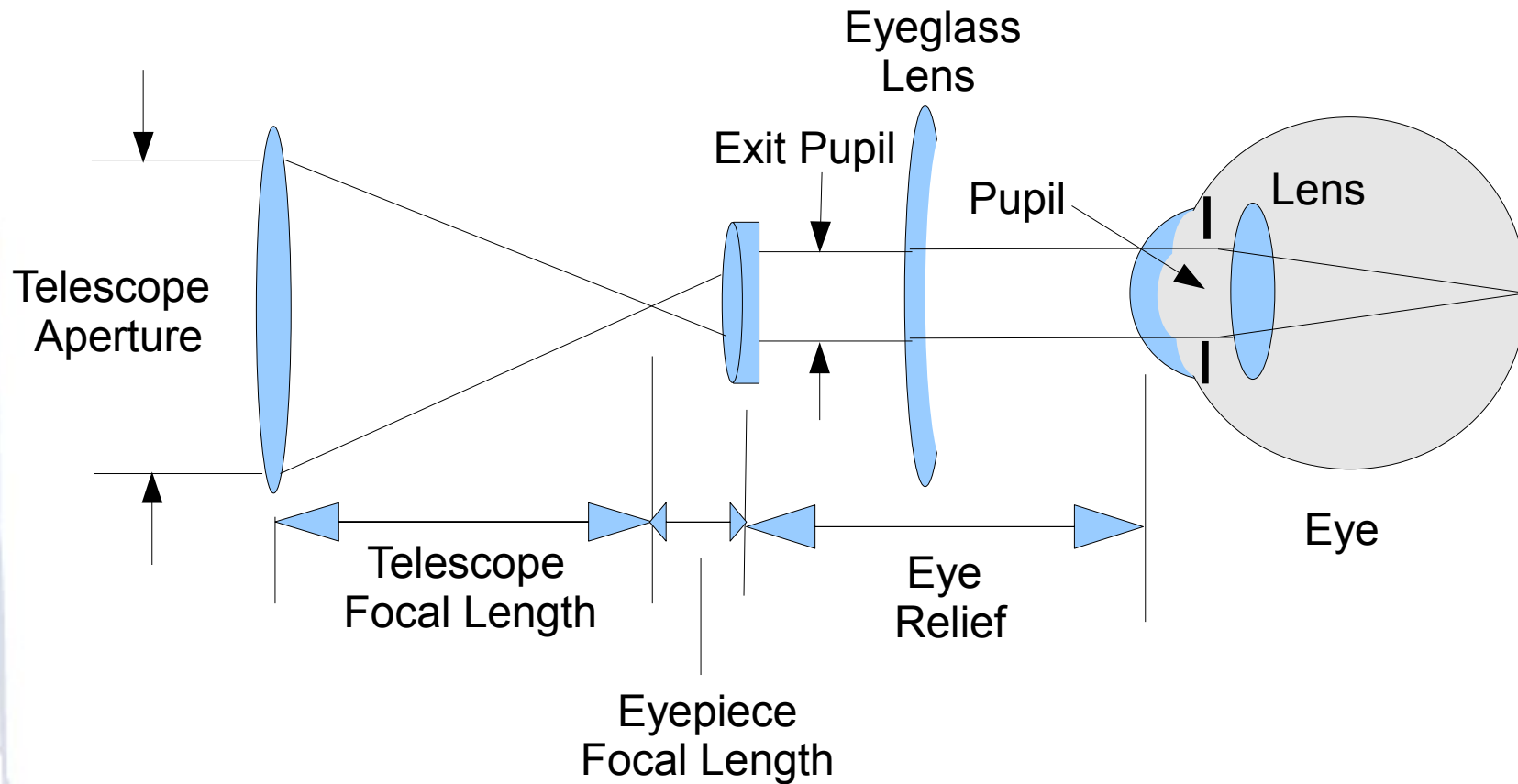


Telescope-Eyepiece-Eye System

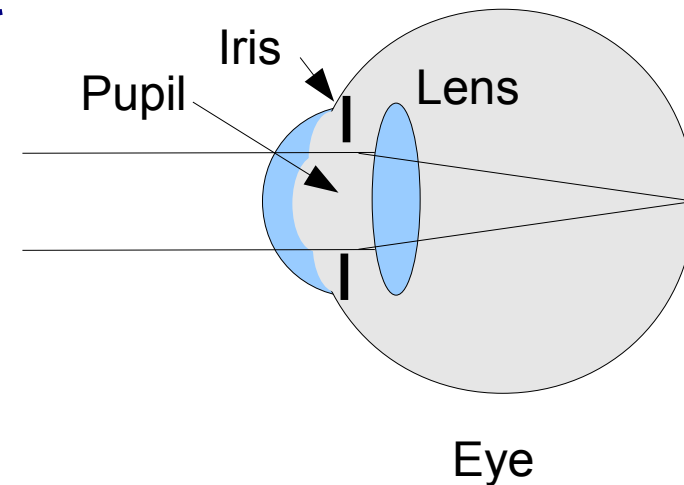
12-March-2010

Telescope-Eyepiece-Eye System



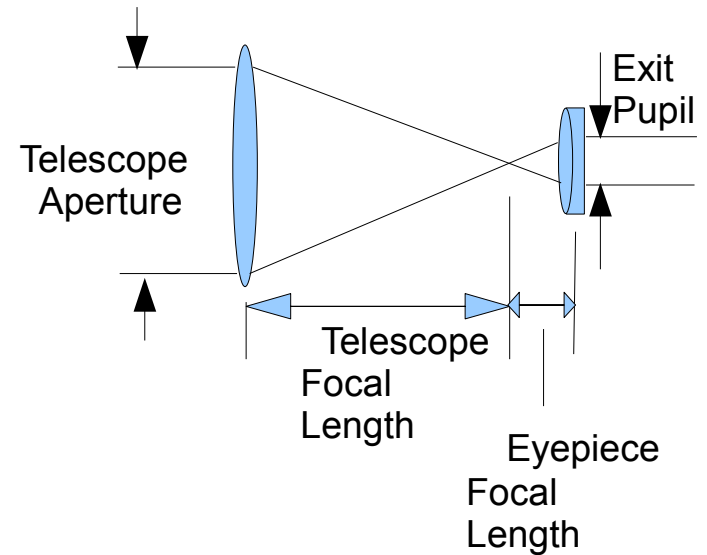
Facts About the Eye

- Pupil controls the amount of light that reaches the back of the eye
- In dark adapted eye, the pupil will range between 5-7mm in diameter
- The bad news is as we age our pupil does not dilate as much – closer to 5 or 6 mm
 - Age < 35 use 7mm



Telescope-Eyepiece

- Magnification = Telescope focal length / Eyepiece focal length
 - $\text{Mag} = \text{TFL} / \text{EFL}$
- Exit pupil = Telescope aperture / Magnification
 - $\text{EP} = \text{Tap} / \text{Mag}$
 - OR**
 - $\text{EP} = \text{EFL} / \text{F-number of scope}$
- **Rule:** when choosing an eyepiece remember the Exit pupil **AND** the capabilities of your eye!
 - Range of exit pupil 1 – 5,6,7mm
 - Sweet spot for your eye is 2mm



Example Eyepiece Selection

F10 Telescope

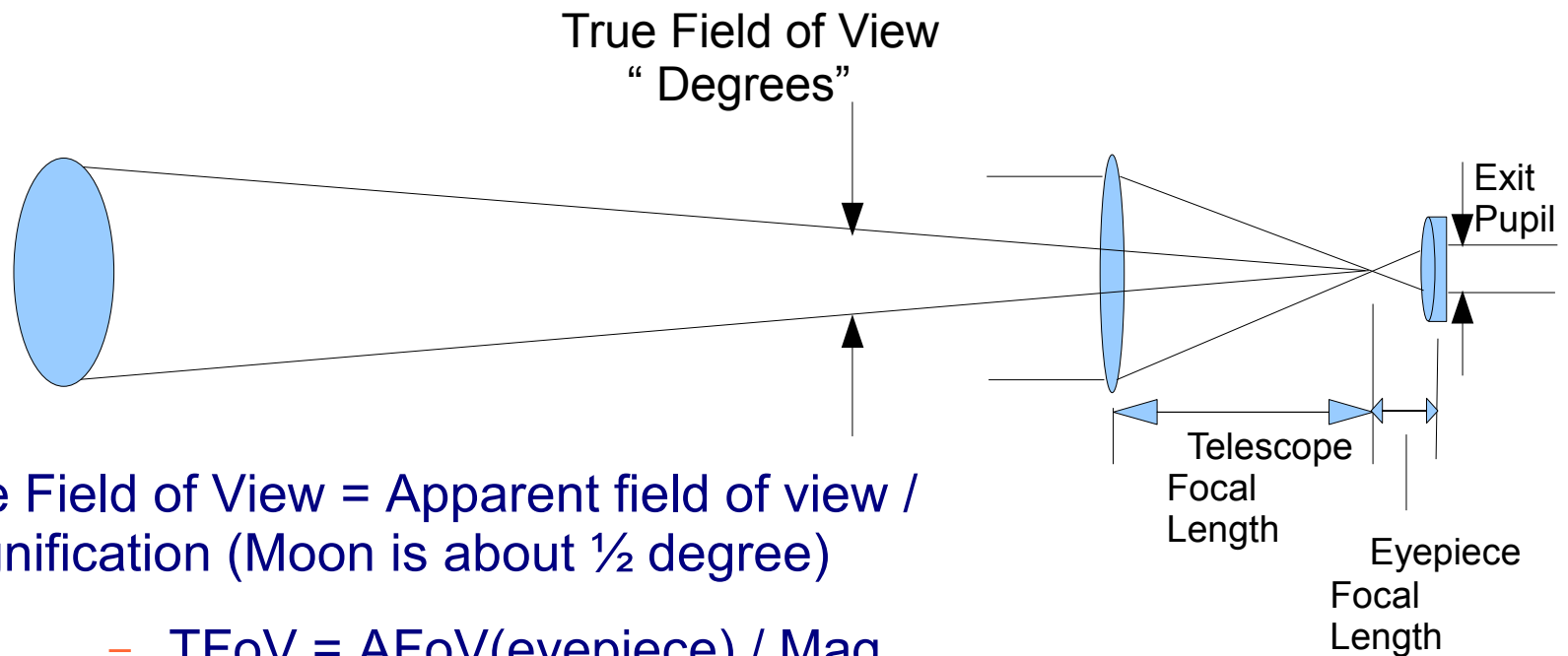
- Telescope has 1500mm focal length and aperture of 150mm. What eyepieces would give min and max viewing capabilities?
 - Minimum would have 1mm exit pupil.
 - Maximum would have 7,6,5 mm exit pupil
 - Best overall would have 2mm exit pupil

Example Eyepiece Selection Cont.

- If you know the telescope F-ratio and desired exit pupil, the eyepiece focal length can be found in the table below:

F Ratio	EFL EP=1	EFL EP=2	EFL EP=5	EFL EP=6	EFL EP=7
5	5	10	15	30	35
8	8	16	24	48	56
10	10	20	30	60	70
15	15	30	45	90	105

Telescope Field of View



- True Field of View = Apparent field of view / Magnification (Moon is about $\frac{1}{2}$ degree)
 - $\text{TFoV} = \text{AFoV}(\text{eyepiece}) / \text{Mag}$
 - this is the field of view of the entire telescope system
 - Moon is approximately $\frac{1}{2}$ degree
 - At the celestial equator, every four seconds, the Earth turns through one minute of arc

Telescope Field of View- Example

- $\text{TFoV} = \text{AFoV}(\text{eyepiece}) / \text{Mag}$
 - $\text{AFoV} = 40 \text{ degrees and } 83 \text{ degrees}$
 - $\text{MAG} = 100$
 - $\text{TFoV @ } 40 \text{ degrees AFoV} = 0.4 \text{ degrees (24 minutes)}$
 - $\text{TFoV @ } 83 \text{ degrees AFoV} = 0.83 \text{ degrees (50 minutes)}$

NOTE: Moon is approximately $\frac{1}{2}$ degree or 30minutes

In Summary

- Telescope System includes telescope, eyepiece and human eye (could also be a camera)
- Human eye has certain limitations that determines maximum, minimum and optimal selection of eyepieces
- The larger the apparent field of view of an eyepiece, the larger FoV of the telescope system (also \$\$\$\$)

References

- **Wikipedia**

<http://en.wikipedia.org/wiki/Eyepiece>

http://en.wikipedia.org/wiki/Exit_pupil

- **Rensseler Polytechnic Institute**

<http://www.rpi.edu/dept/phys/observatory/earthsky1b.pdf>

- **Saguaro Astronomy Club**

<http://www.saguaroastro.org/content/EYEPIECE.htm>