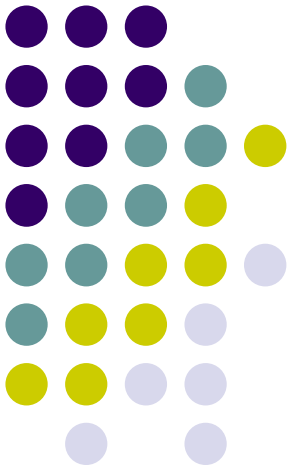
# The *Error Lens* Concept

*Basic Optics*, Chapter 8



# The *Error Lens* Concept

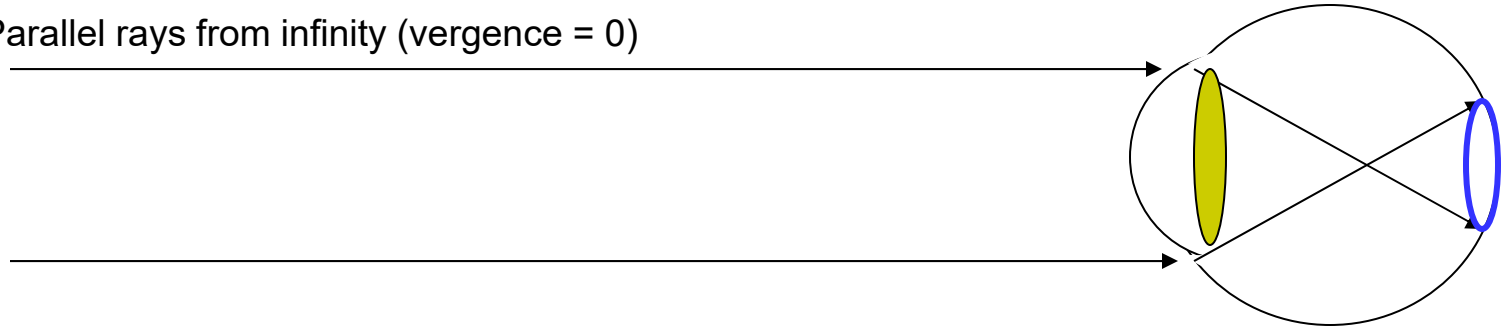
- Another way of thinking about refractive error

# The *Error Lens* Concept

## The Myopic Eye

*The myopic eye has* ***too much converging power*** *for its length*

Parallel rays from infinity (vergence = 0)



We have noted that the refractive error of a myopic eye can be thought of as resulting from excess converging power. To 'explain' this extra convergence…

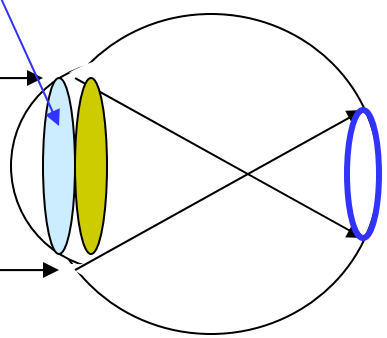
# The *Error Lens* Concept

## The Myopic Eye

*It's as if the myopic eye has an extra 'plus' lens within it that's causing the refractive error*

*The myopic eye has **too much converging power** for its length*

Parallel rays from infinity (vergence = 0)



We have noted that the refractive error of a myopic eye can be thought of as resulting from excess converging power. To 'explain' this extra convergence… We can think of it as resulting from an extra (as in extraneous or unneeded) *plus* lens built into the myopic eye. It is this extra plus lens that causes the excess convergence that results in the myopic refractive error.

# The *Error Lens* Concept

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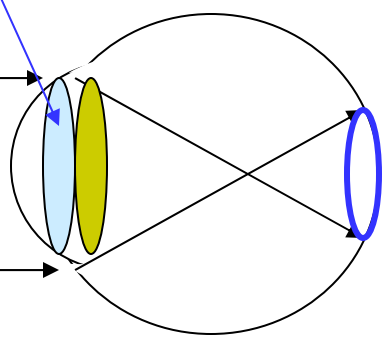

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*This is the concept of the **Error Lens***

# The *Error Lens* Concept

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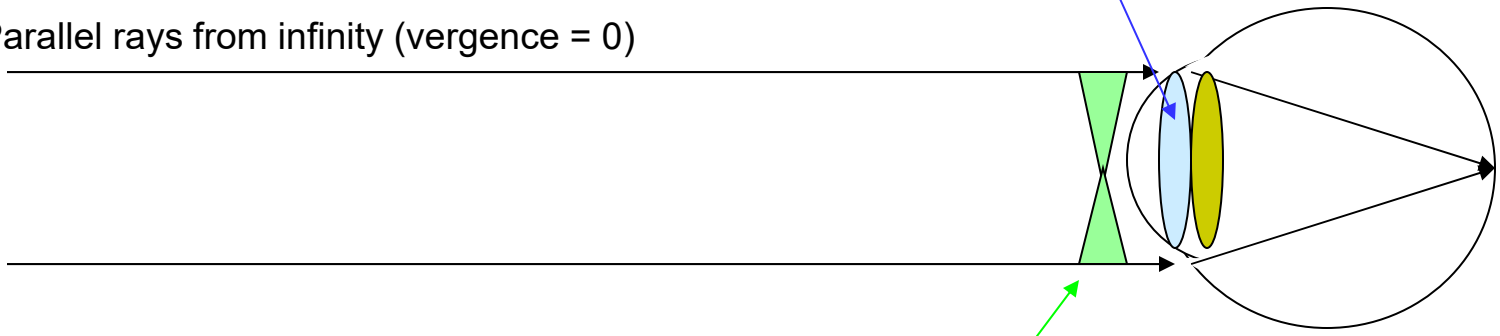


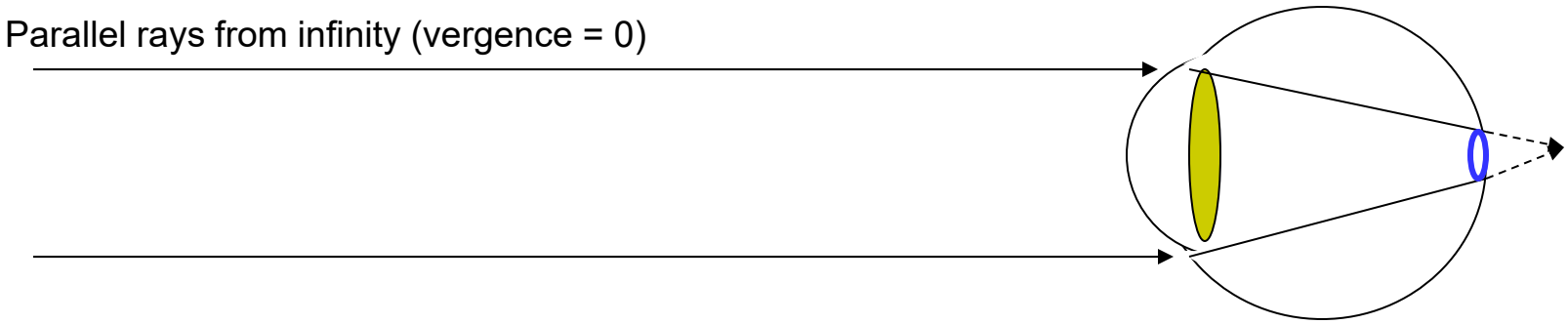
The error-lens concept explains why a myopic eye requires a minus lens to correct its refractive error—the minus lens is needed to counteract the excess convergence provided by the **plus** error lens.

*This is the concept of the **Error Lens***

# The *Error Lens* Concept

## The Hyperopic Eye

*The hyperopic eye has too little converging power for its length*

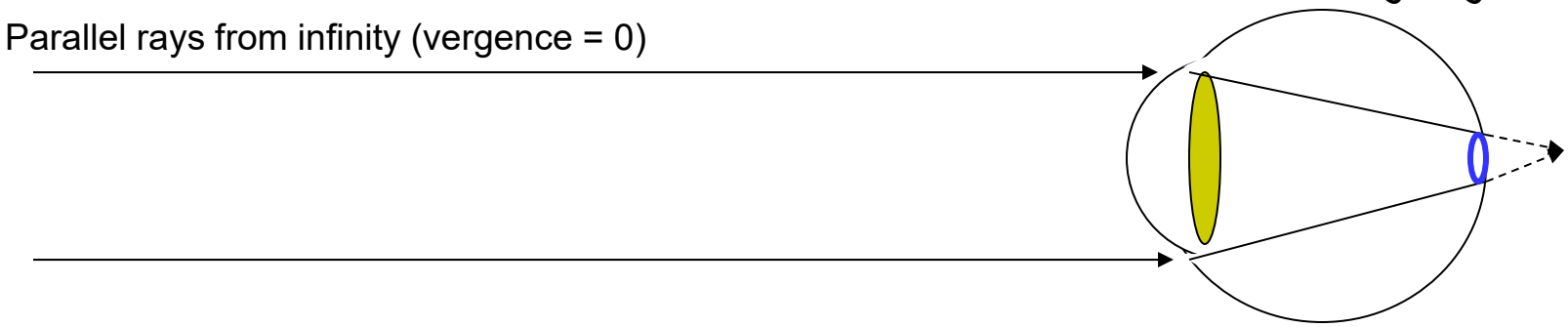



We have noted that the refractive error of a ***hyperopic*** eye can be thought of as resulting from too little converging power. However…

# The *Error Lens* Concept

## The Hyperopic Eye

much
v
*The hyperopic eye has too ~~little~~ ~~converging~~ power for its length*
^
diverging




We have noted that the refractive error of a ***hyperopic*** eye can be thought of as resulting from too little converging power. However…
We could also describe it as resulting from excess ***diverging*** power. To 'explain' this extra divergence…

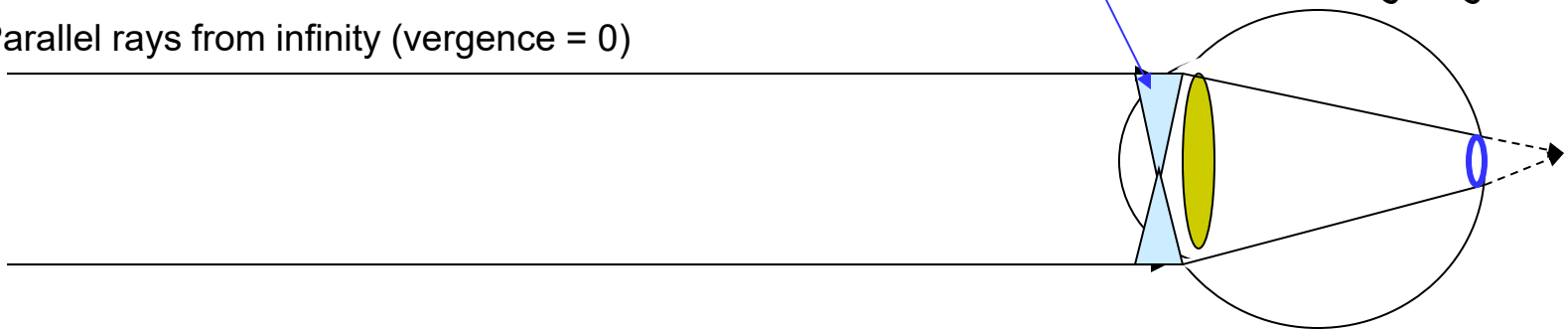
# The *Error Lens* Concept

## The Hyperopic Eye

*It's as if the hyperopic eye has an extra 'minus' lens within it that's causing the refractive error*

*The hyperopic eye has too ~~little~~ much*
*~~converging~~ diverging power for its length*

Parallel rays from infinity (vergence = 0)



We have noted that the refractive error of a ***hyperopic*** eye can be thought of as resulting from too little converging power. However…
We could also describe it as resulting from excess ***diverging*** power. To 'explain' this extra divergence…
We can think of it as resulting from an extra *minus* lens built into the hyperopic eye. It is this extra minus lens that causes the excess divergence that results in the hyperopic refractive error.

# The *Error Lens* Concept

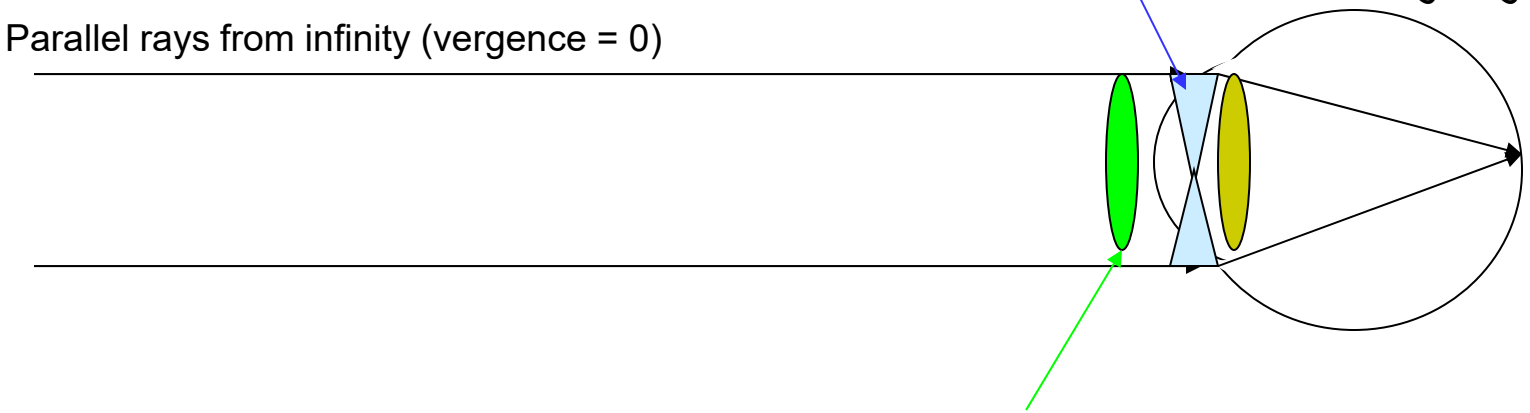
## The Hyperopic Eye

*It's as if the hyperopic eye has an extra 'minus' lens within it that's causing the refractive error*

*The hyperopic eye has too ~~little~~ ~~converging~~ power for its length*

much
v
diverging
^

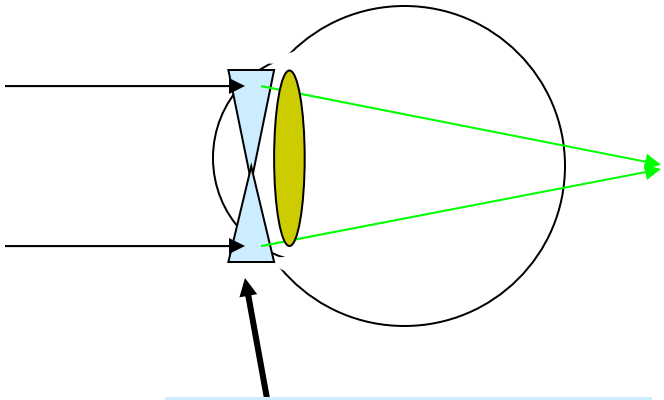
Parallel rays from infinity (vergence = 0)



The error-lens concept explains why a hyperopic eye requires a plus lens to correct its refractive error—the plus lens is needed to counteract the excess divergence of the **minus** error lens.

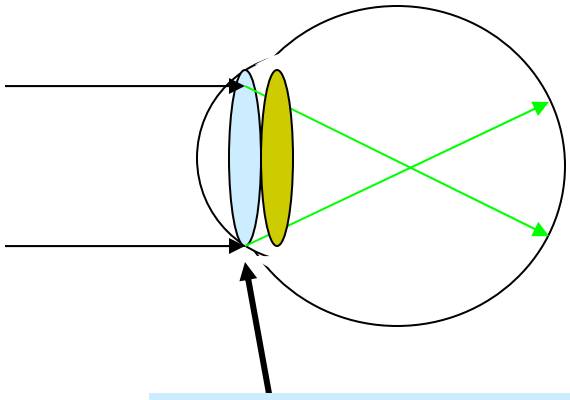
# The *Error Lens* Concept

**Hyperopic Eye**



**Eye Error Lens: -2D**

**Myopic Eye**

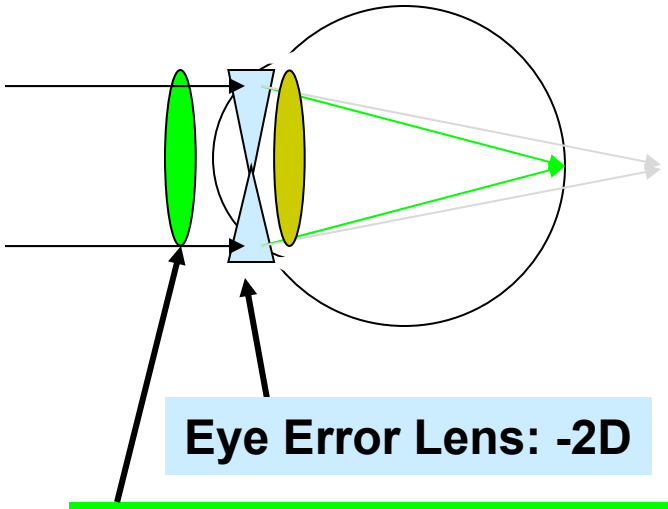


**Eye Error Lens: +4**

Summarizing: The error lens keeps parallel rays from falling on the retina.

# The *Error Lens* Concept

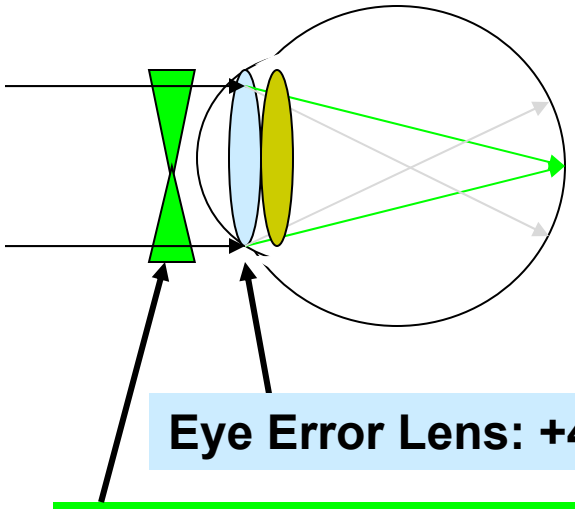
**Hyperopic Eye**



**Eye Error Lens: -2D**

**Corrective Lens Needed: +2**

**Myopic Eye**



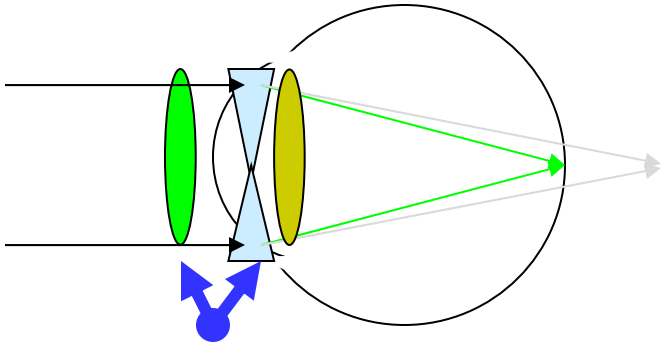
**Eye Error Lens: +4**

**Corrective Lens Needed: -4**

Summarizing: The error lens keeps parallel rays from falling on the retina.
To offset it, the corrective lens needs to be of equal but opposite power (except for whatever adjustment is needed to account for vertex distance).

# The *Error Lens* Concept

**Hyperopic Eye**



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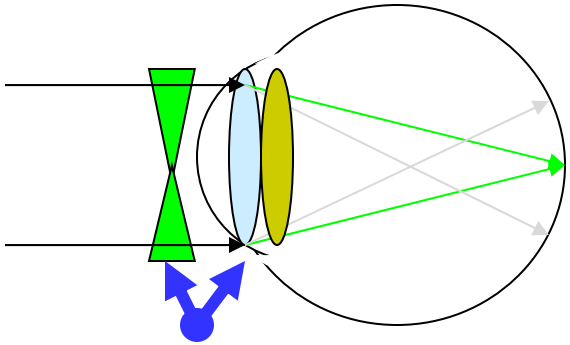

Note that spectacle-corrected hyperopes and myopes are looking through both a plus **and** a minus lens--the only difference is the order in which these lenses are 'placed' in front of the eye.

*Can you think of a common optical device that is composed of a plus lens and minus lens?*

# The *Error Lens* Concept

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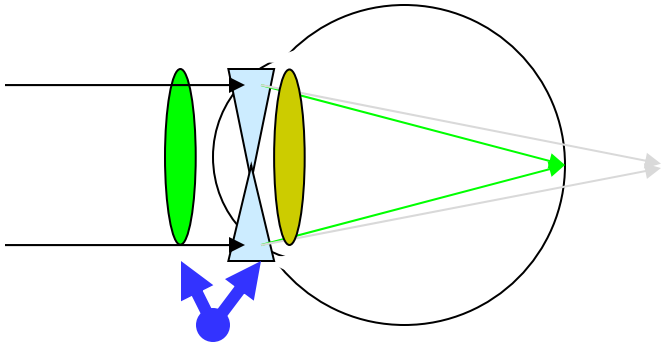

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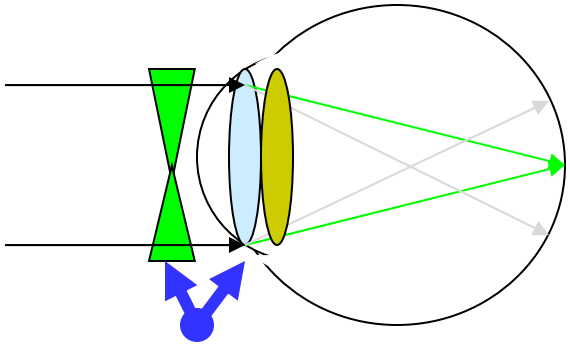

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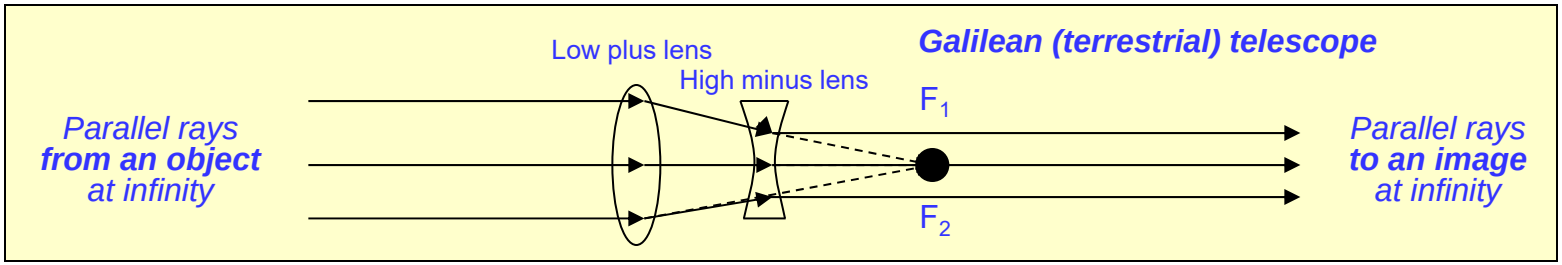
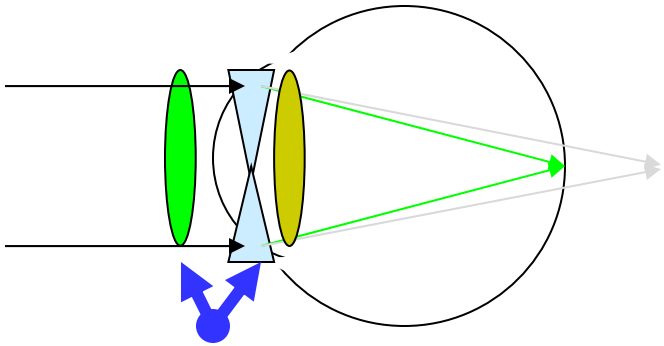
*Can you think of a common optical device that is composed of a plus lens and minus lens?*
A **Galilean telescope** is composed of a low-plus objective lens and a high-minus eyepiece lens.
*So why bring this up now? What's the relevance to refractive correction?*



# The *Error Lens* Concept

**Hyperopic Eye**



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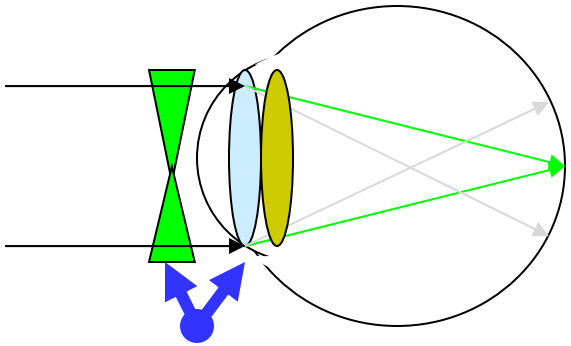

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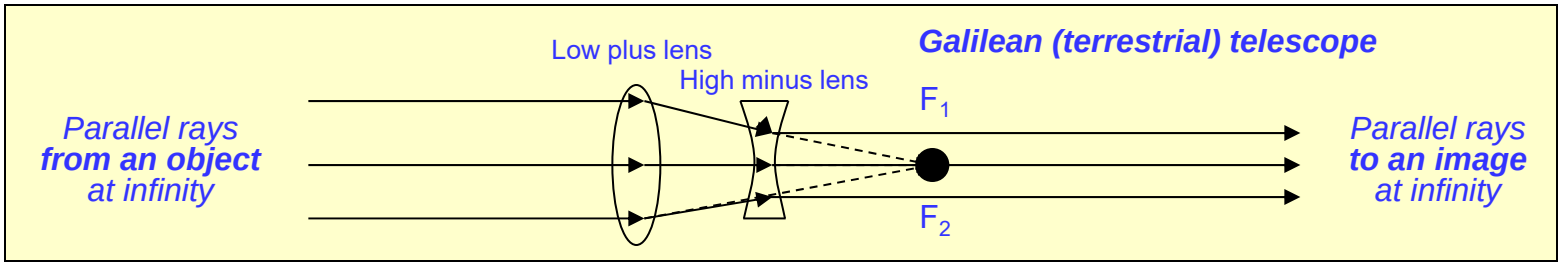
It explains the image magnification/minification effects of refractive correction. Because a spectacle-corrected hyperope is, in essence, looking through a Galilean telescope, the image is **magnified**. In contrast, because a myope is looking through a Galilean telescope *backwards*, the image is **minified**.



# The *Error Lens* Concept

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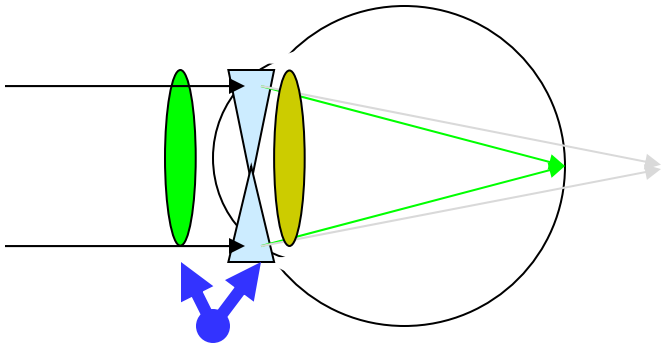

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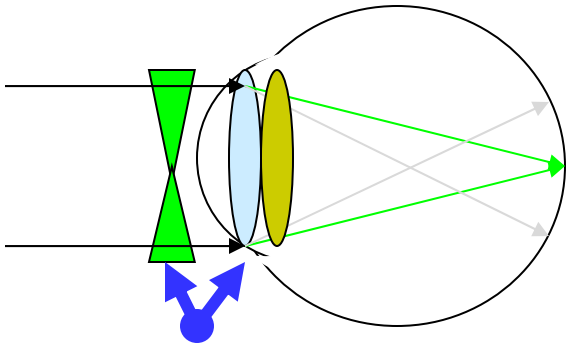

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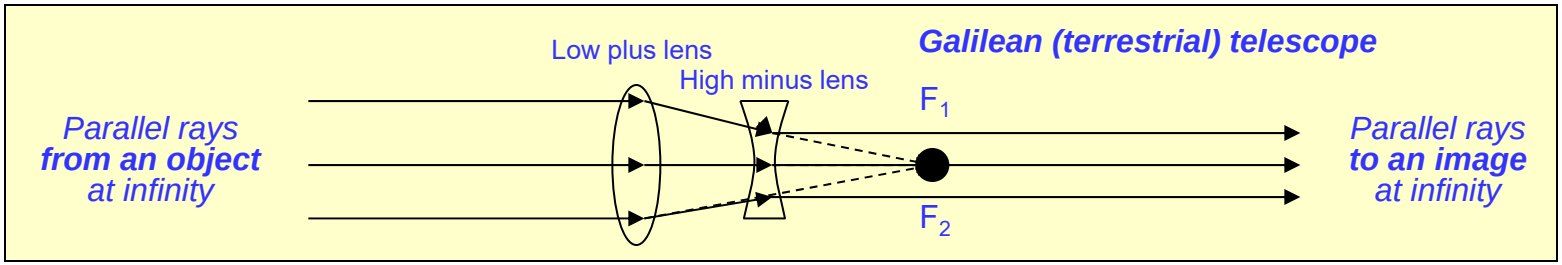
By the way, telescopes are very much-in play on the OKAPs! We will discuss magnification/minification, as well as Galilean (and other) telescopes, at length in a future chapter.



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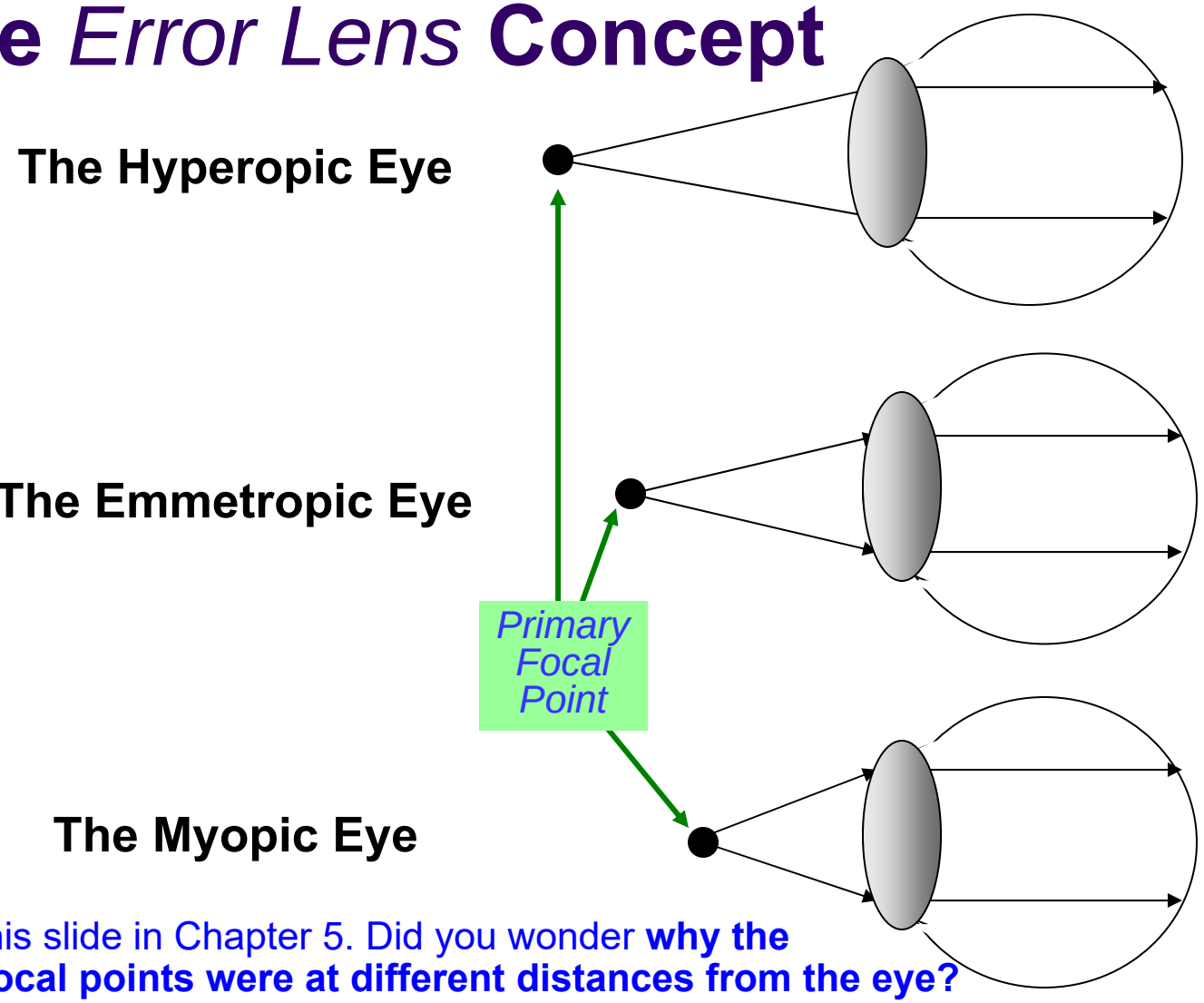
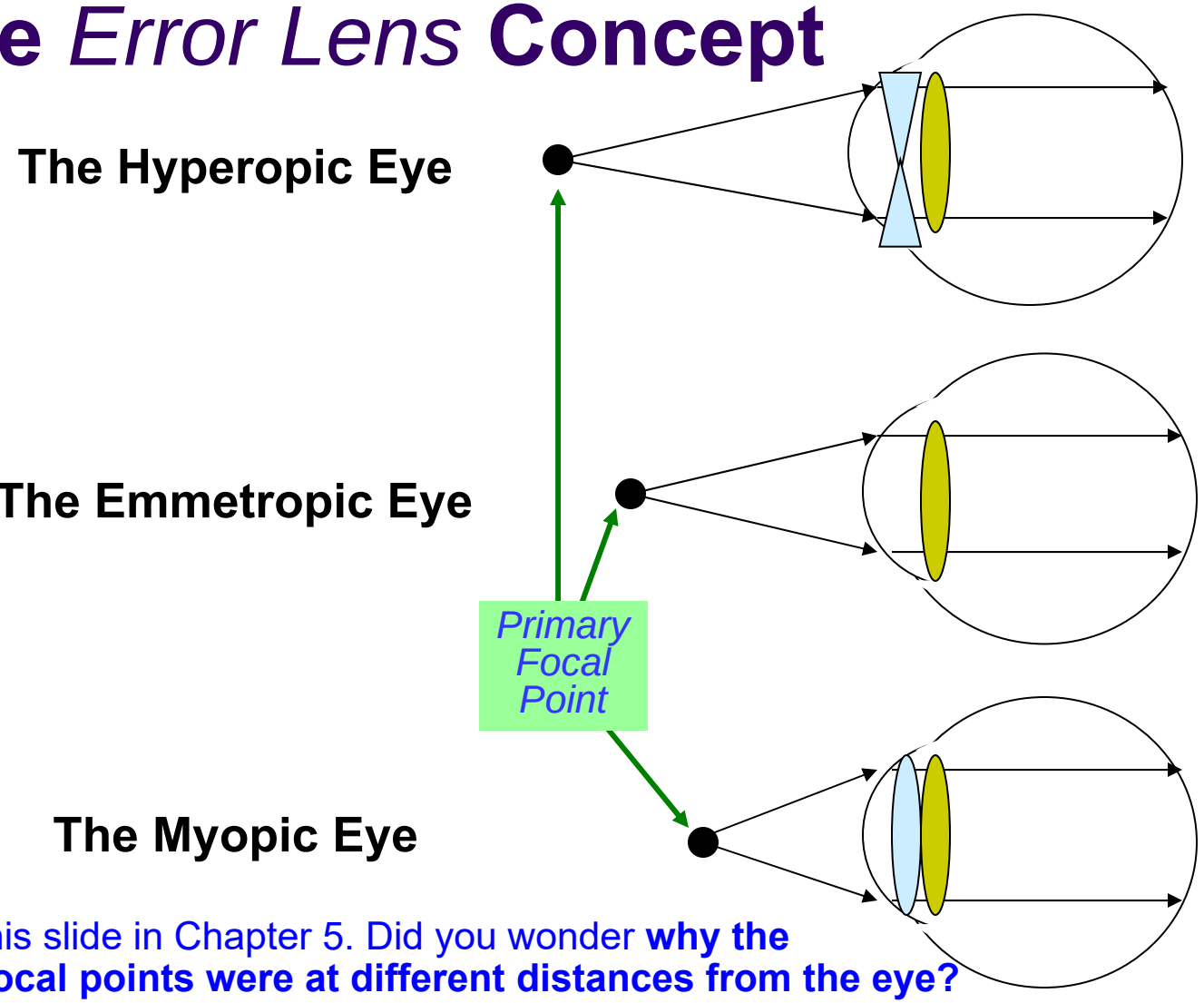



We saw this slide in Chapter 5. Did you wonder **why the primary focal points were at different distances from the eye?**

# The *Error Lens* Concept




We saw this slide in Chapter 5. Did you wonder **why the primary focal points were at different distances from the eye?** The error lens concept provides a nice explanation. Compared to the emmetropic eye, the myopic eye has excess convergence owing to its extra *plus* lens. Thus, the primary focal point of the myopic eye must be closer in order to provide the extra divergence needed to offset the plus error lens. Likewise, the minus error lens of the hyperopic eye gives it less converging power than the emmetropic eye, so as a result it needs less offsetting divergence from its primary focal point.