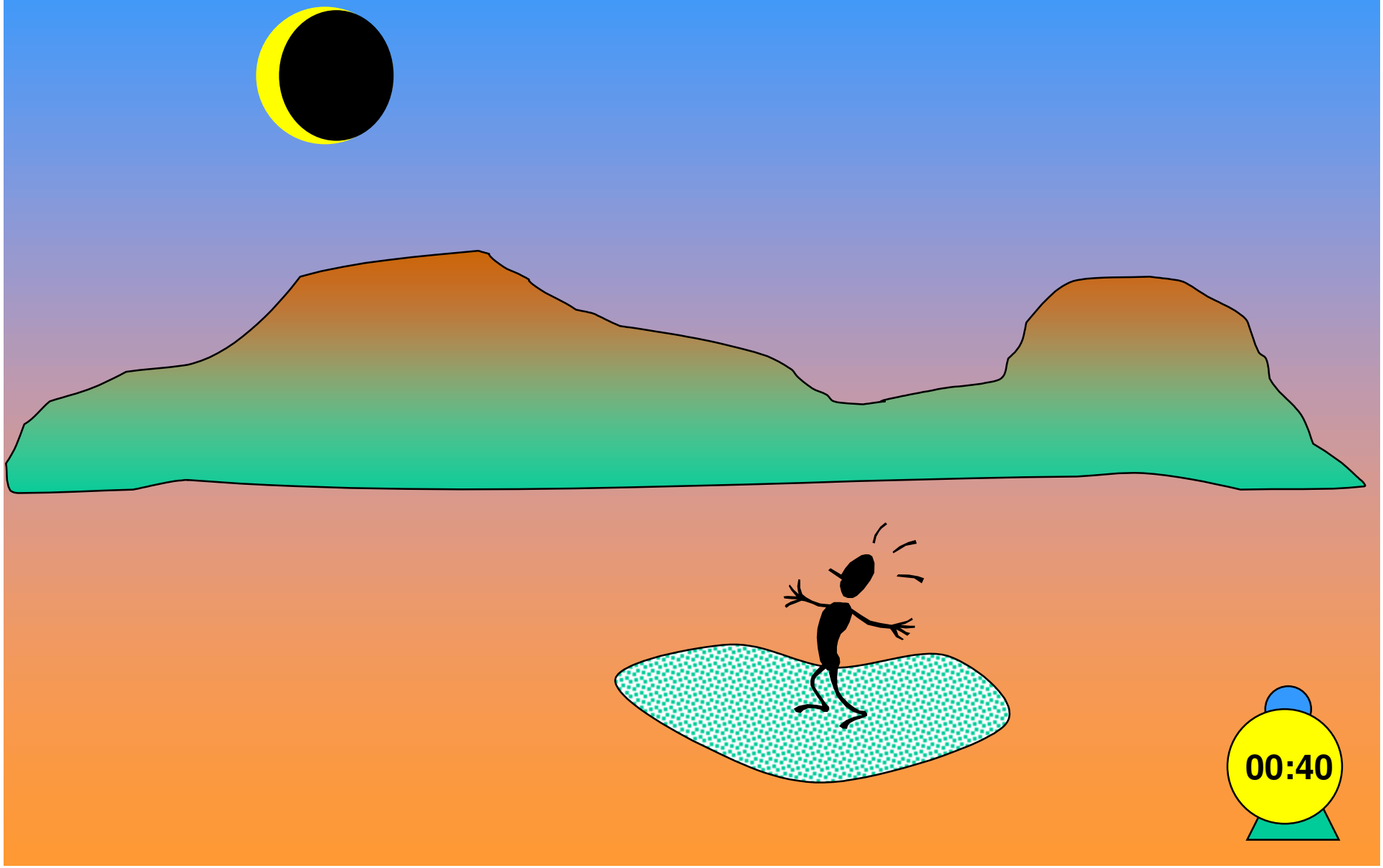
Eclipse Solar Parcial



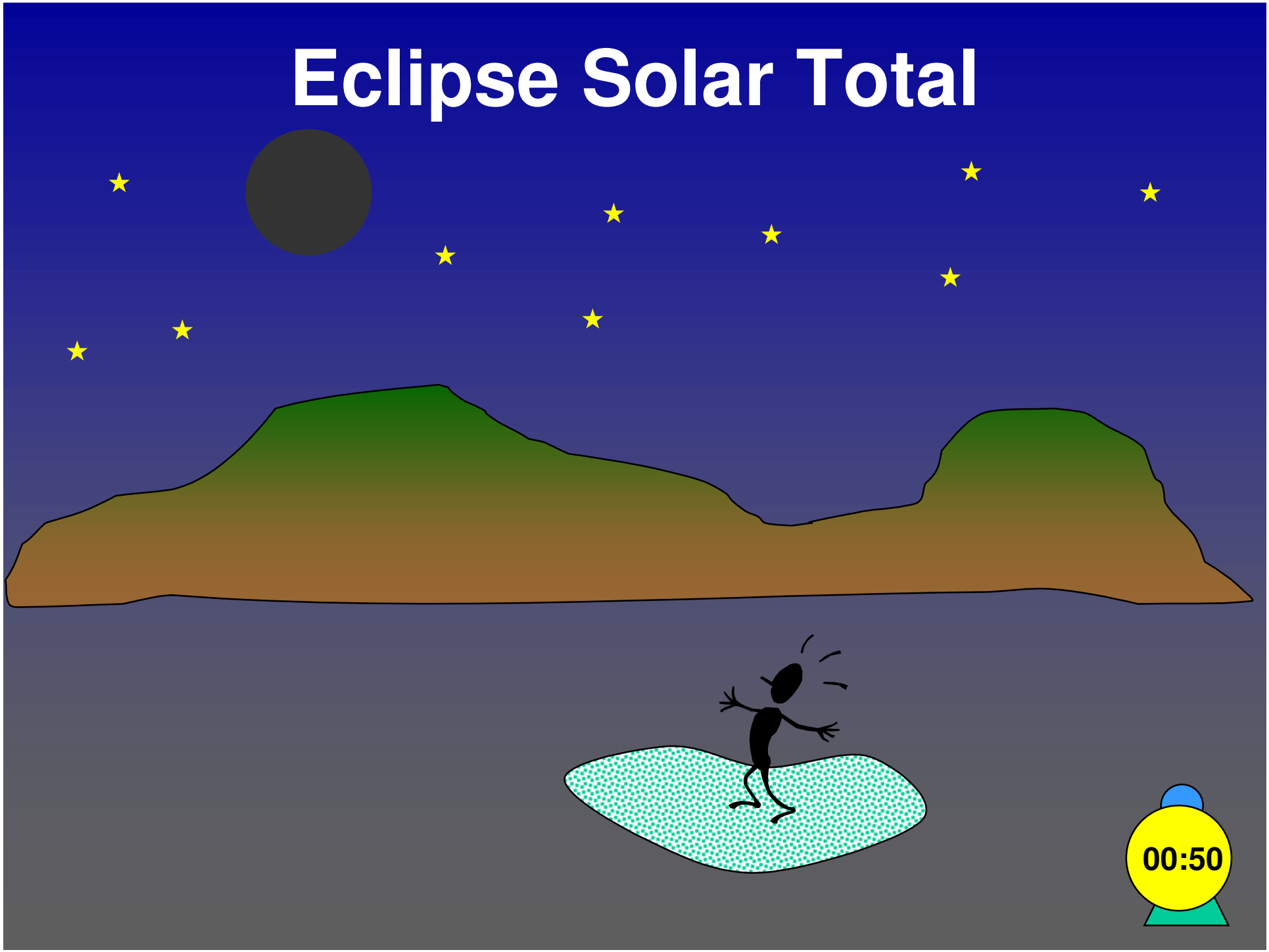
Eclipse Solar Parcial



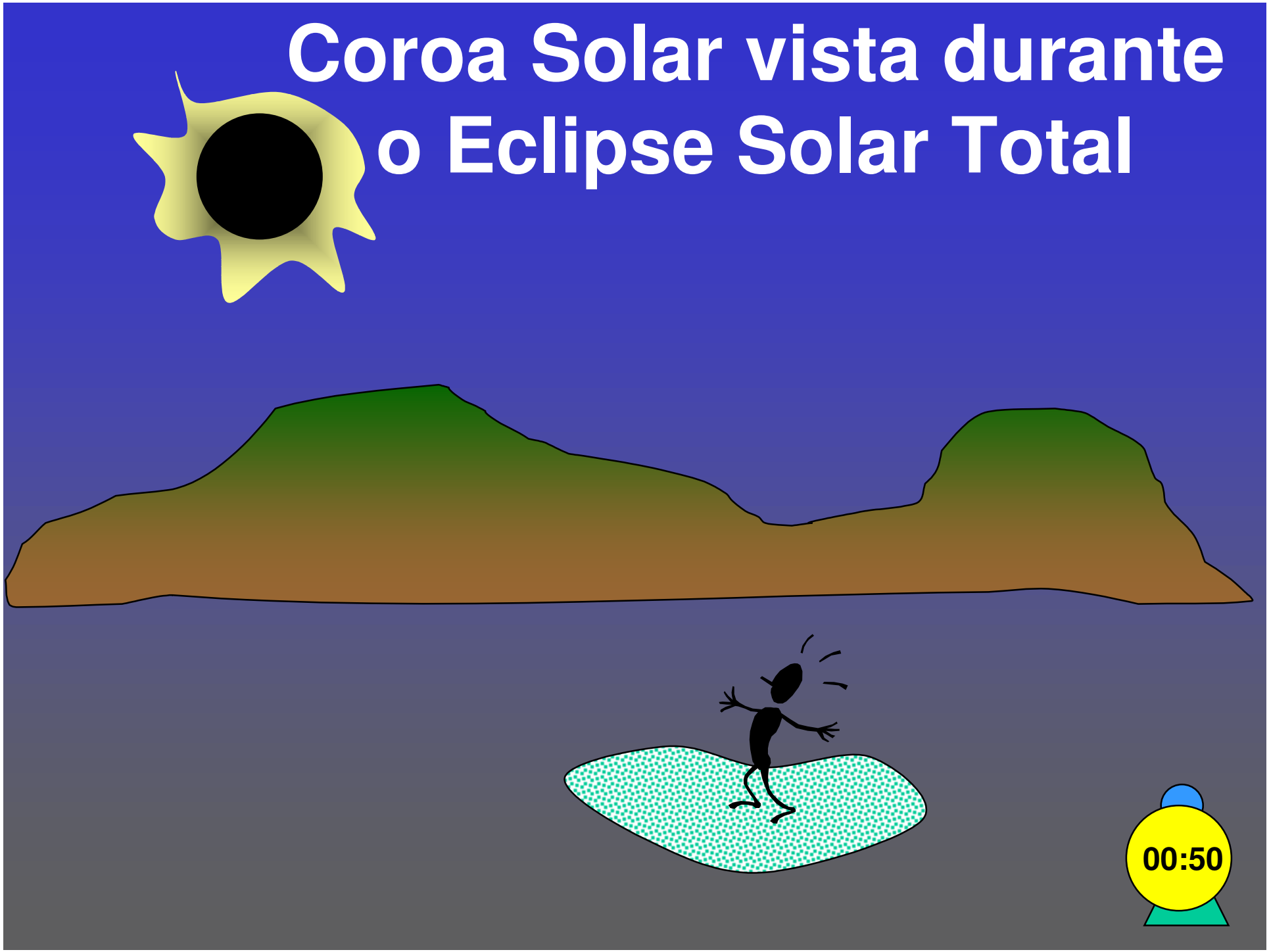
Eclipse Solar Parcial



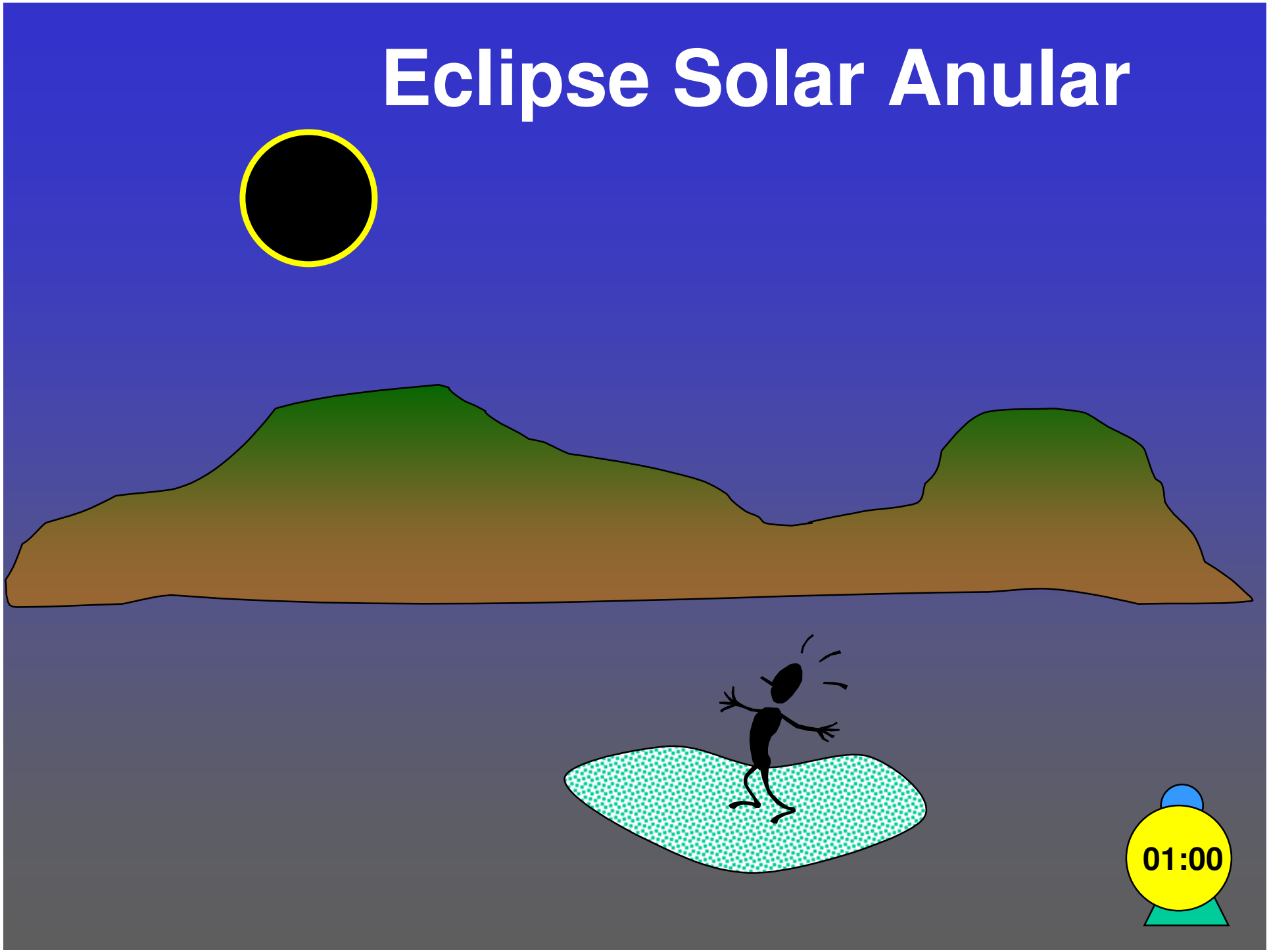
Eclipse Solar Total



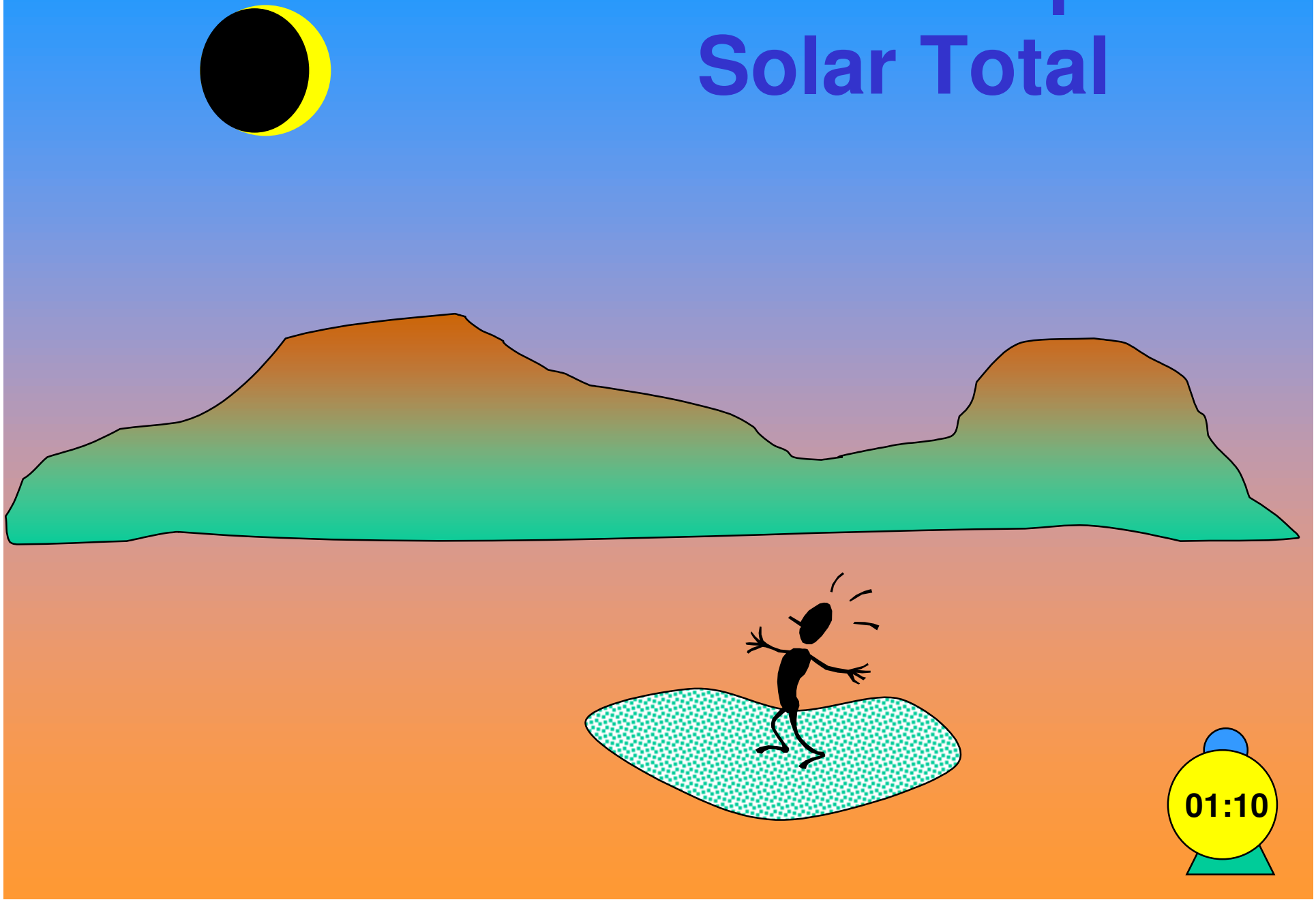
Coroa Solar vista durante o Eclipse Solar Total



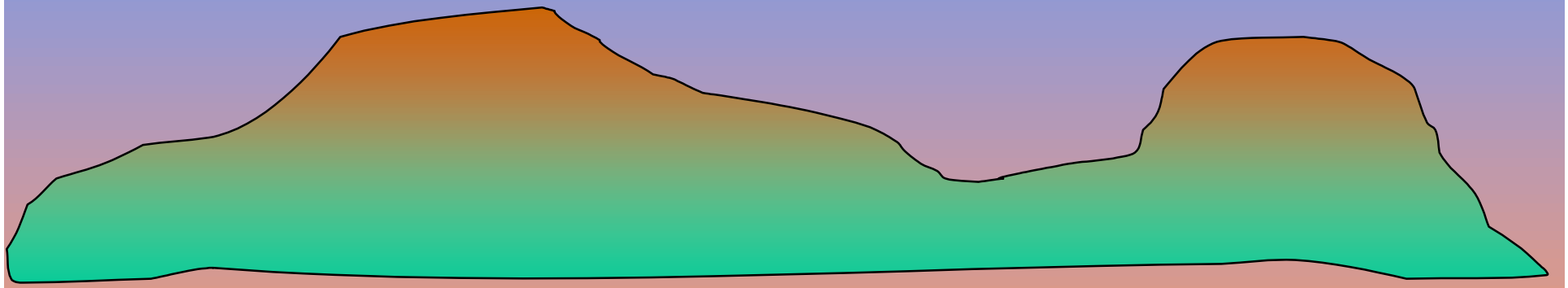
Eclipse Solar Anular



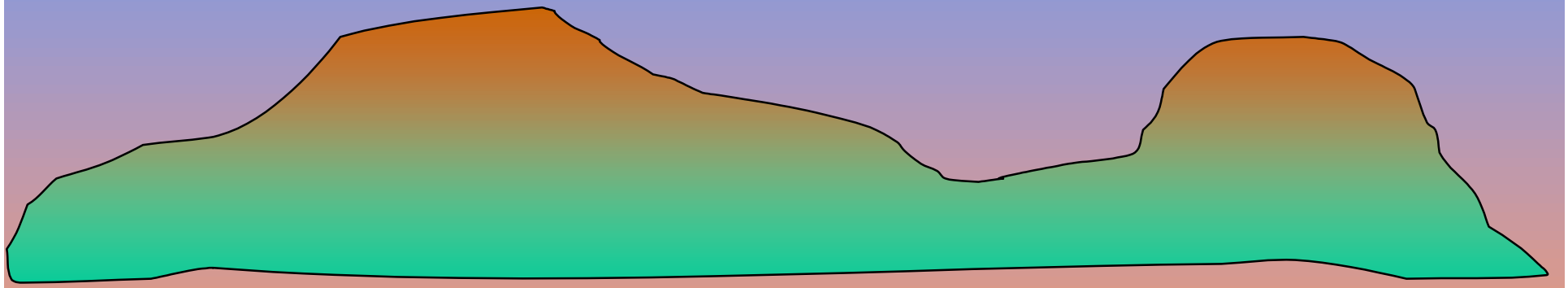
Fim do Eclipse Solar Total



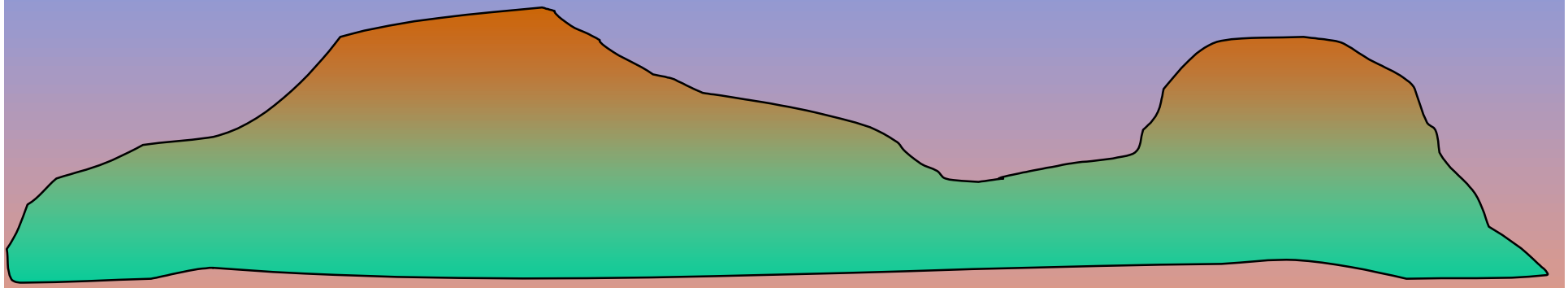
Eclipse Solar Parcial



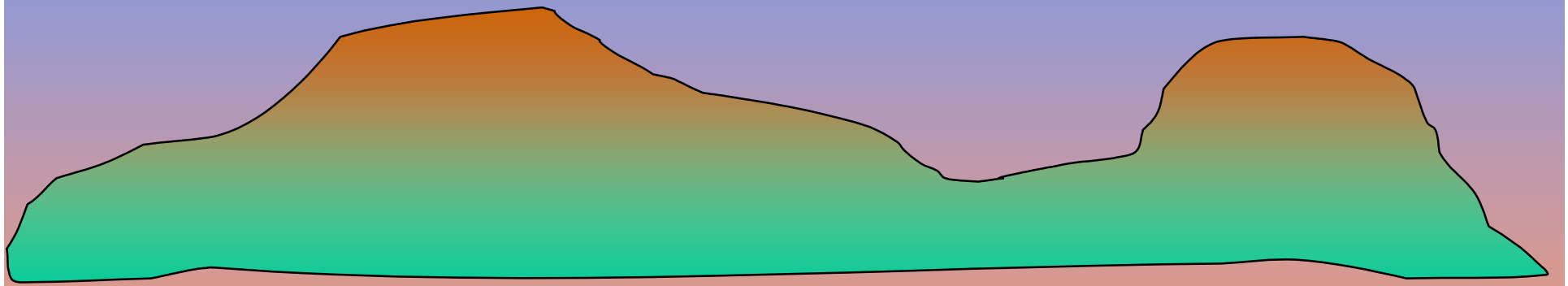
Eclipse Solar Parcial



Finalzinho do Eclipse Solar Parcial

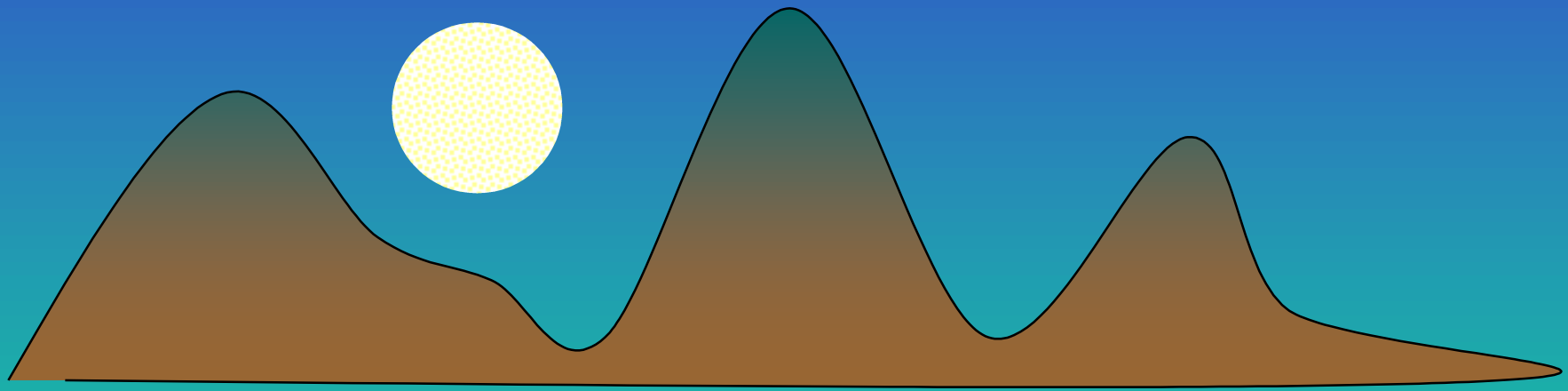


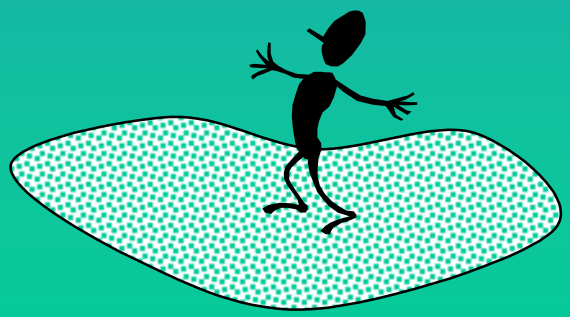
Fim do Eclipse Solar



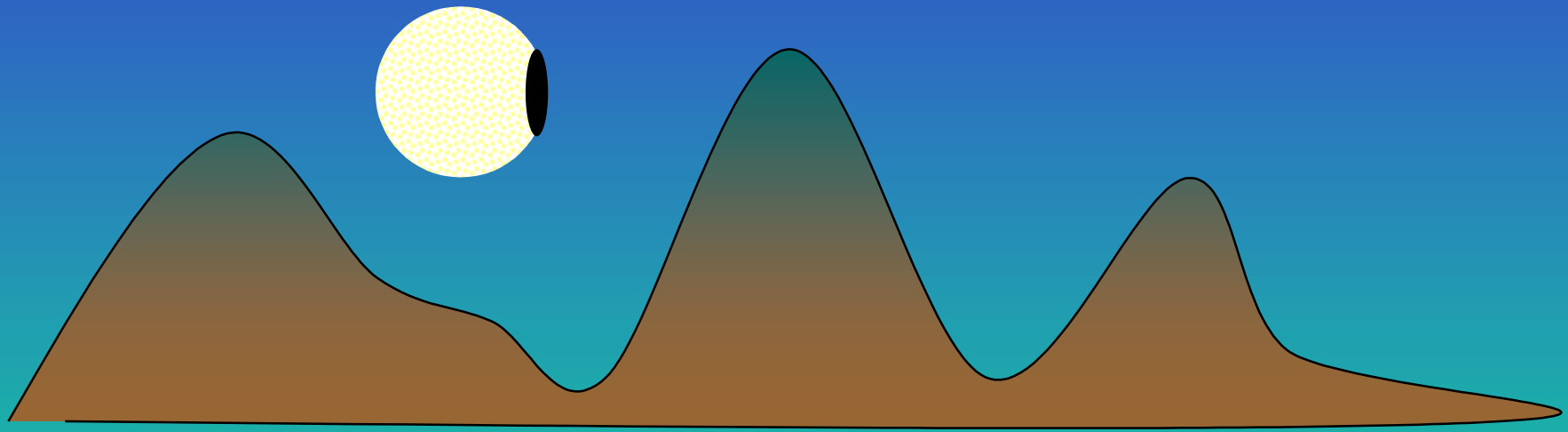
Seqüência de um Eclipse Lunar

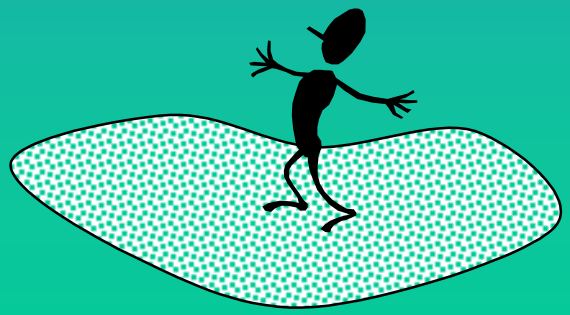
Lua Cheia vista no céu



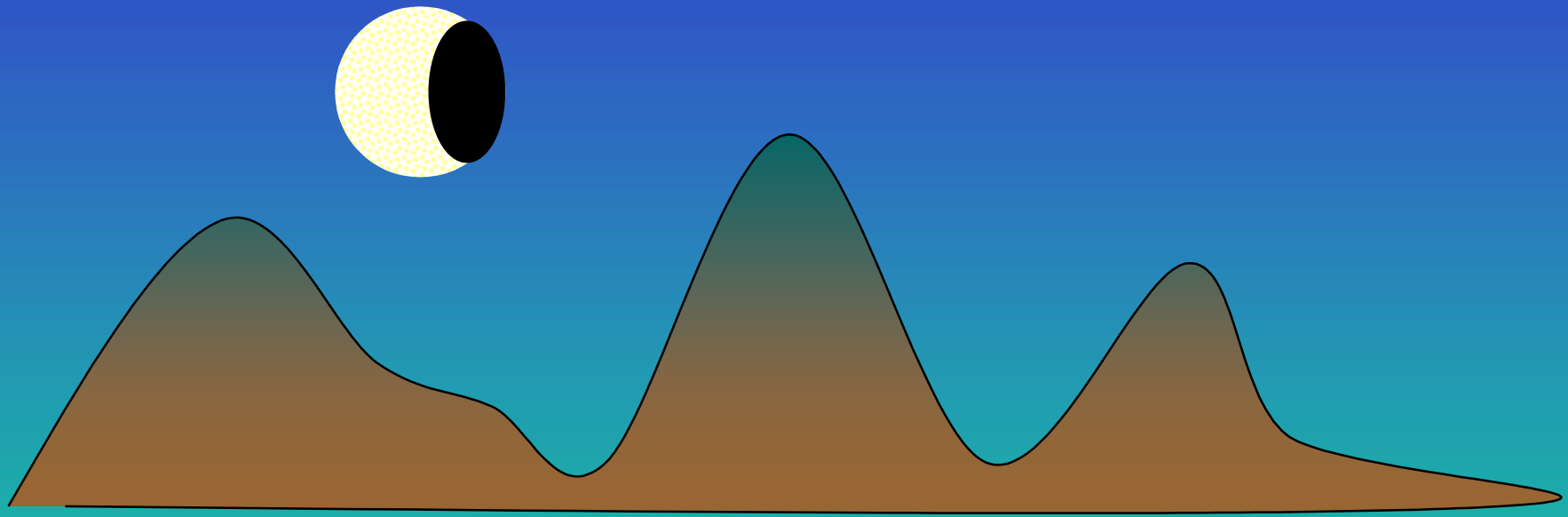


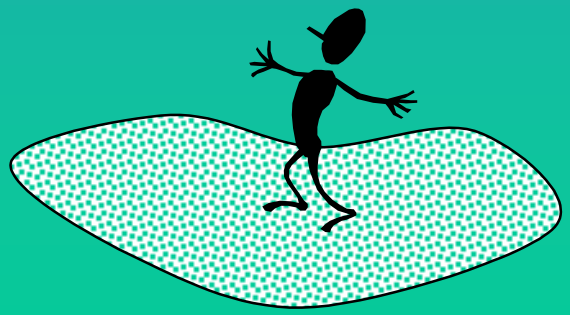
Lua Cheia (?) vista no céu



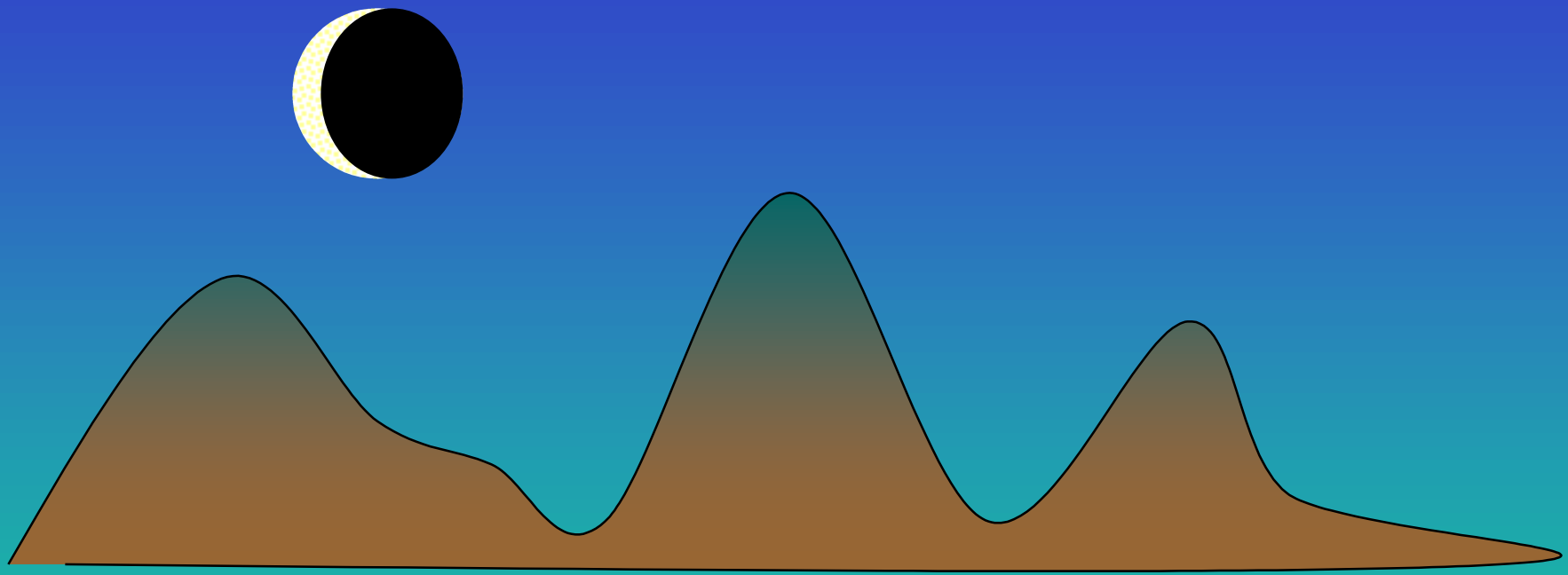


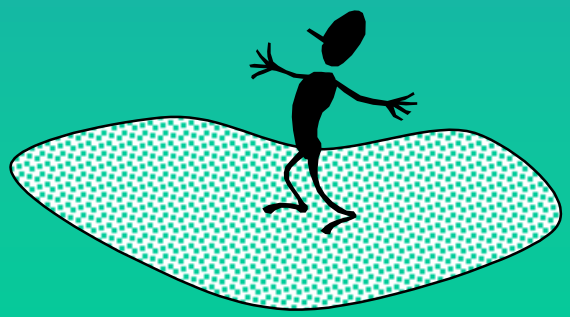
Lua Cheia (?) vista no céu



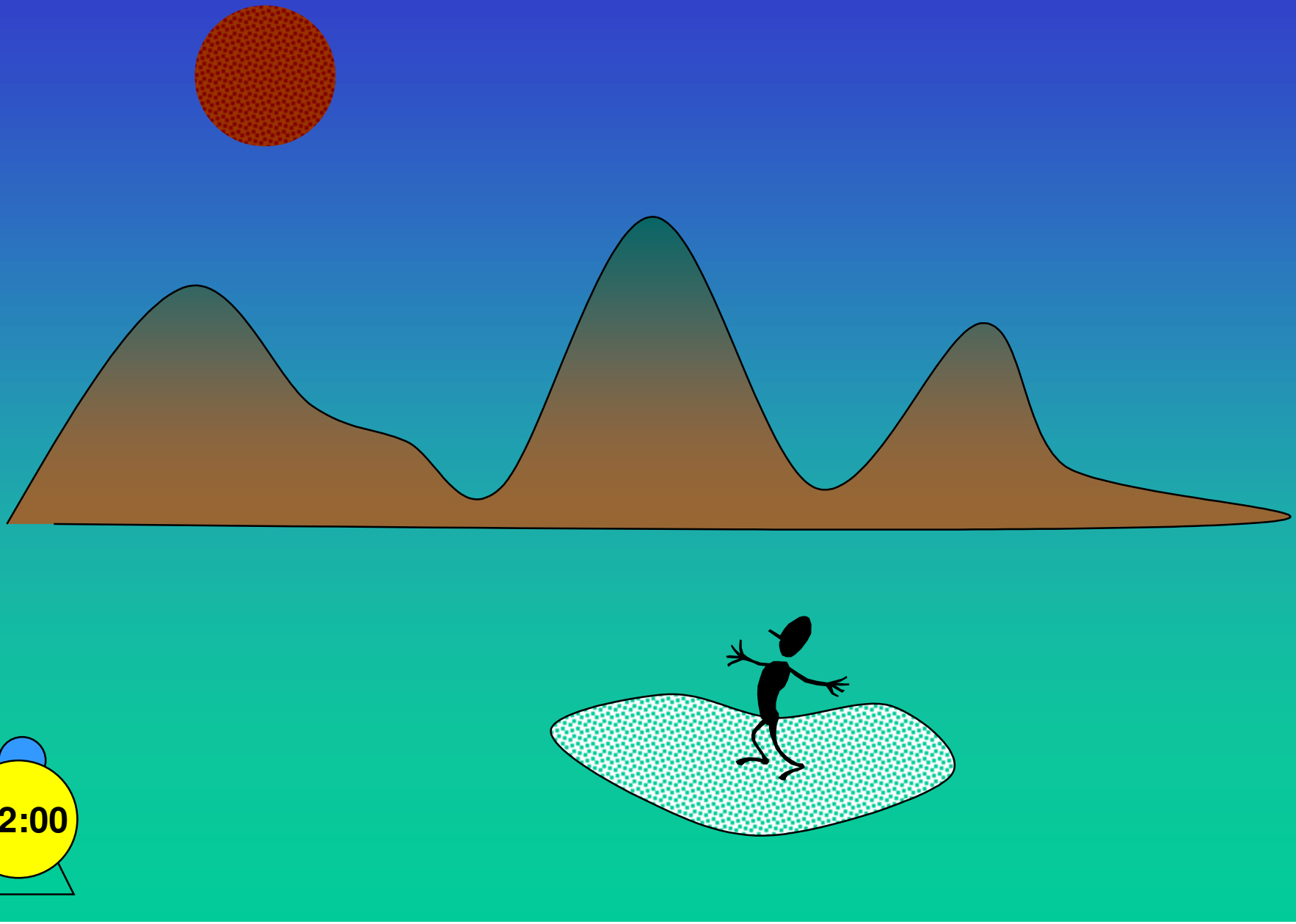


Lua Cheia (?) vista no céu

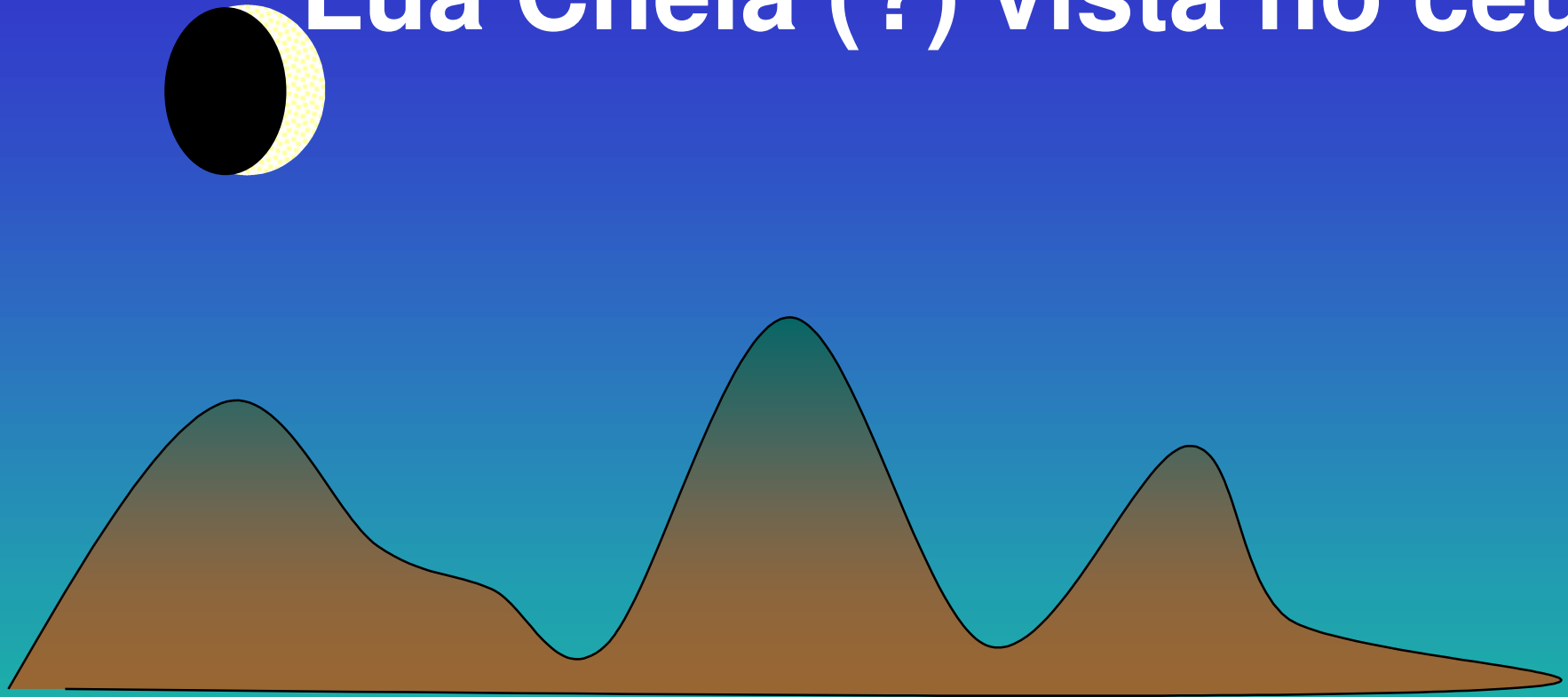


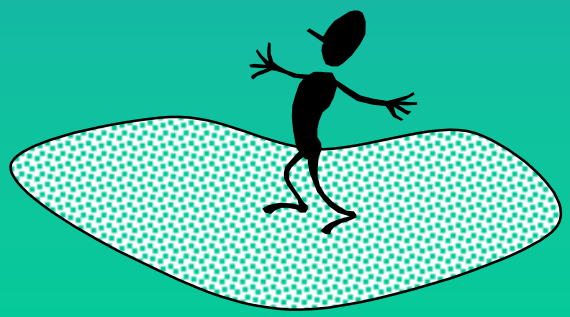


Eclipse Total Lunar

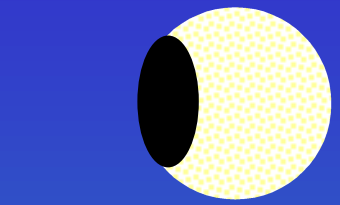


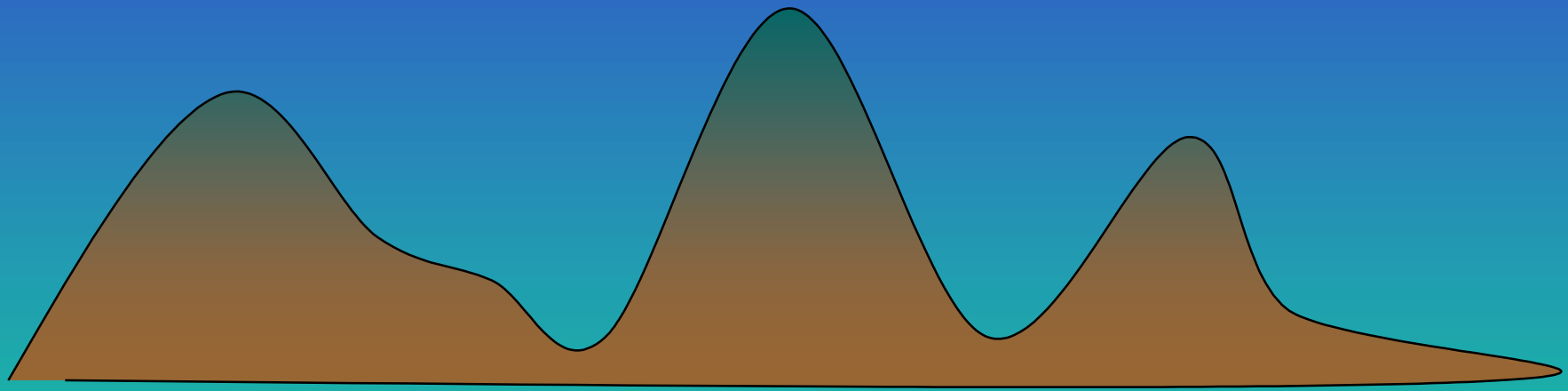
Lua Cheia (?) vista no céu

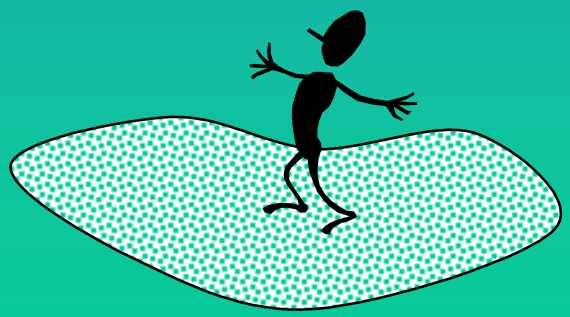




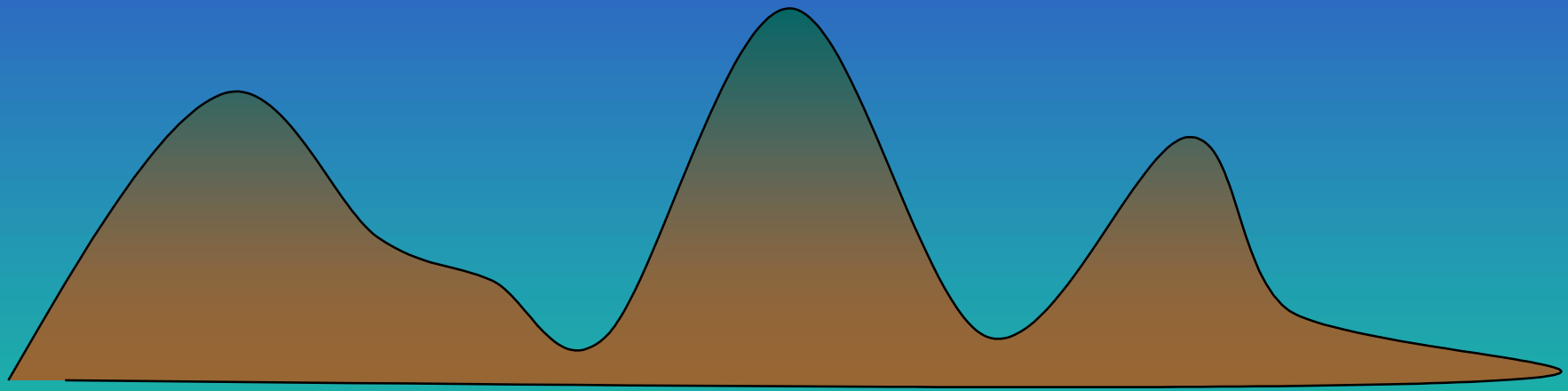
Lua Cheia (?) vista no céu

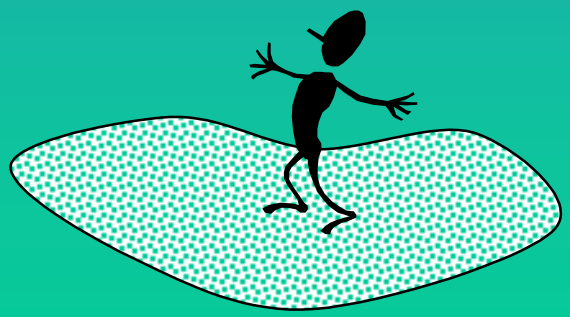




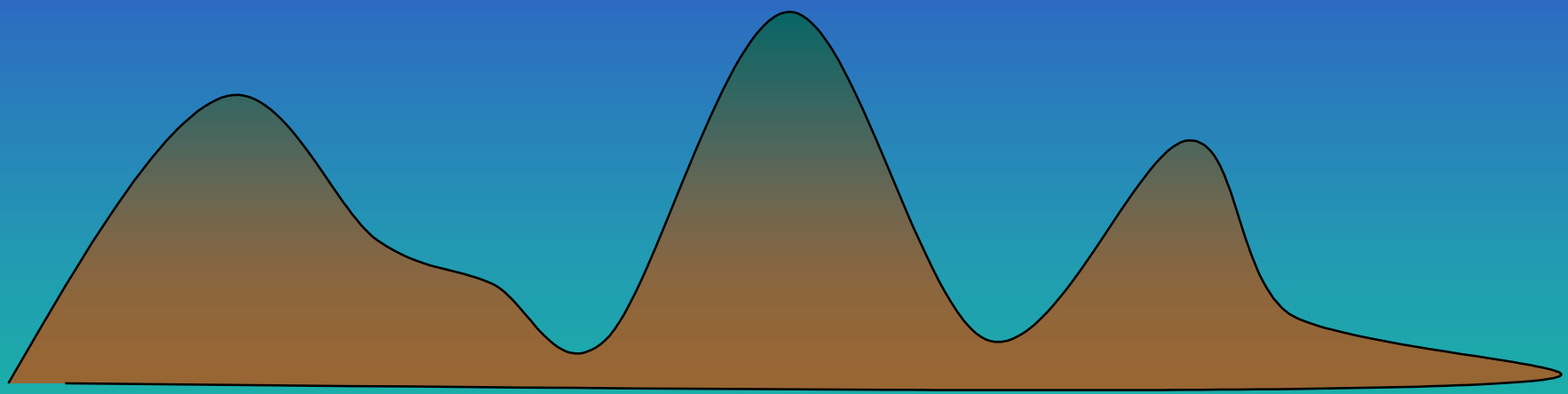


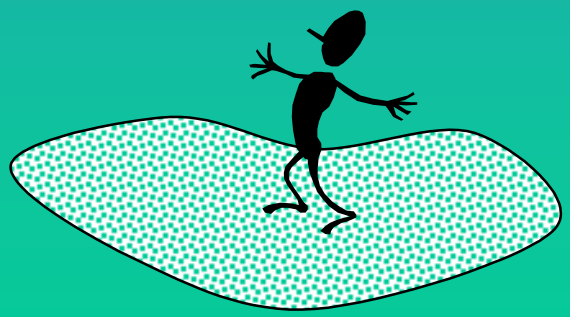
Lua Cheia (?) vista no céu





Lua Cheia vista no céu



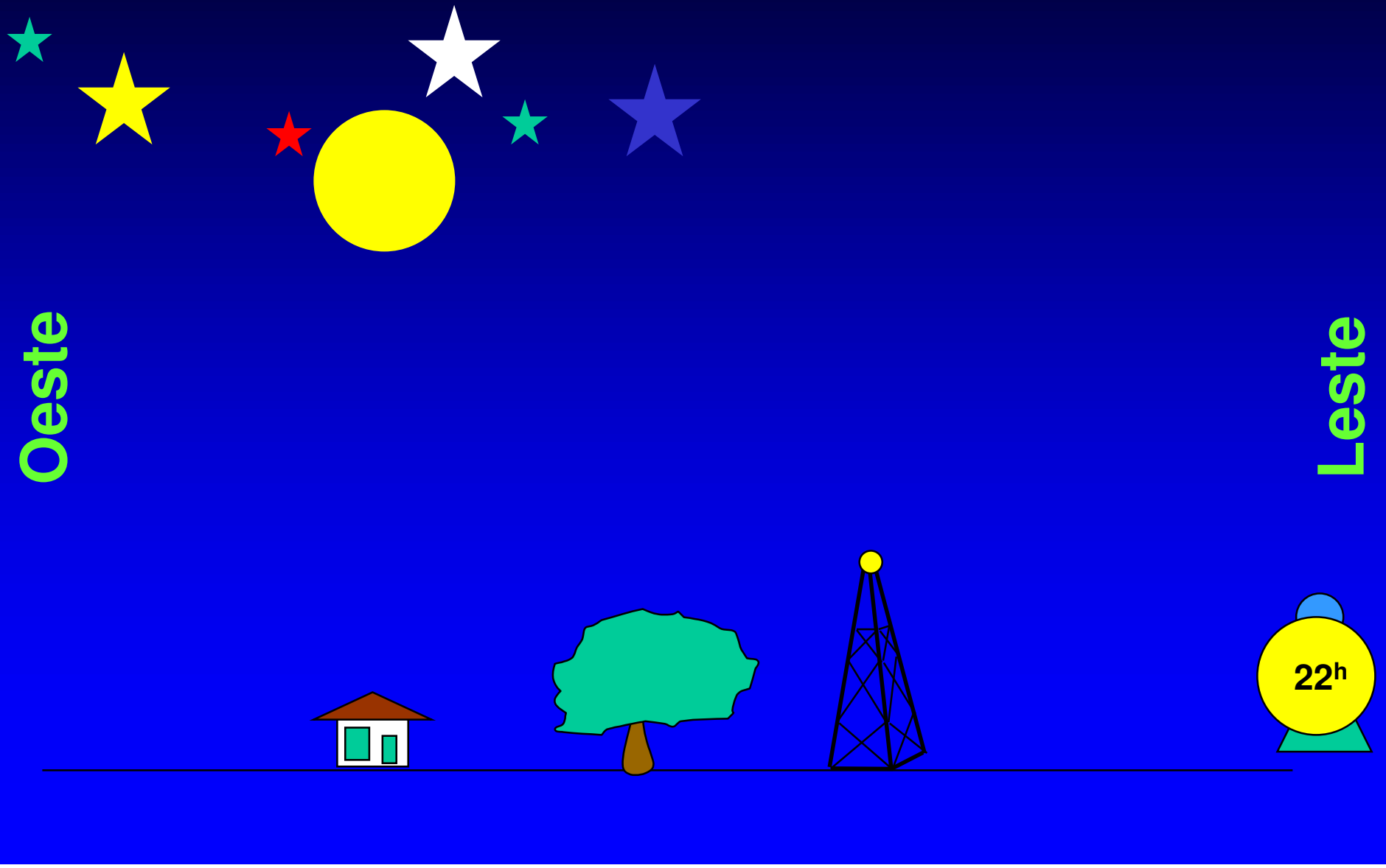


Movimento diurno aparente da Lua

Movimento da Lua no céu

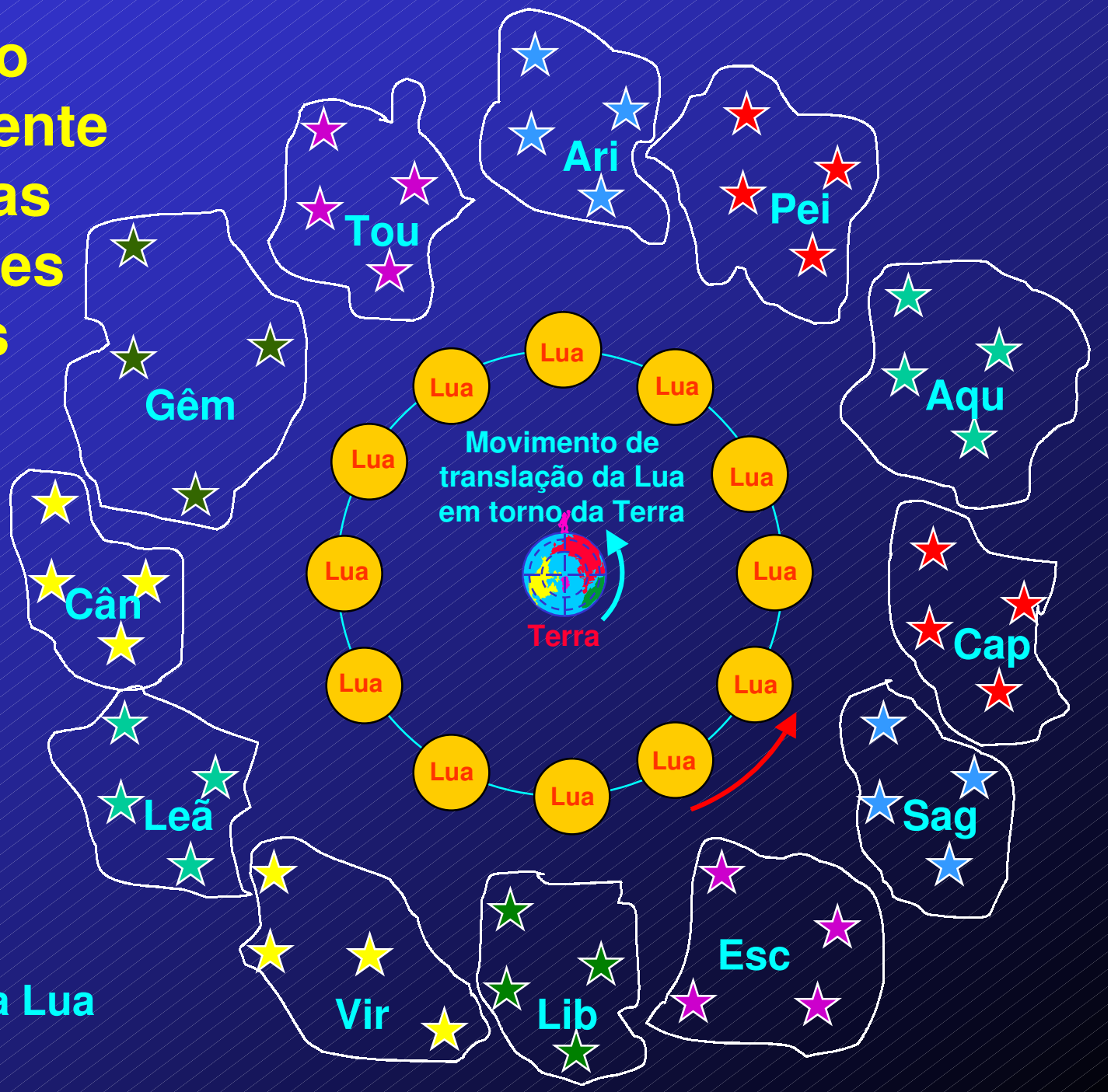
Movimento da Lua no céu

Movimento da Lua no céu



Movimento da Lua no céu

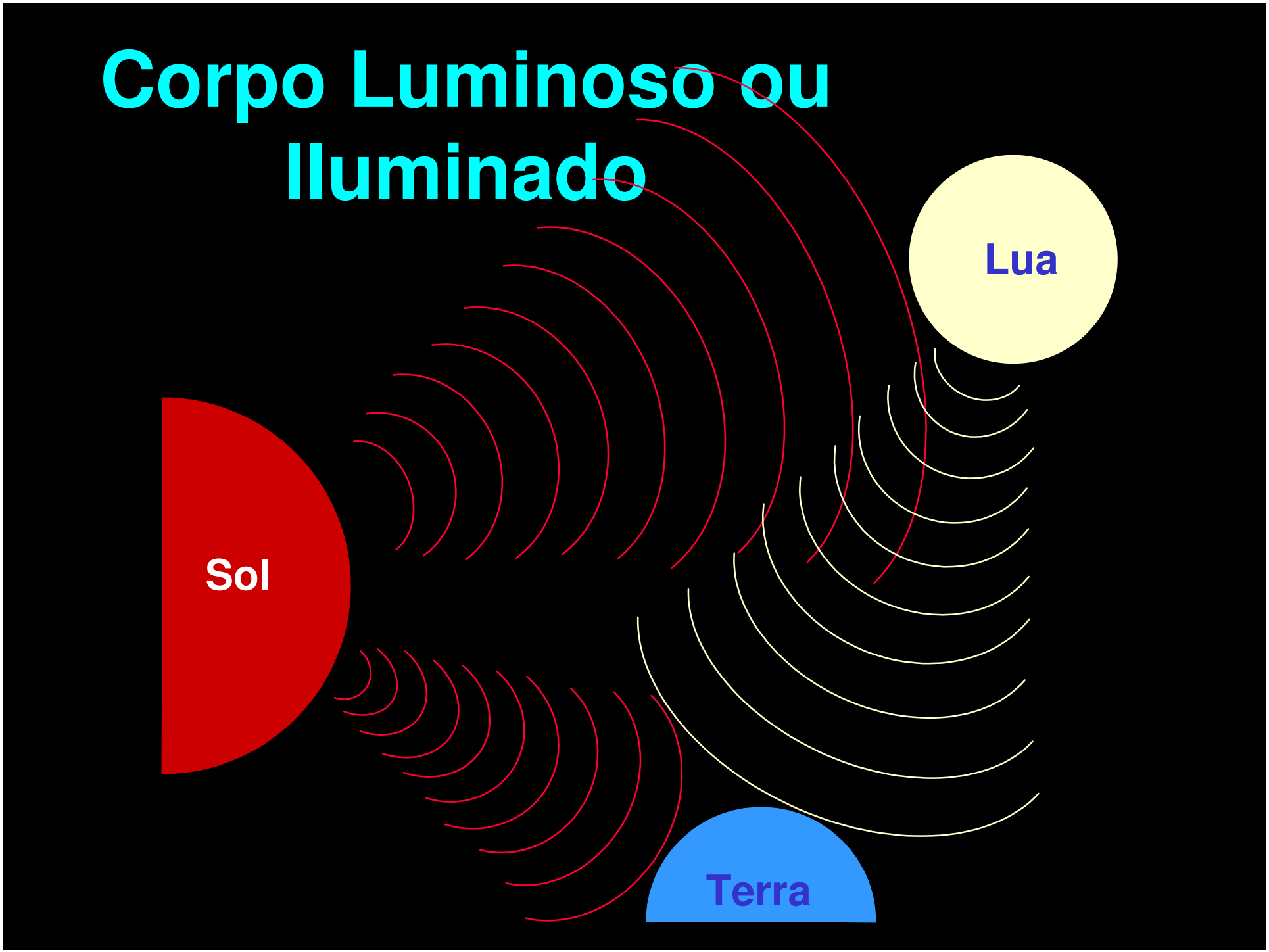
Movimento Mensal Aparente da Lua pelas Constelações Zodiacais



Período orbital da Lua
~27,3 dias

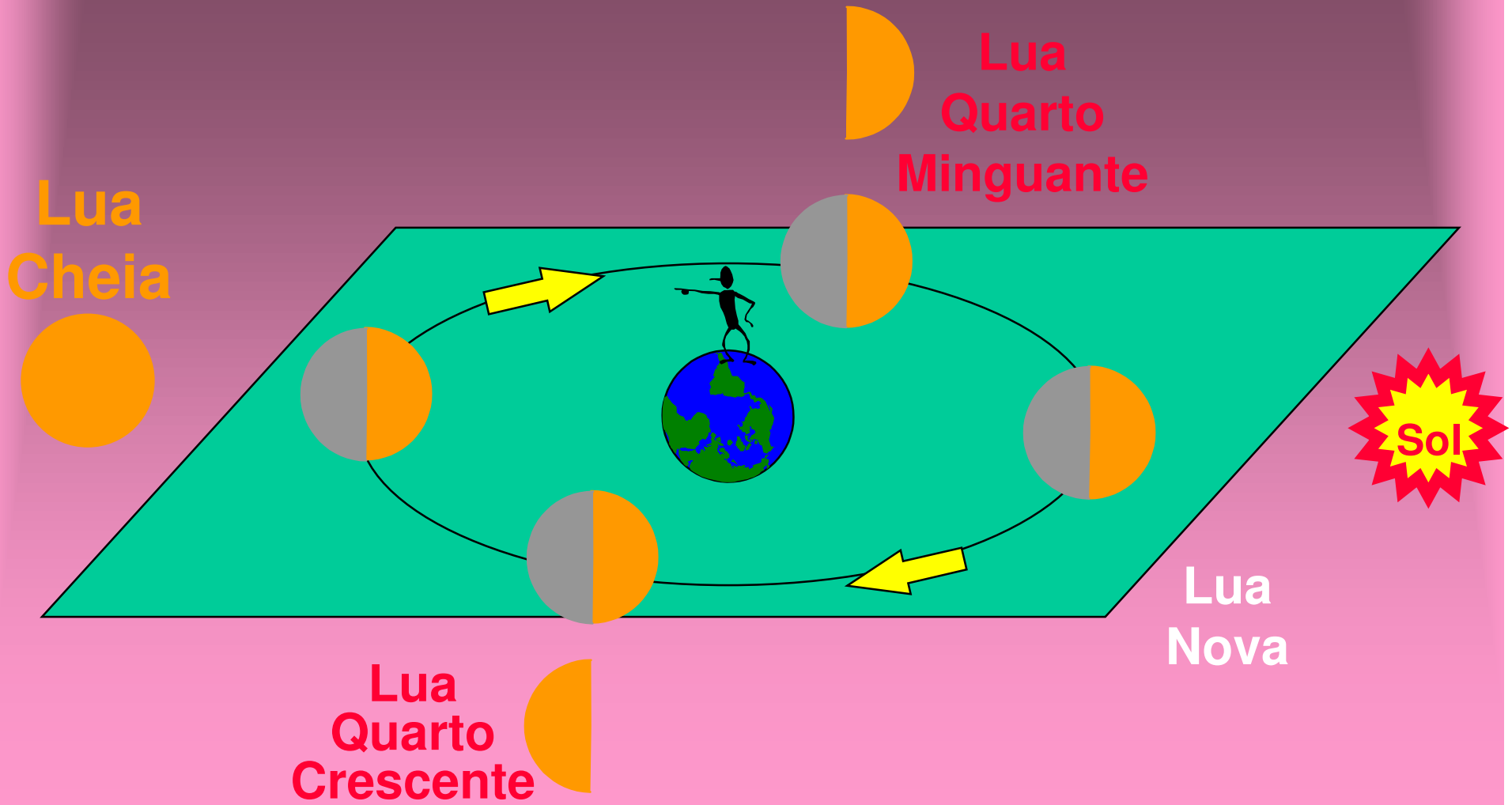
Fases da Lua

Corpo Luminoso ou Iluminado

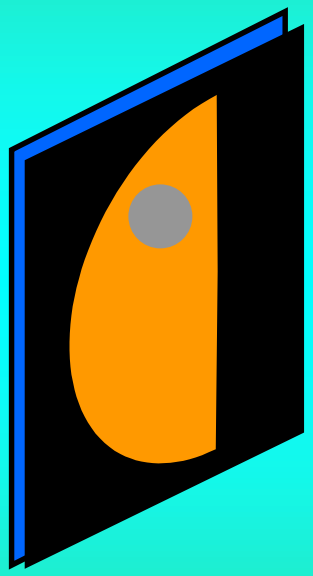


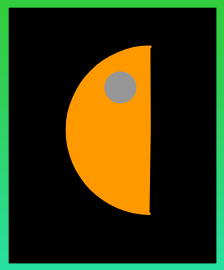
Motivos das fases da Lua

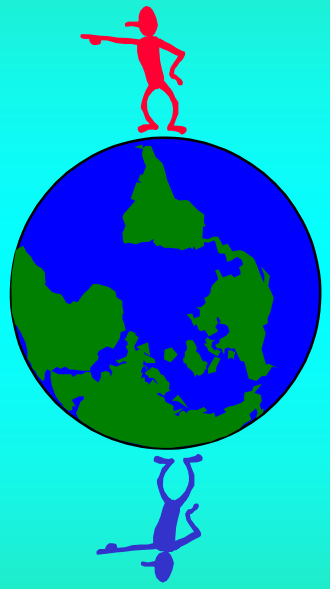
(Aristarco, séc. III a .C.)

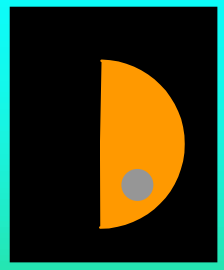


Visão da Lua



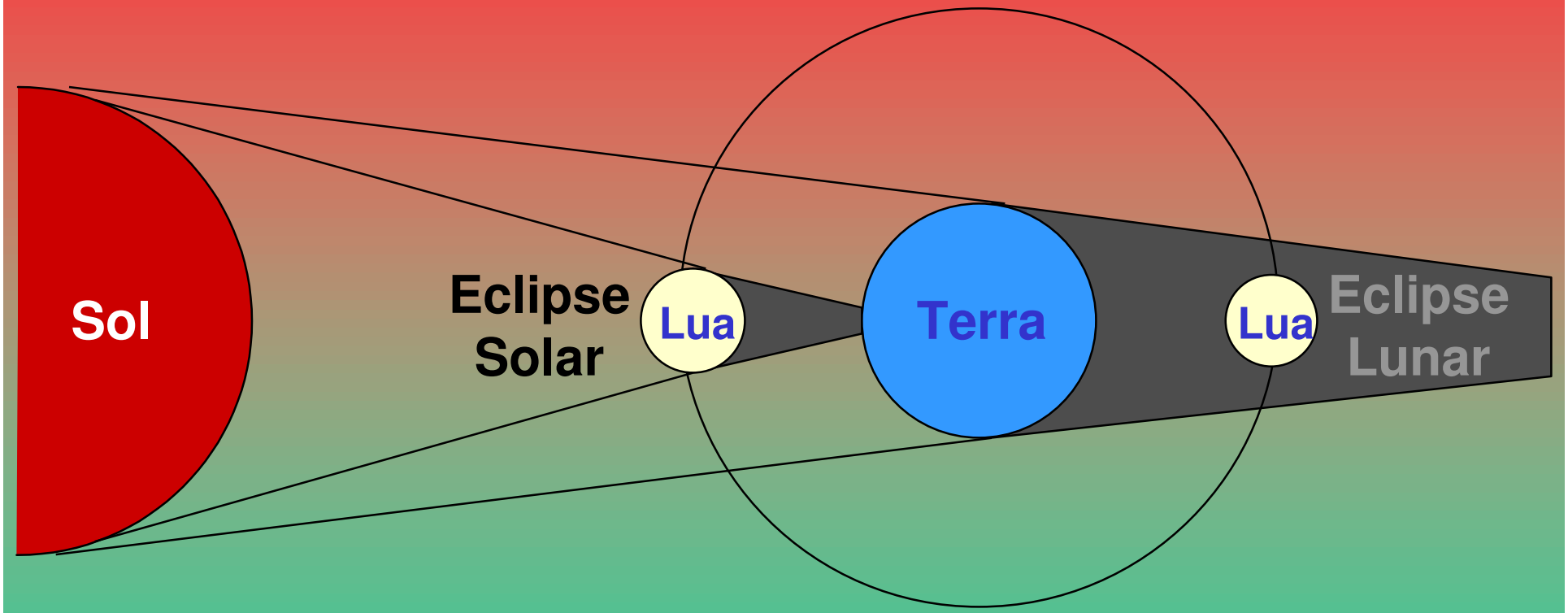






Eclipses

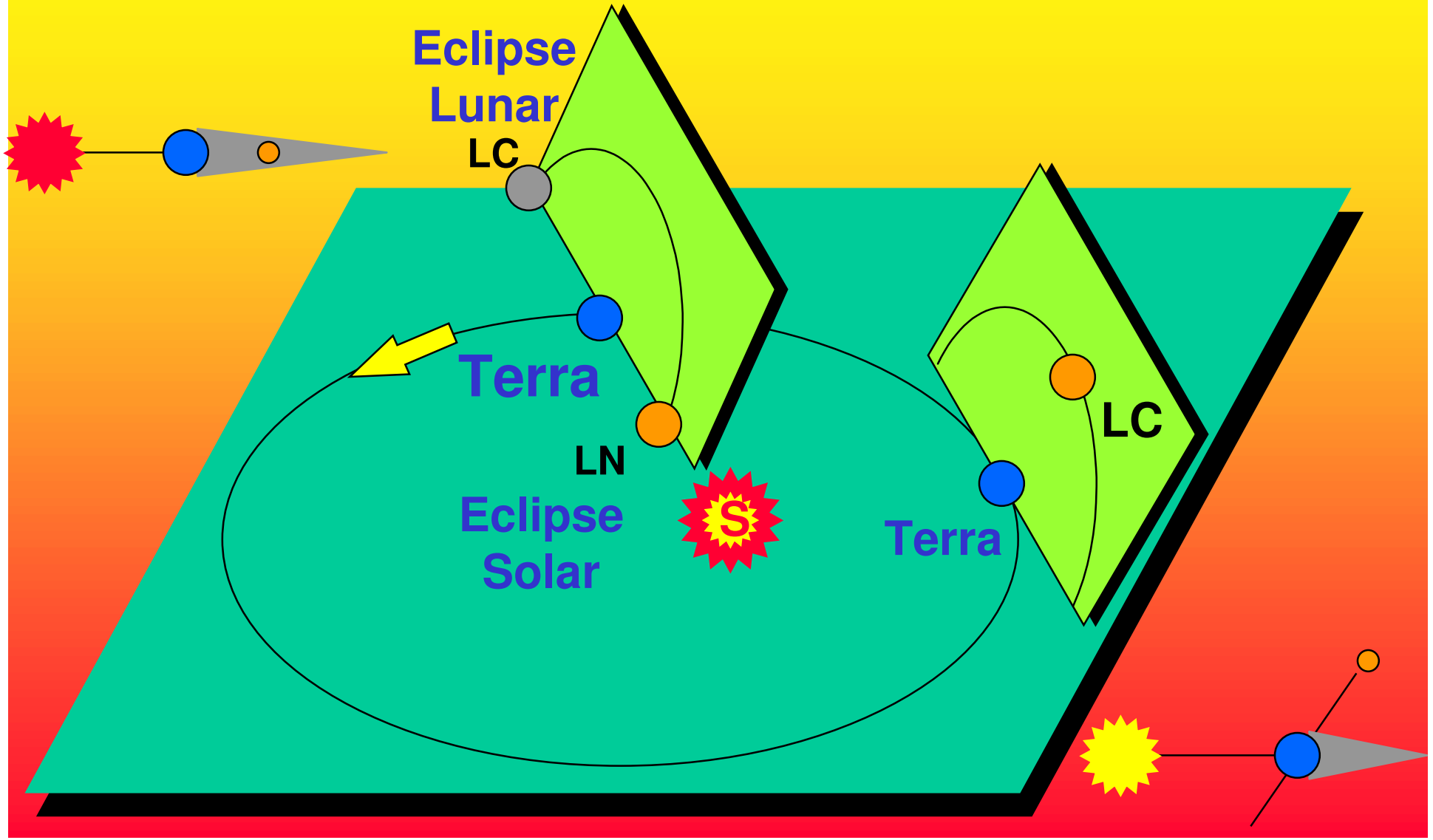
Tipos de Eclipses



Porque não ocorrem 2 ou 3 eclipses por mês?

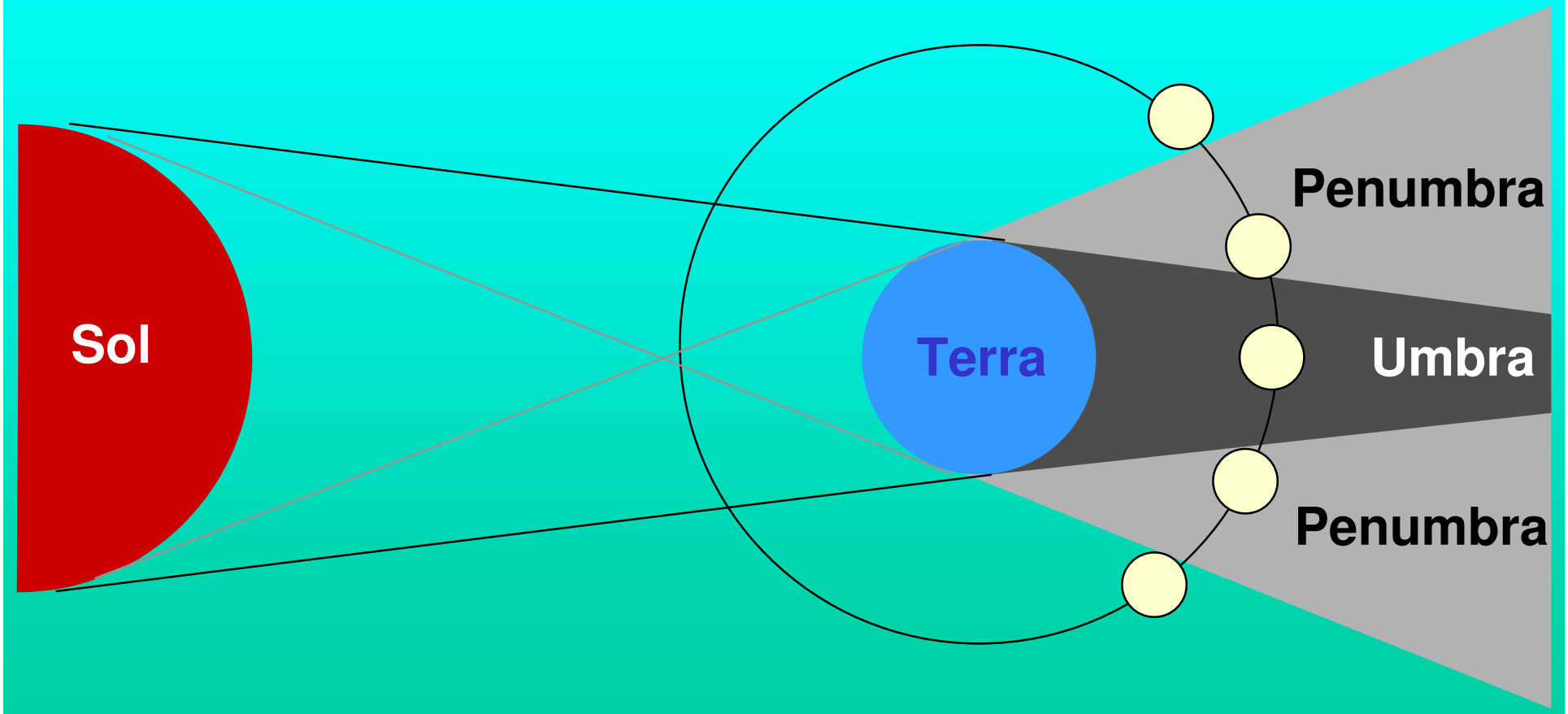
Lunação = 29,583582 dias

Eclipses e fases da Lua

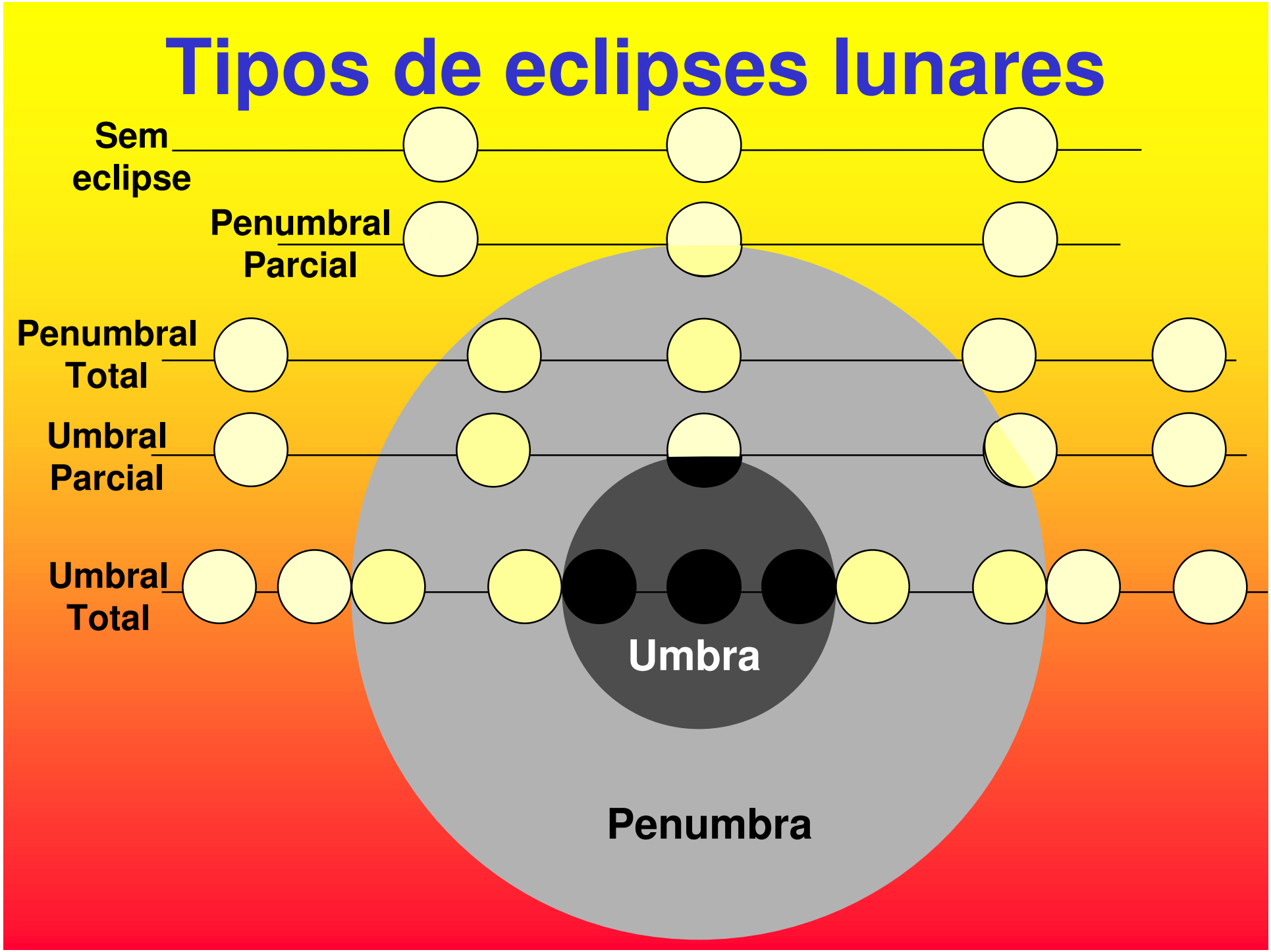


Eclipses Lunares

Ocorrência de Eclipse Lunar

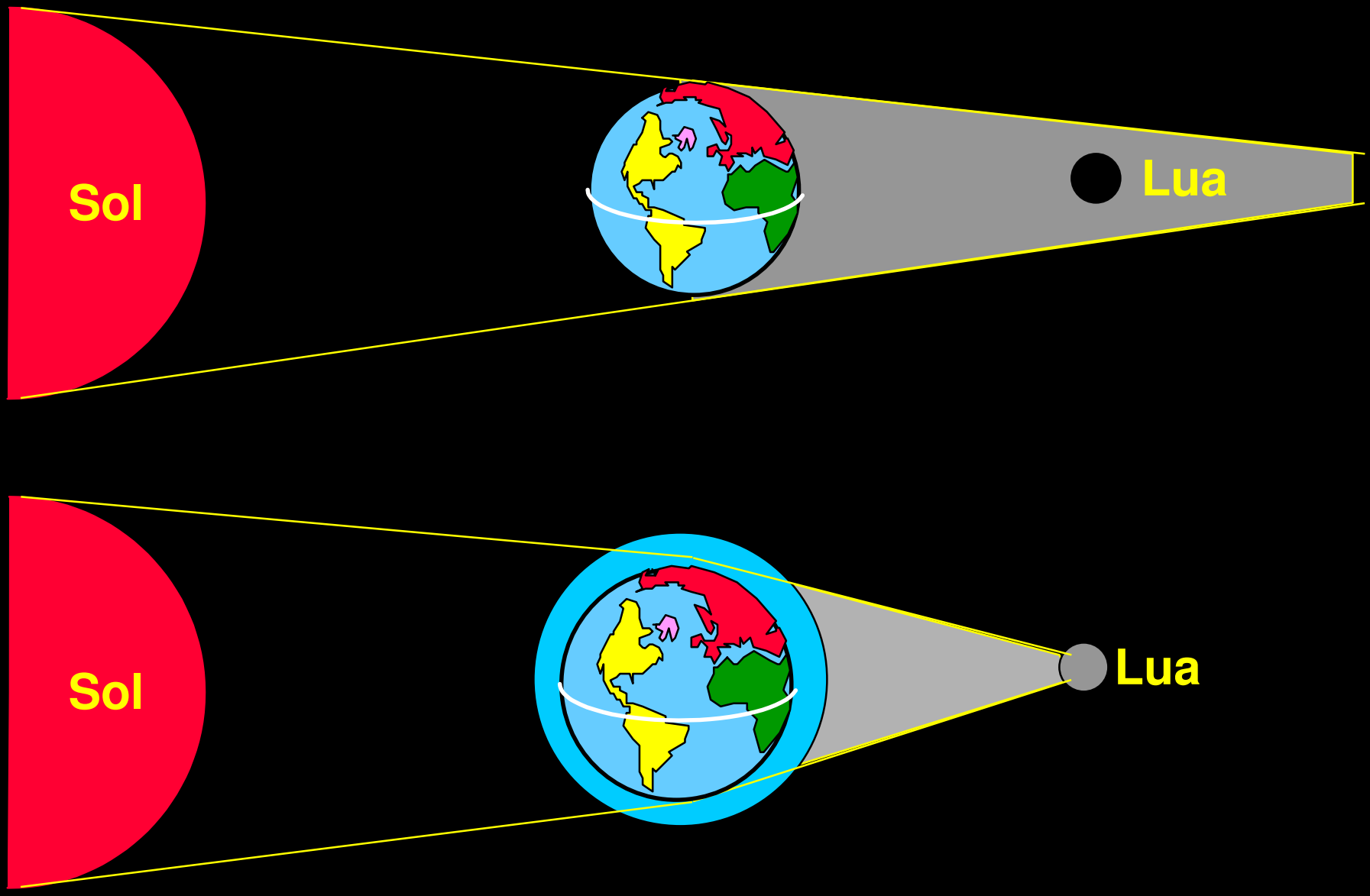


Tipos de eclipses lunares



Por que se pode ver a Lua mesmo durante um eclipse lunar total?

Iluminação da Lua no Eclipse

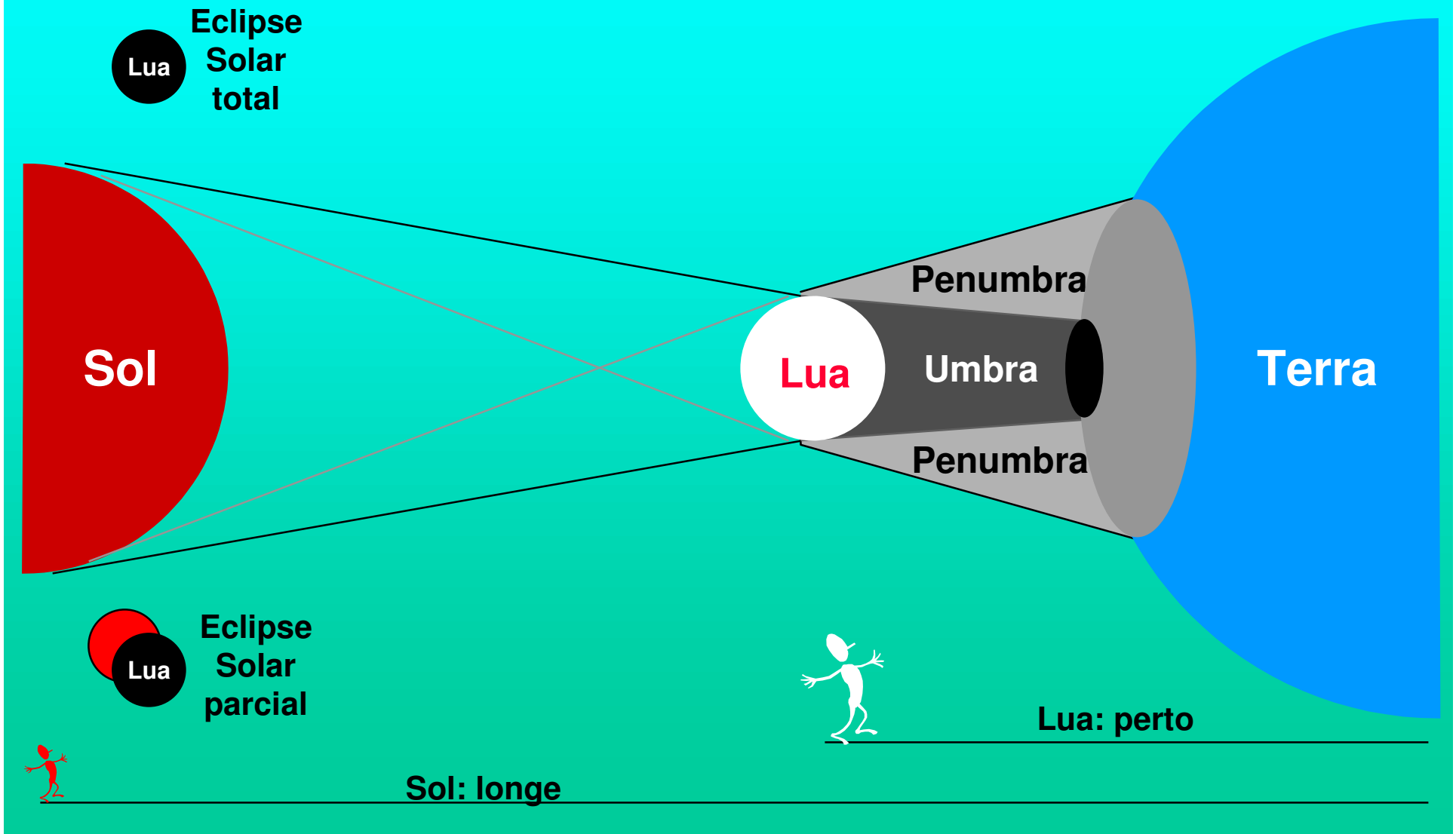


Visibilidade de um eclipse lunar

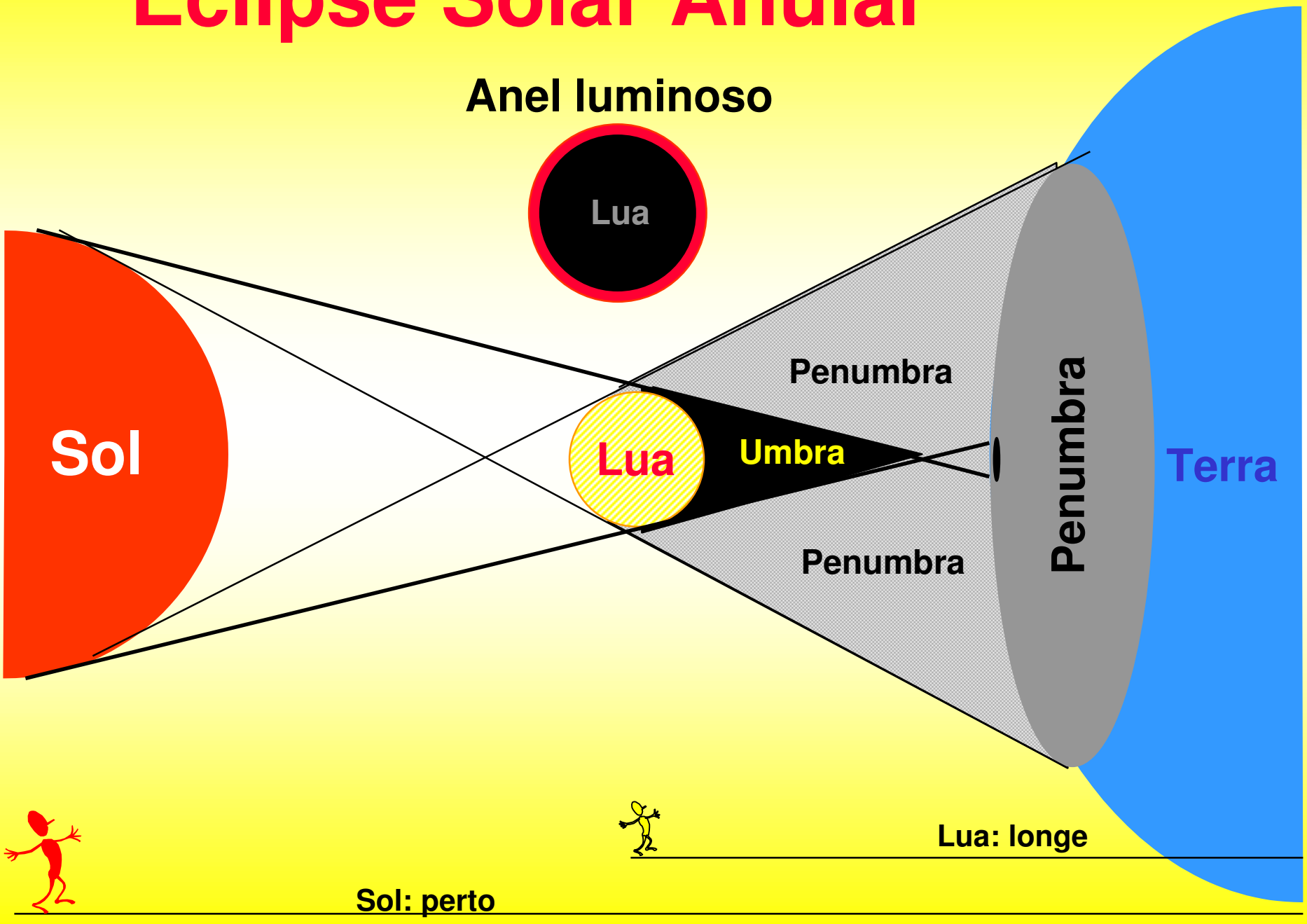
Visibilidade de um eclipse lunar

Eclipses Solares

Eclipse Solar Total ou Parcial

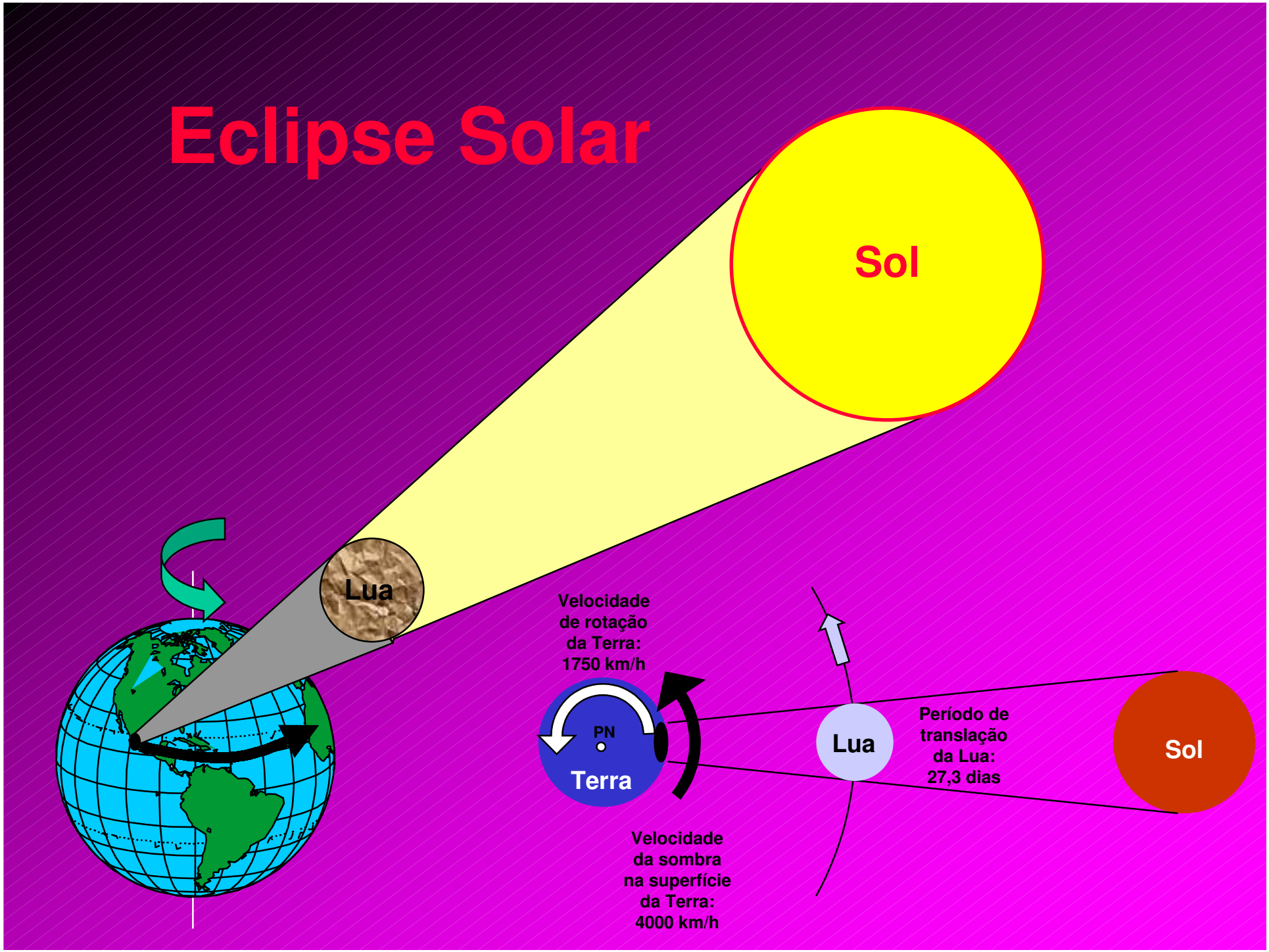


Eclipse Solar Anular

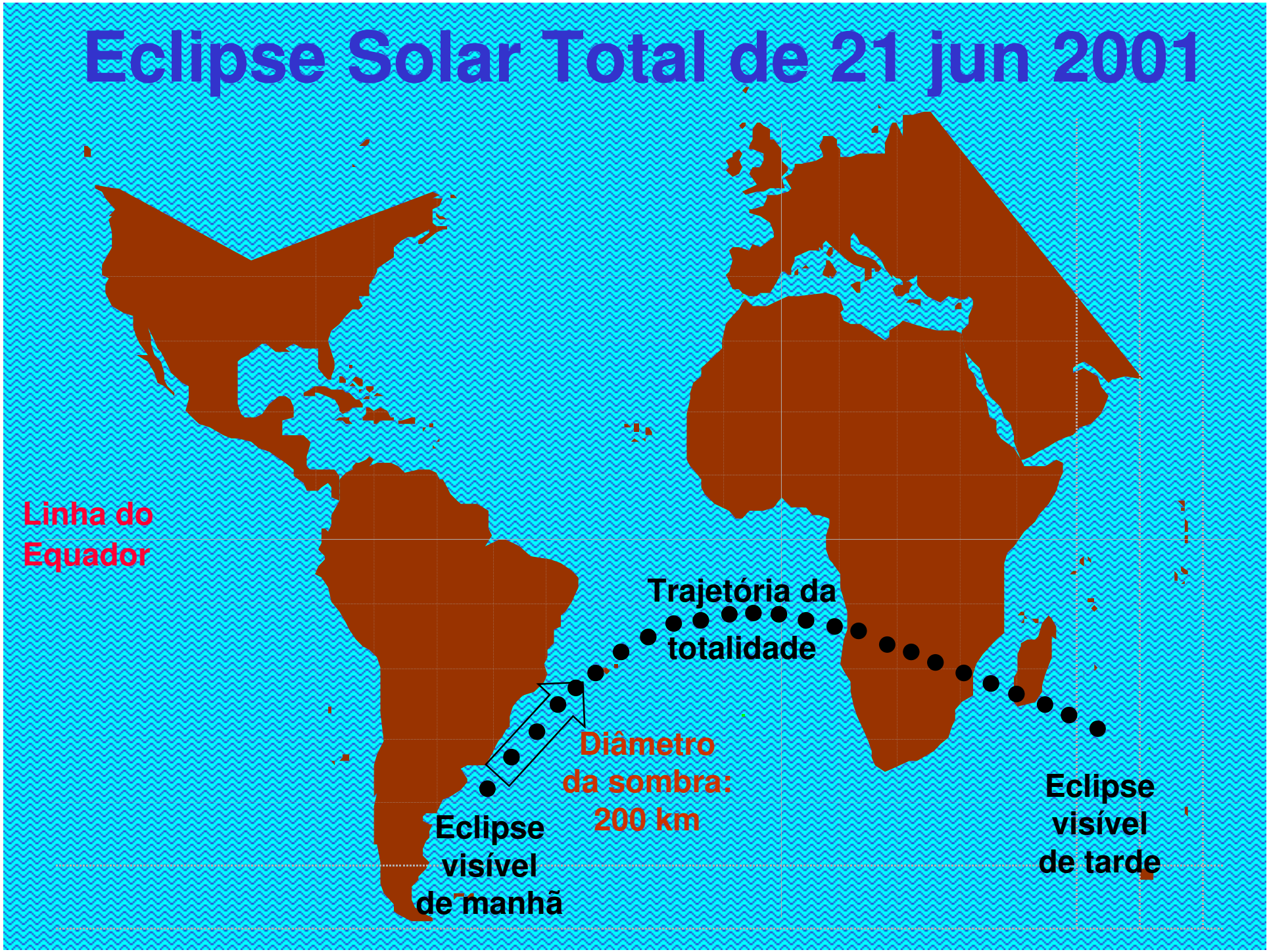


Trajetórias da sombra durante um eclipse solar

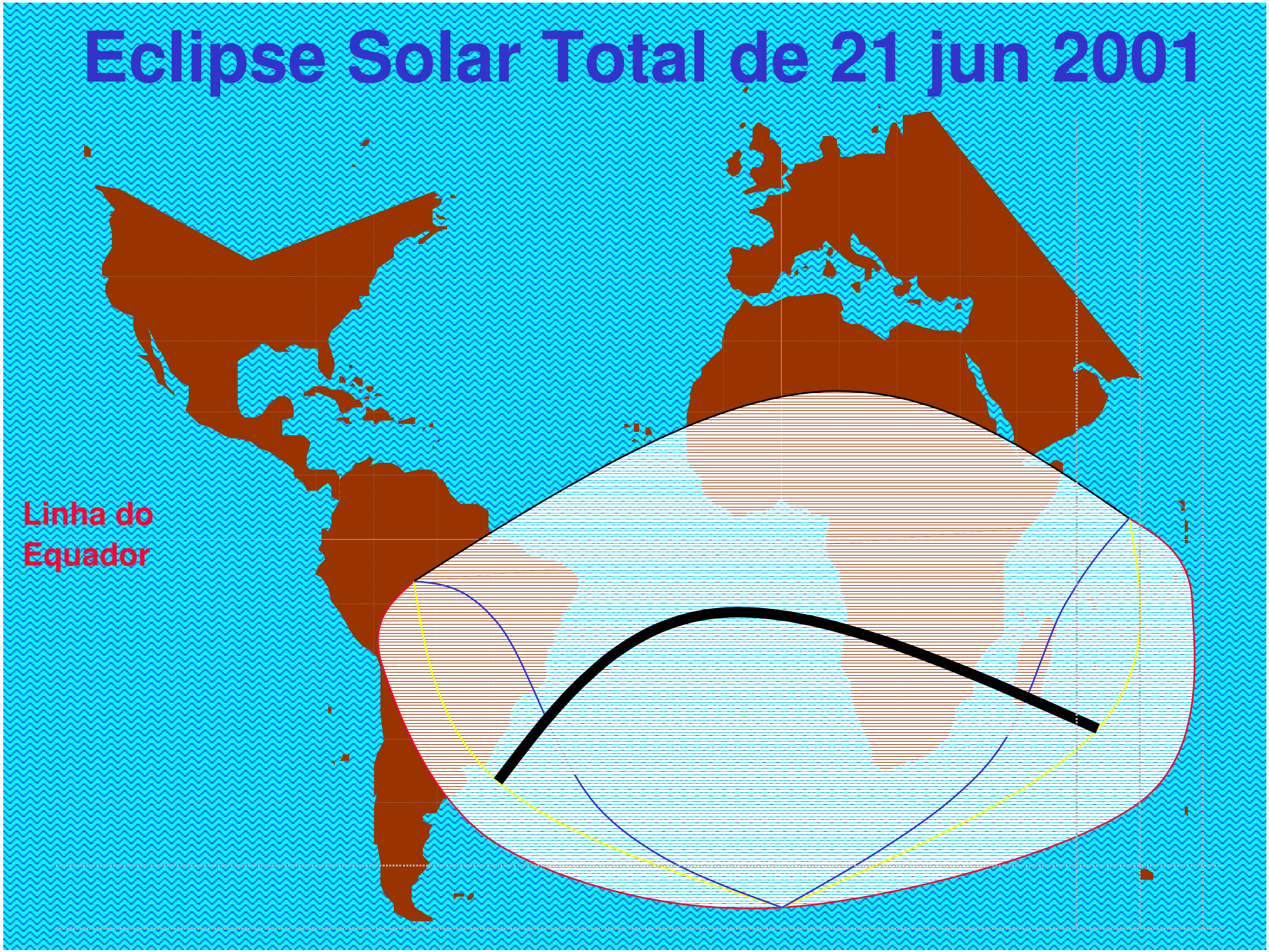
Eclipse Solar



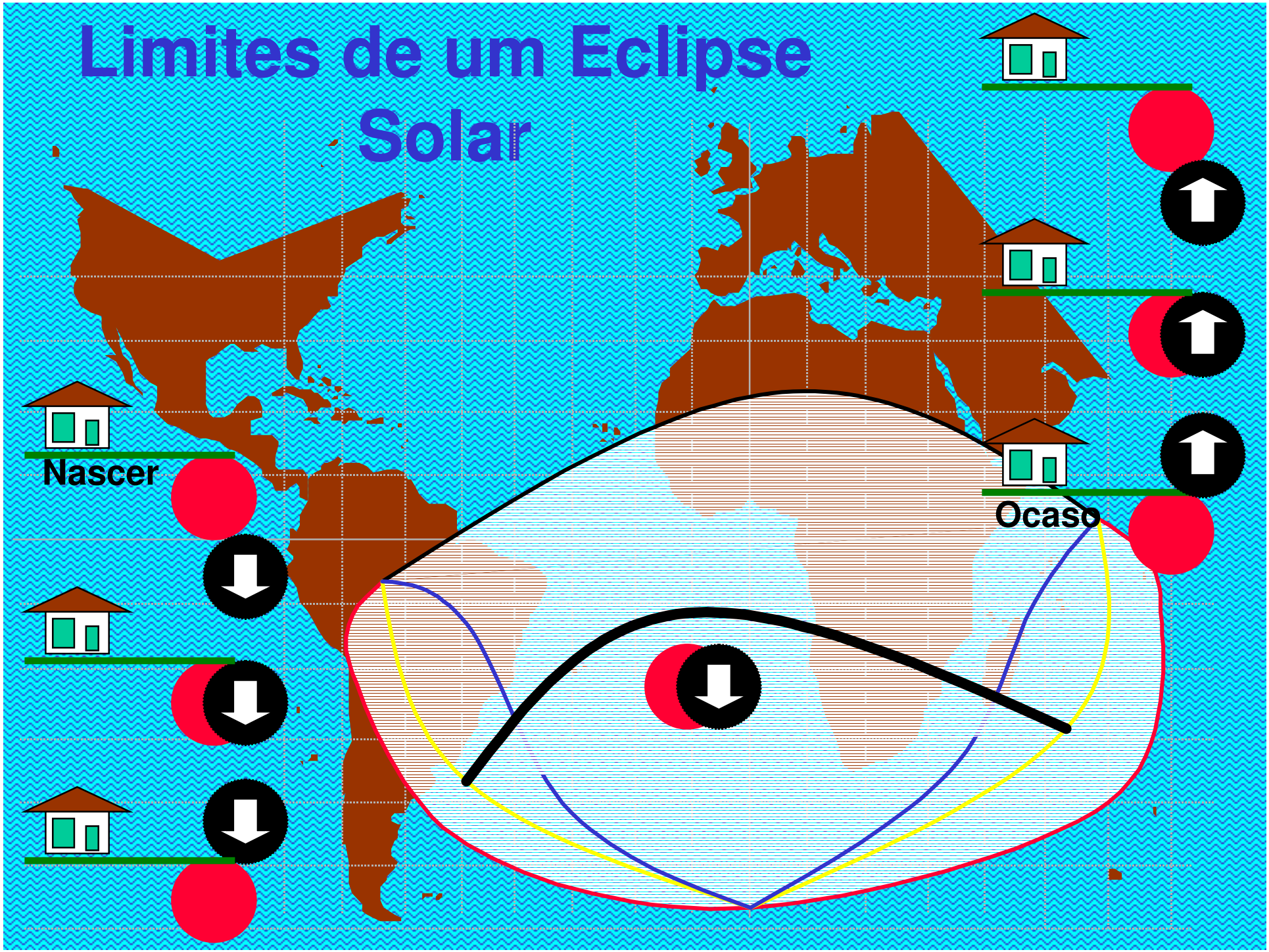
Eclipse Solar Total de 21 jun 2001



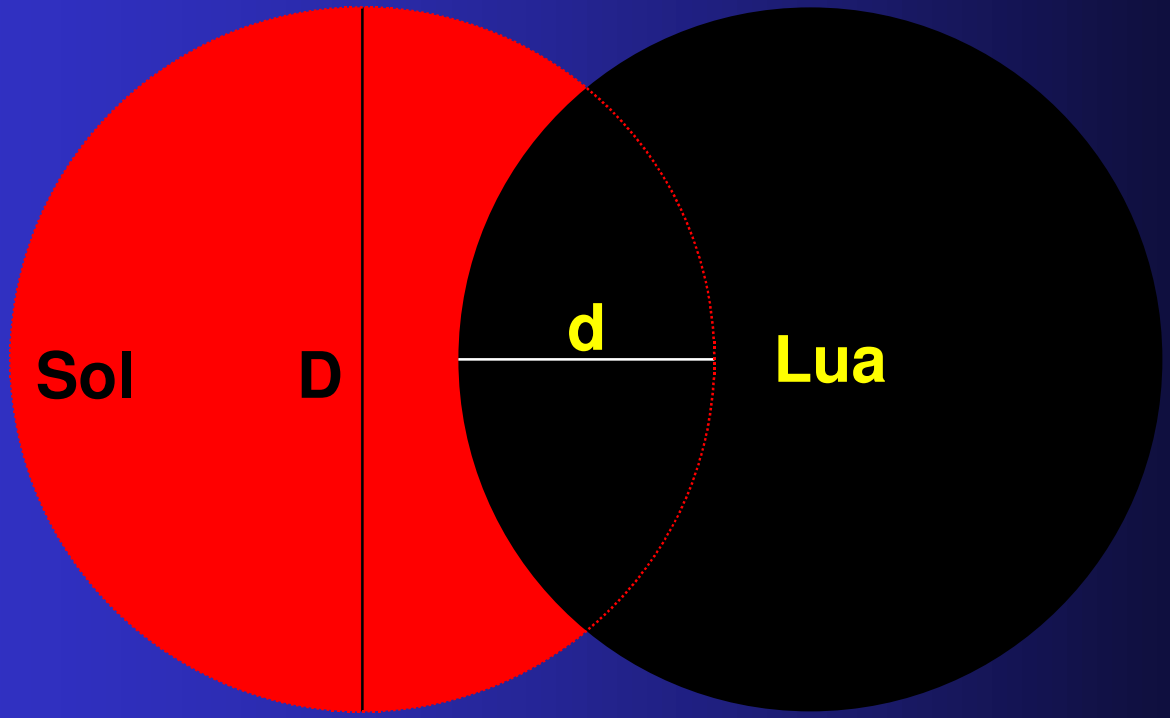
Eclipse Solar Total de 21 jun 2001



Limites de um Eclipse Solar



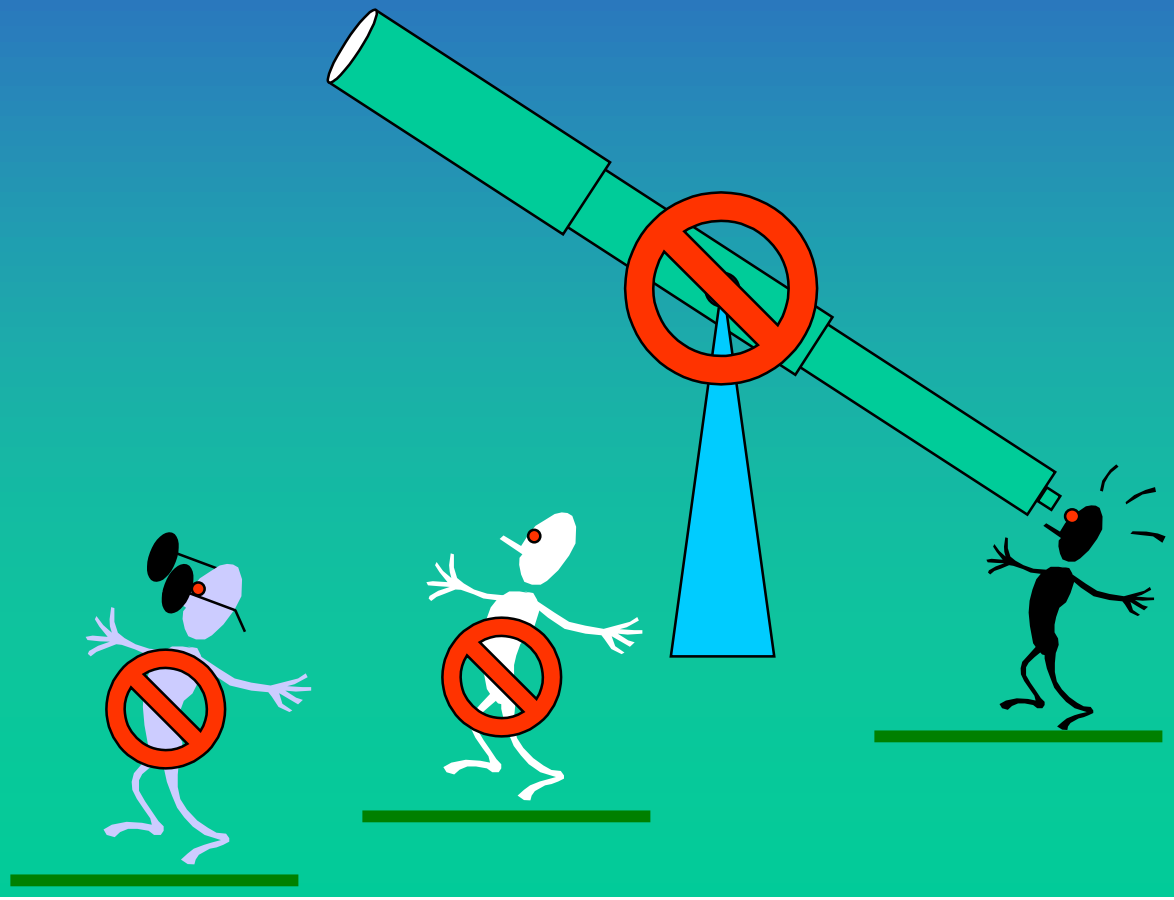
Magnitude de um eclipse



$$m = (d / D) * 100\ \%$$

Cuidados para a observação de um eclipse solar

Como não observar um eclipse



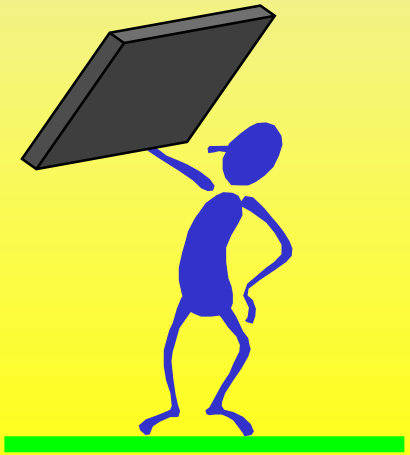
Como observar um eclipse

- Sanduíche de filmes branco e preto velados e revelados

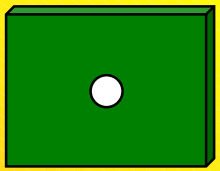
- Filme de raio X (parte bem escura)

- Vidro de máscara de soldador # 14

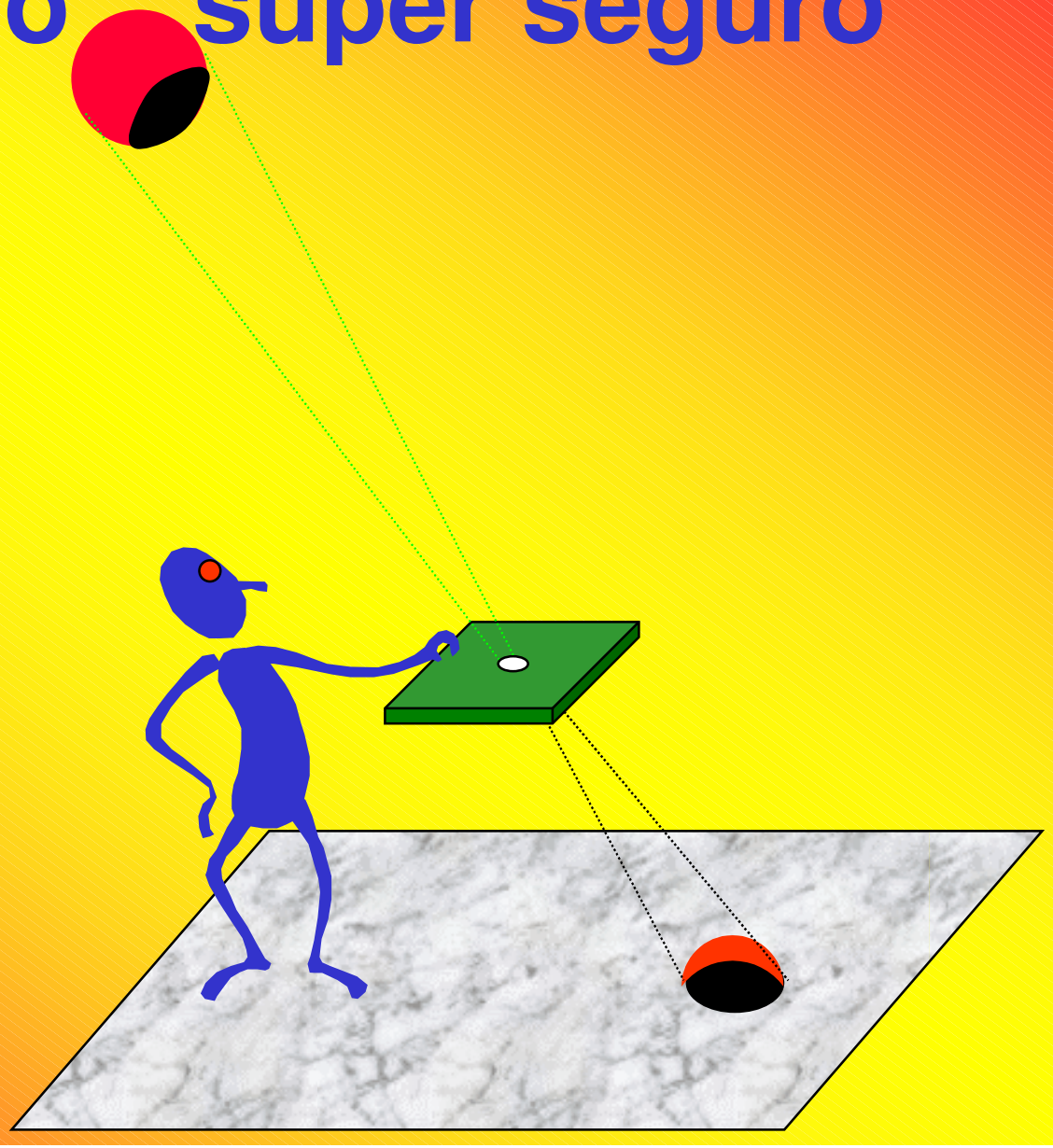
Mesmo com esses cuidados, deve-se observar por pouco tempo!!!!!!



Como observar um eclipse de modo super seguro

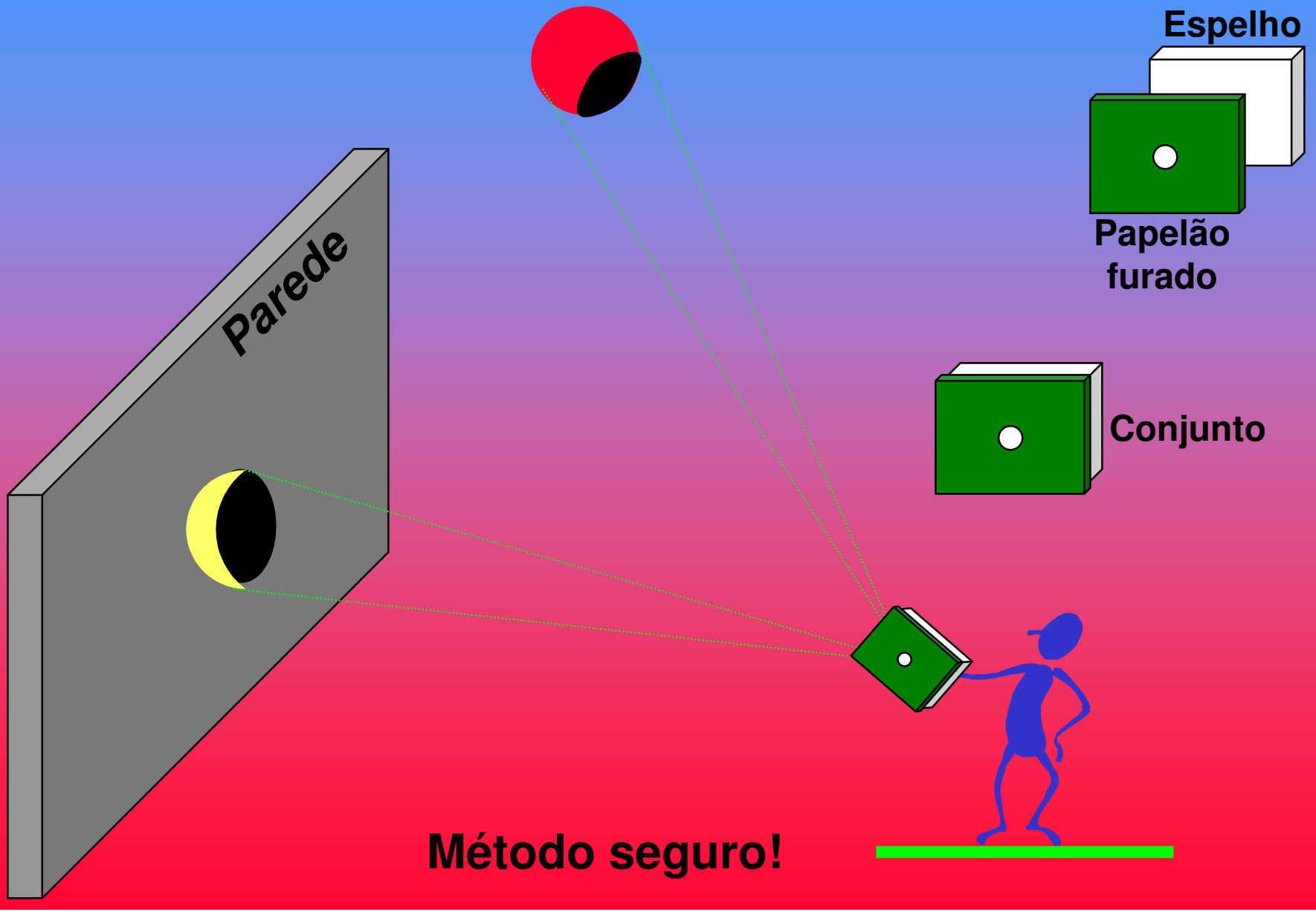


Papelão furado



Método seguro!

Como bem observar um eclipse



Método seguro!

Utilidade de um eclipse solar total

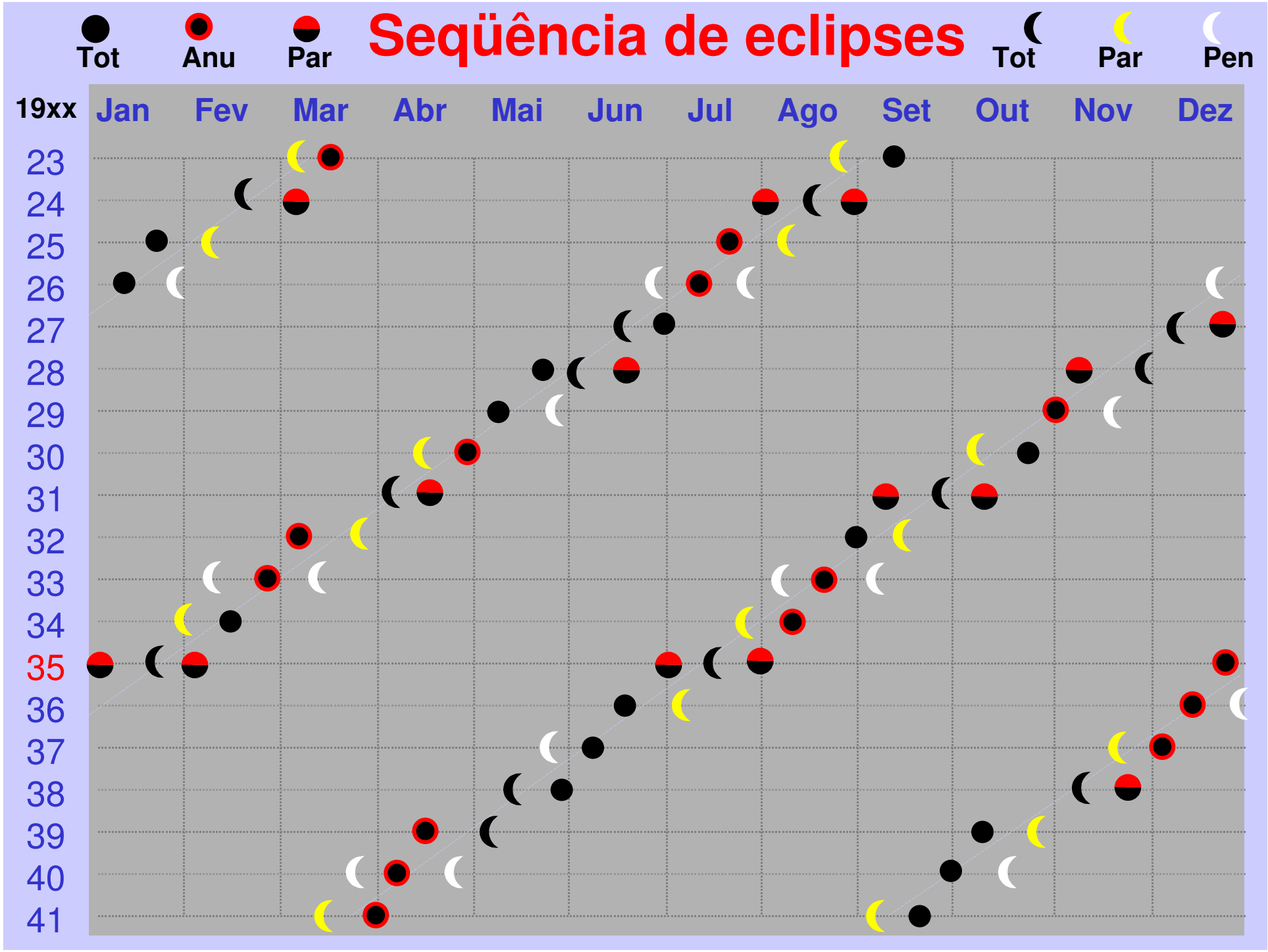
Para que observar o Sol durante o eclipse total?

Sol não eclipsado

Sol eclipsado totalmente

Fotosfera do Sol

Repetição dos eclipses


Tot
Anu
Par
Seqüência de eclipses
Tot
Par
Pen
19xx
Jan
Fev
Mar
Abr
Mai
Jun
Jul
Ago
Set
Out
Nov
Dez
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41

Repetição dos eclipses

Em média, a cada 18 anos e 11 dias temos:

43  **+ 43**  **= 86 eclipses**

Período de Saros

(Descoberto pelos antigos caldeus)

Em média, a cada 18 anos e 11 dias temos:

41  **+ 29**  **= 70 eclipses visíveis**

Não estão computados os penumbrais da Lua.

Por quê?

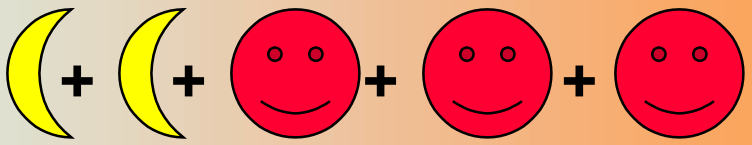
Os antigos não podiam distingui-los a olho nu!

Curiosidades

Eclipses visíveis por ano:

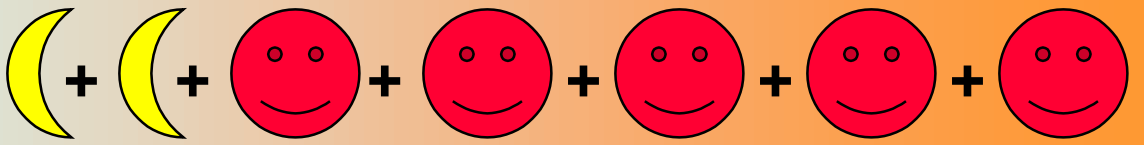
2 da Lua + 2 do Sol

2 da Lua + 3 do Sol

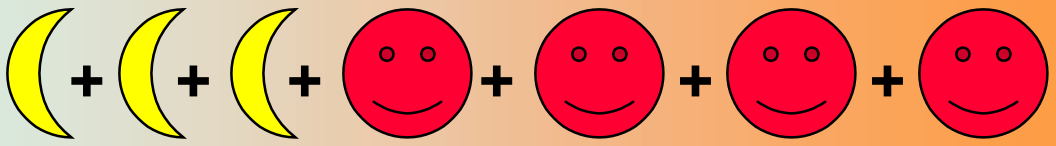


2 da Lua + 4 do Sol

2 da Lua + 5 do Sol



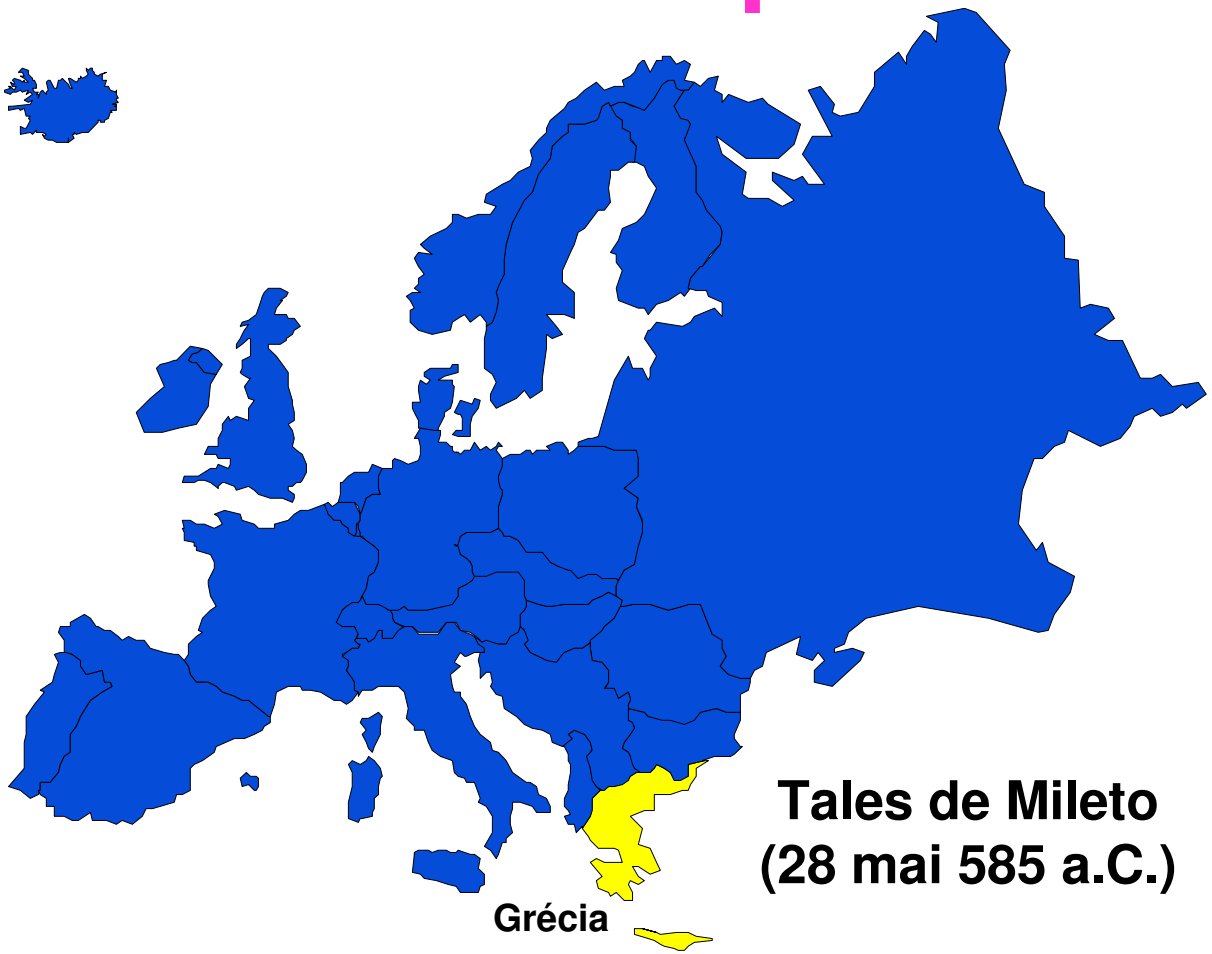
3 da Lua + 4 do Sol



Último eclipse Total do Sol visto no Brasil : 03 nov 1994

Próximo eclipse Total do Sol visível no Brasil : 02 ago 2046

Primeira previsão de um eclipse solar



Tales de Mileto
(28 mai 585 a.C.)

Assustou Medos e Lidos que estavam prestes a combater entre si

É o mais antigo evento histórico com data perfeitamente determinada

Antes de Tales : fenômenos naturais eram divinos e não compreensíveis

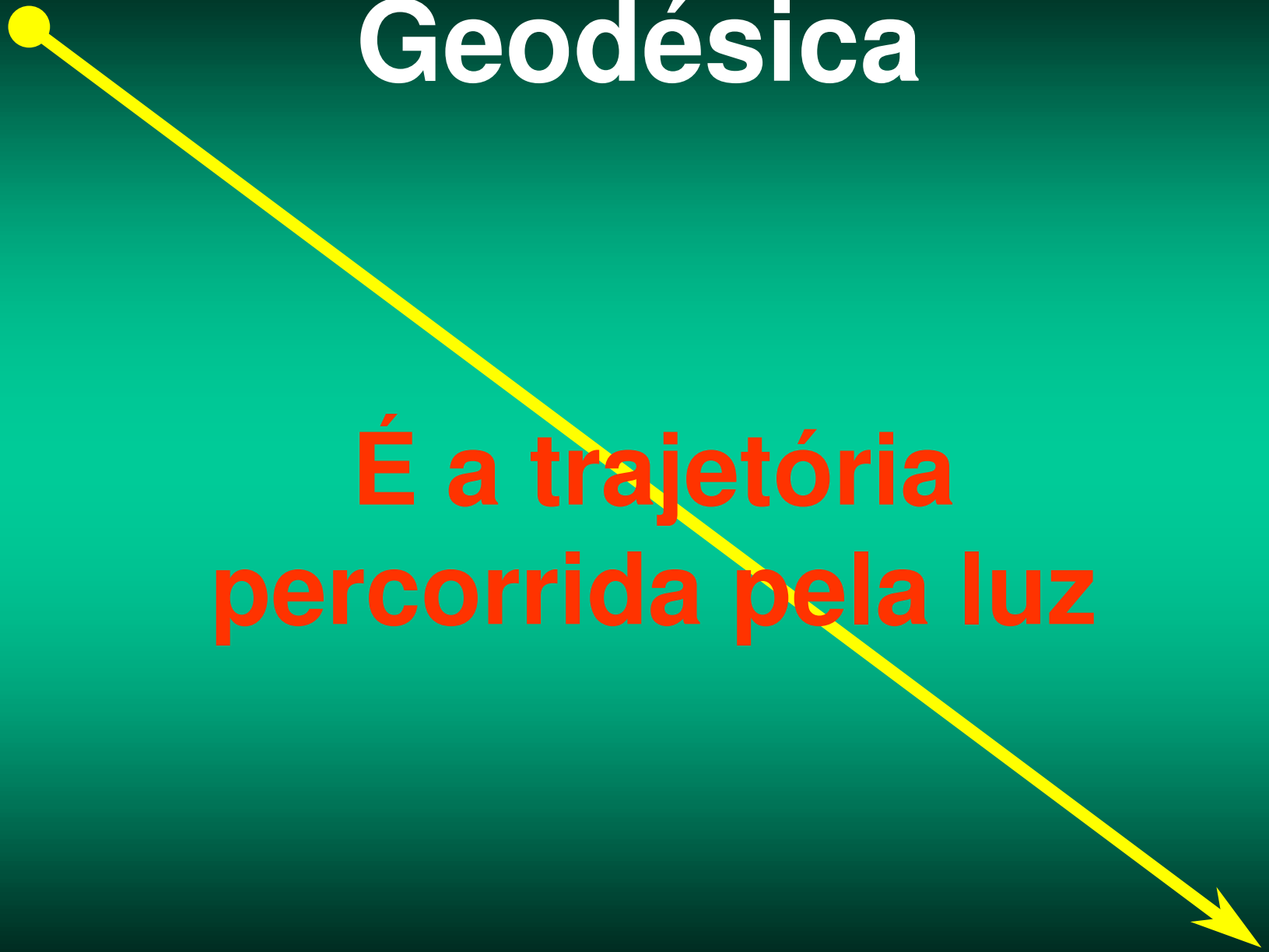
Depois de Tales: os céus passam a ser acessíveis ao pensamento humano

Alguns eclipses importantes

28 mai 585 a.C.	Primeiro eclipse previsto
18 jul 1860	Primeiro a ser fotografado
18 ago 1868	Primeira análise da composição química dos gases das proeminências
07 ago 1869	Primeira foto e análise espectroscópica da coroa solar
29 mai 1919	Confirmação da deflexão da luz num campo gravitacional (Einstein). Observado em Sobral, Ceará, Brasil

Prova da Teoria da relatividade através de um eclipse solar total

Geodésica

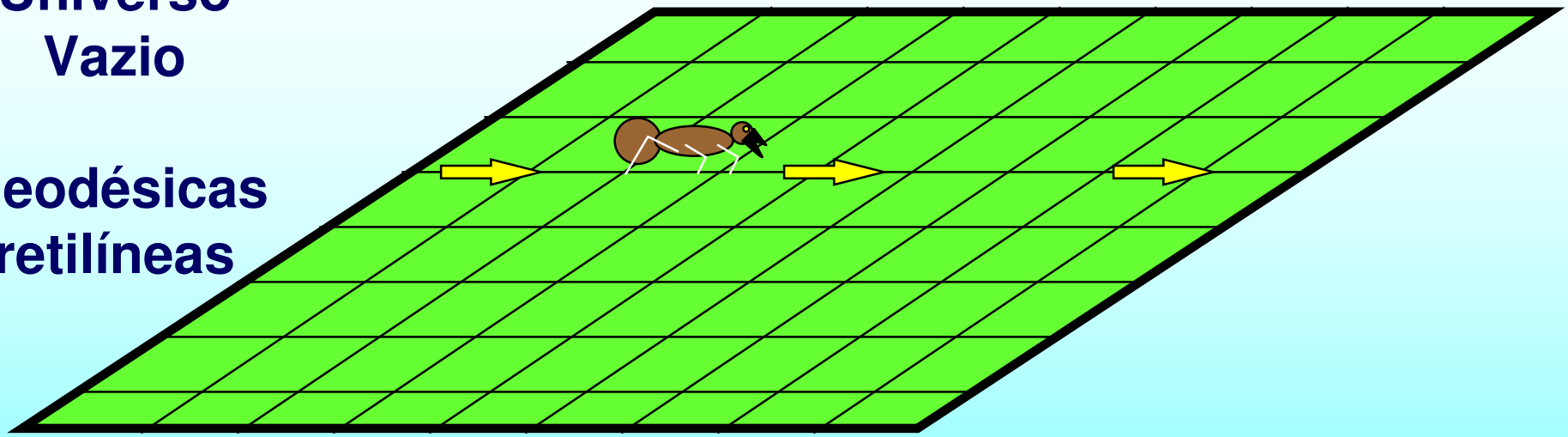


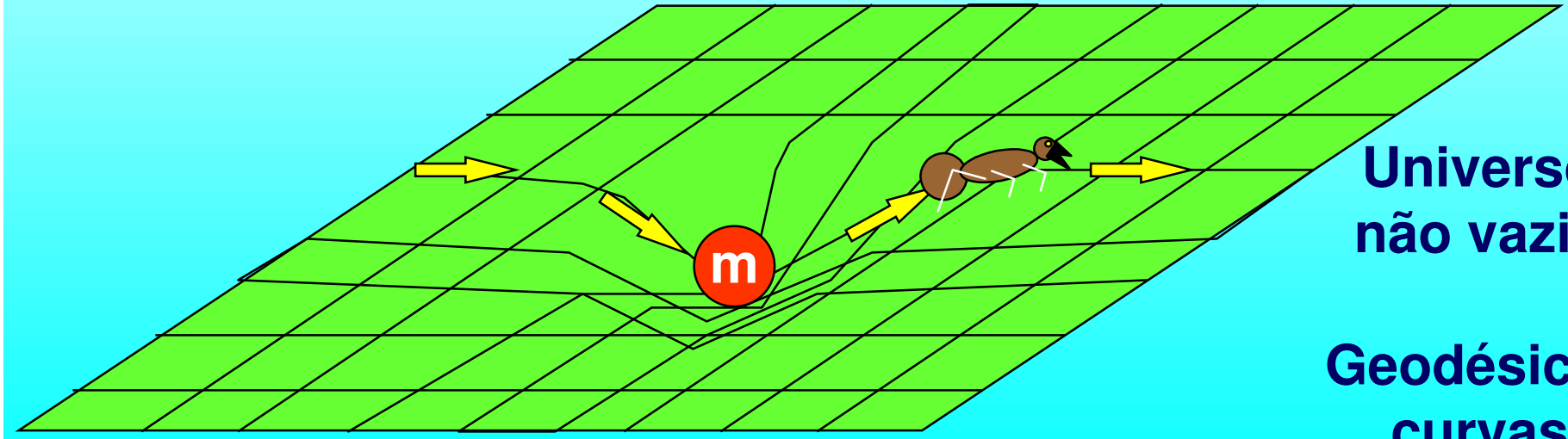
É a trajetória percorrida pela luz

Curvatura do Universo

Universo
Vazio

Geodésicas
retilíneas

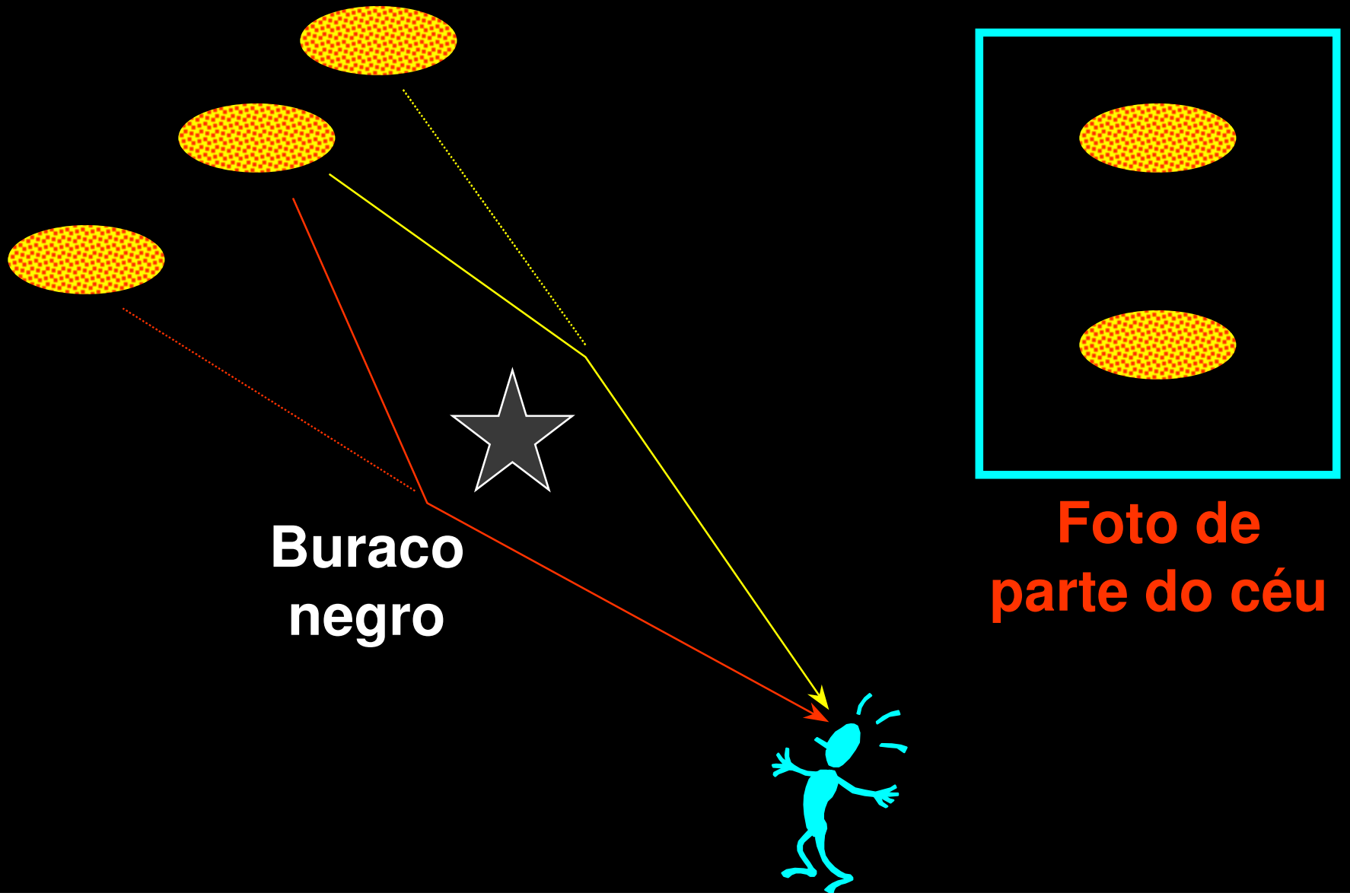




Universo
não vazio

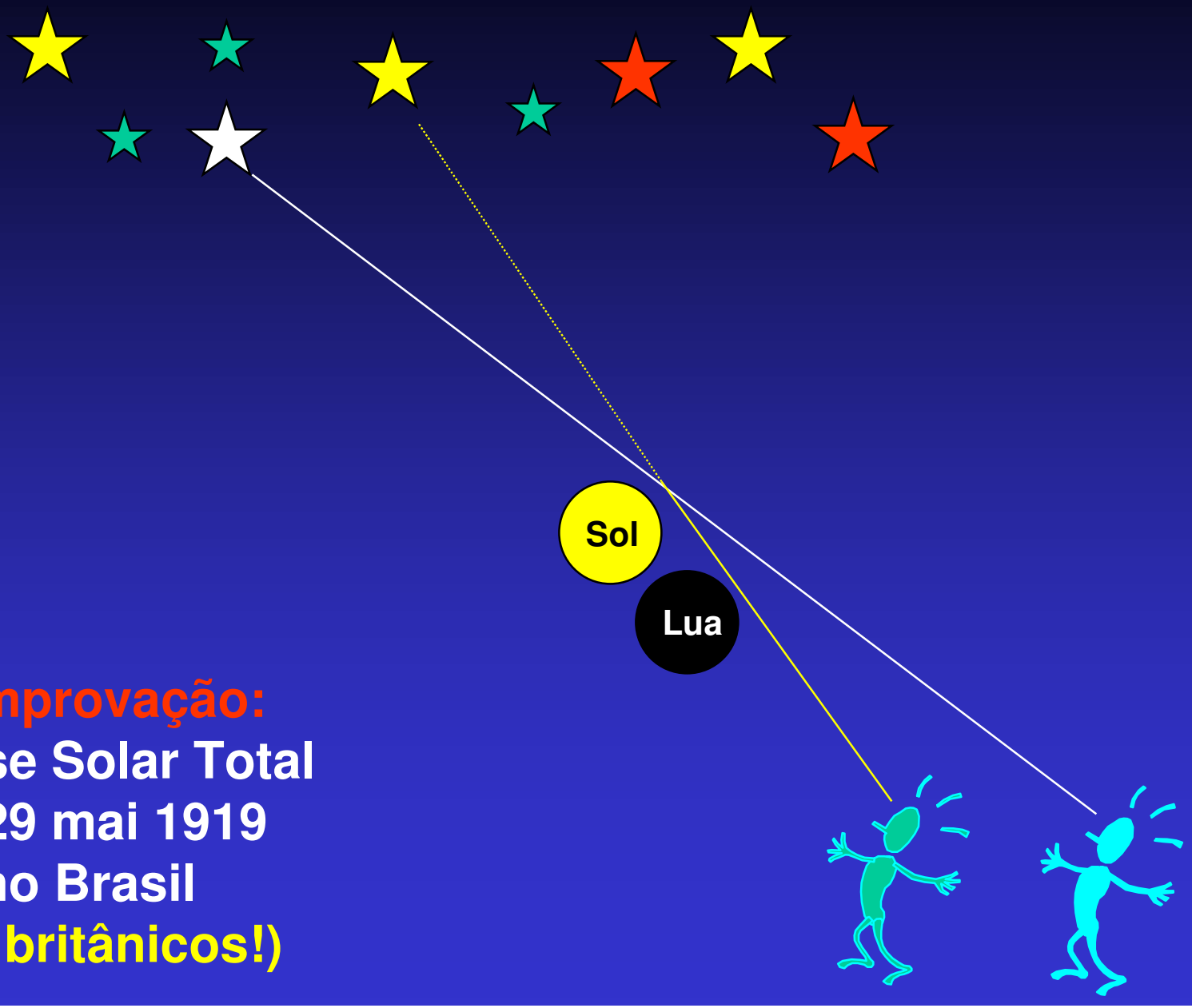
Geodésicas
curvas

Lente Gravitacional



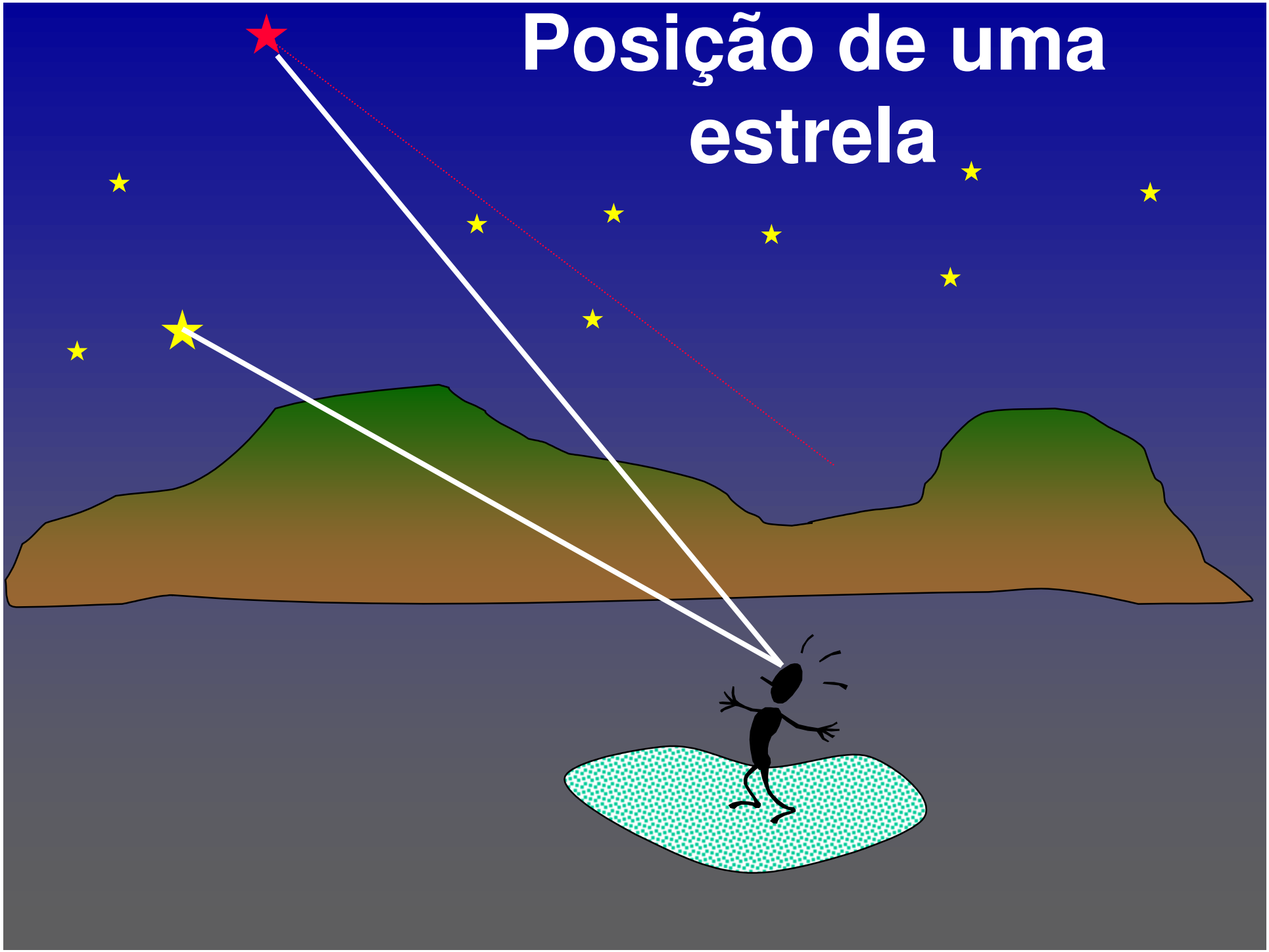
Deflexão da luz

Deflexão da luz



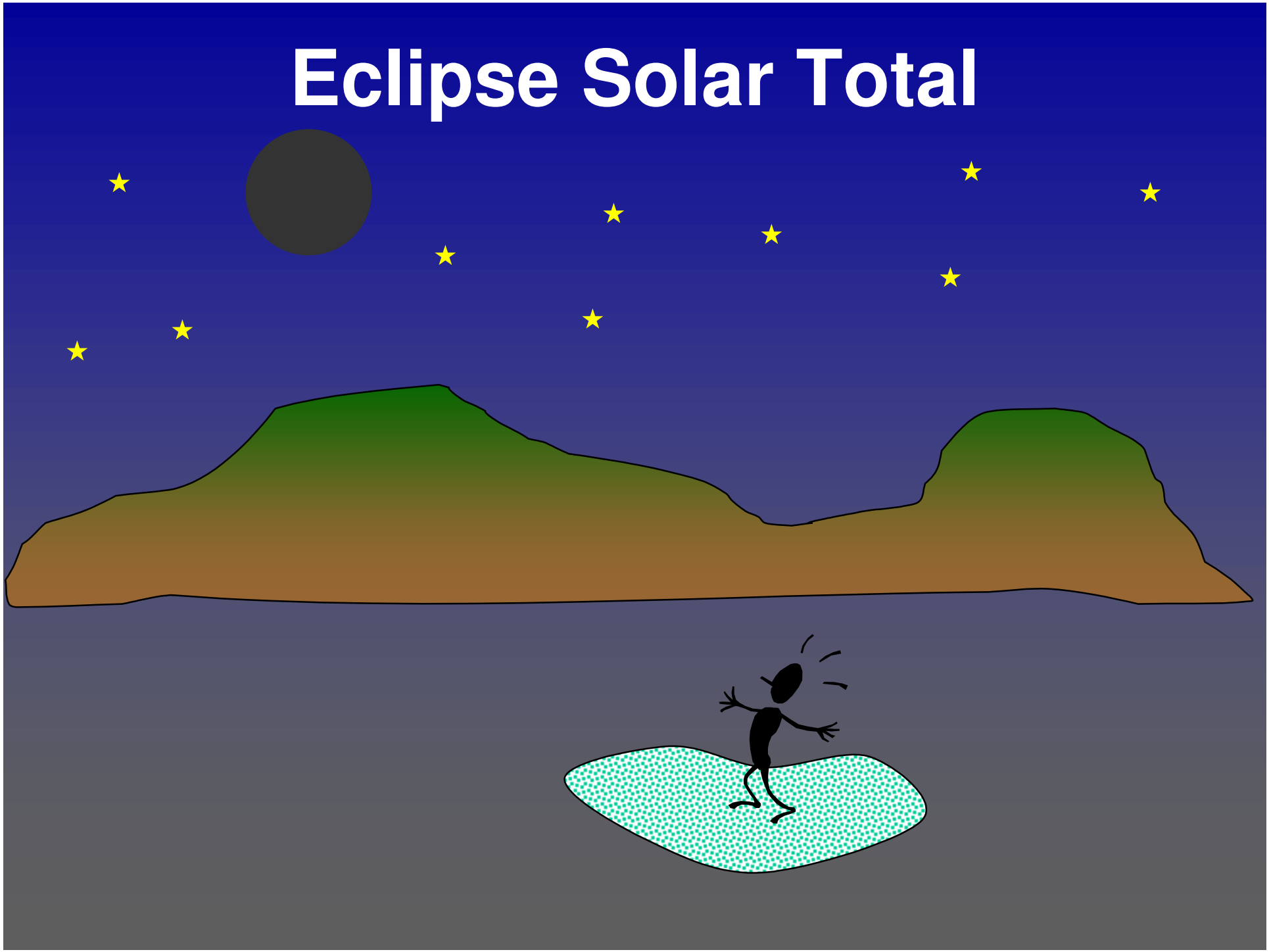
Comprovação:
Eclipse Solar Total
de 29 mai 1919
no Brasil
(por britânicos!)

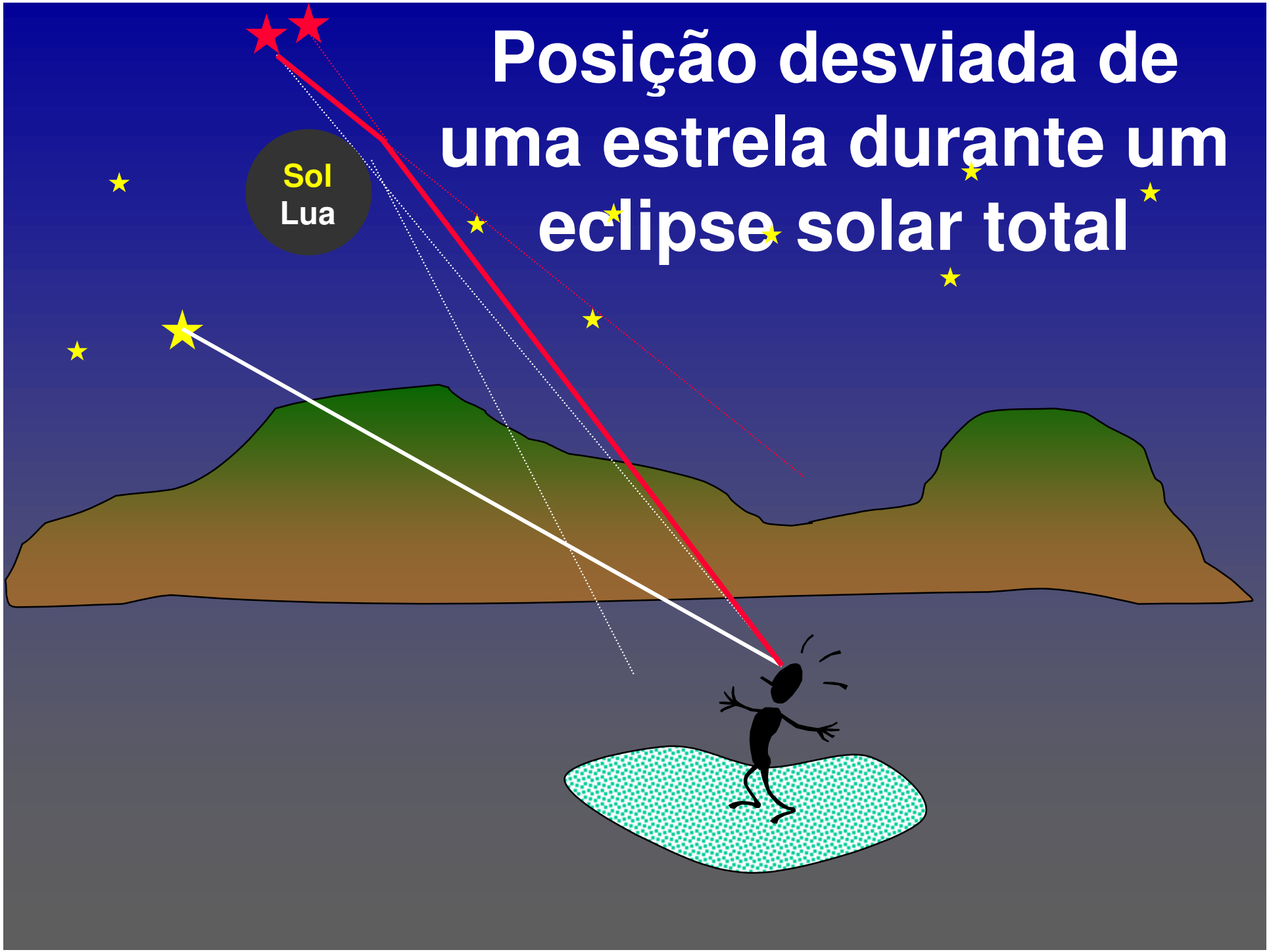
Posição de uma estrela



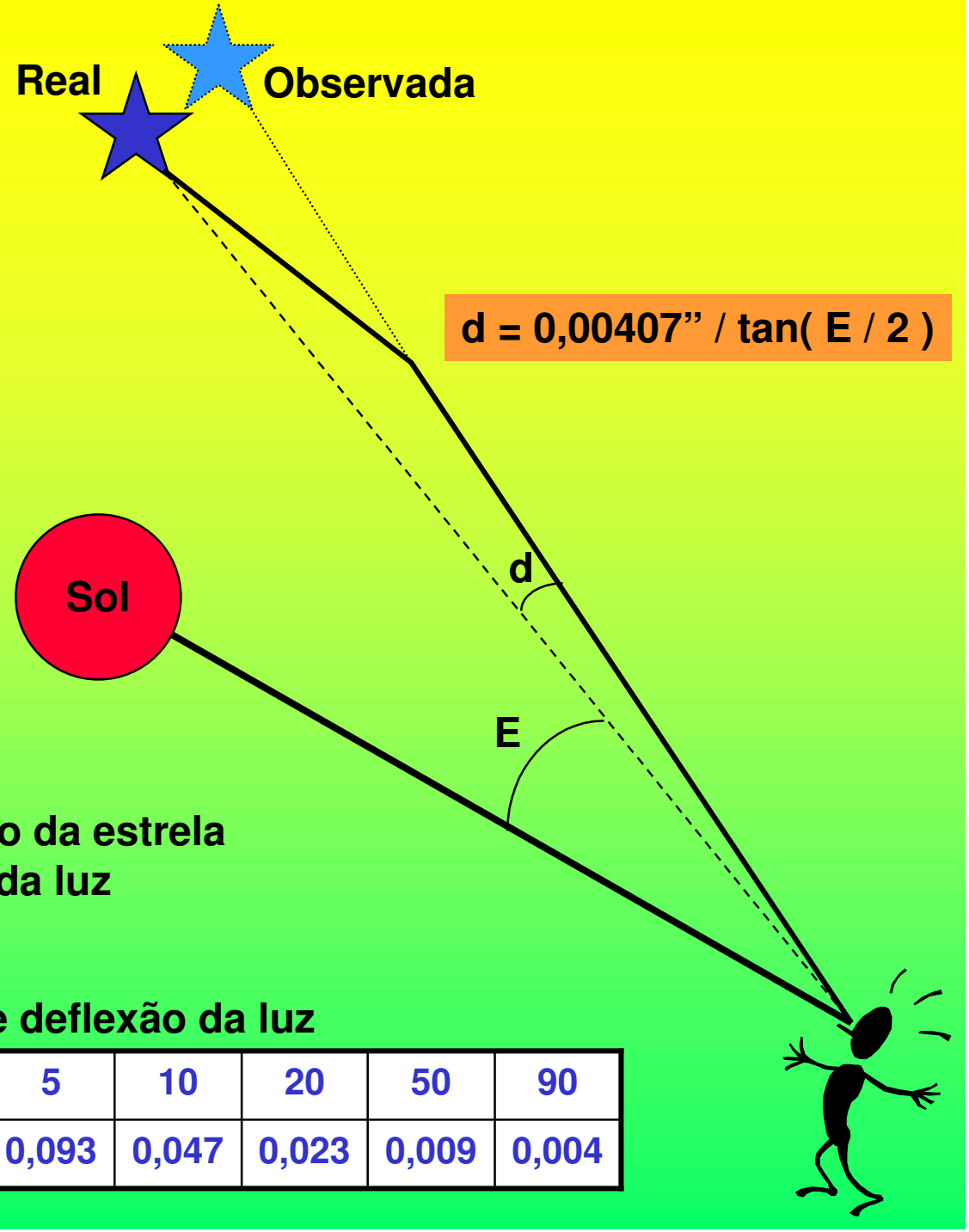
Sol visto no céu

Eclipse Solar Total




Posição desviada de uma estrela durante um eclipse solar total
Sol
Lua

Deflexão da luz nas proximidades do Sol



$$d = 0{,}00407'' / \tan(E / 2)$$

E = elongação da estrela
d = deflexão da luz

Alguns valores de deflexão da luz

E (º)	0,25	0,5	1	2	5	10	20	50	90
d (“)	1,866	0,933	0,466	0,233	0,093	0,047	0,023	0,009	0,004

Arquivo de eclipses

Canon der Finsternisse

Theodor von Oppolzer
(1841-1886)

Eclipses do Sol e da Lua
desde 1207 a 2161

(sem penumbrais da Lua)

Fim