

LIGHT, PINHOLES AND LENSES: CAMERAS AND COMPUTER IMAGING

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MODERN CAMERAS

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youtube.com/SlowMoLaboratory

ABOUT LIGHT

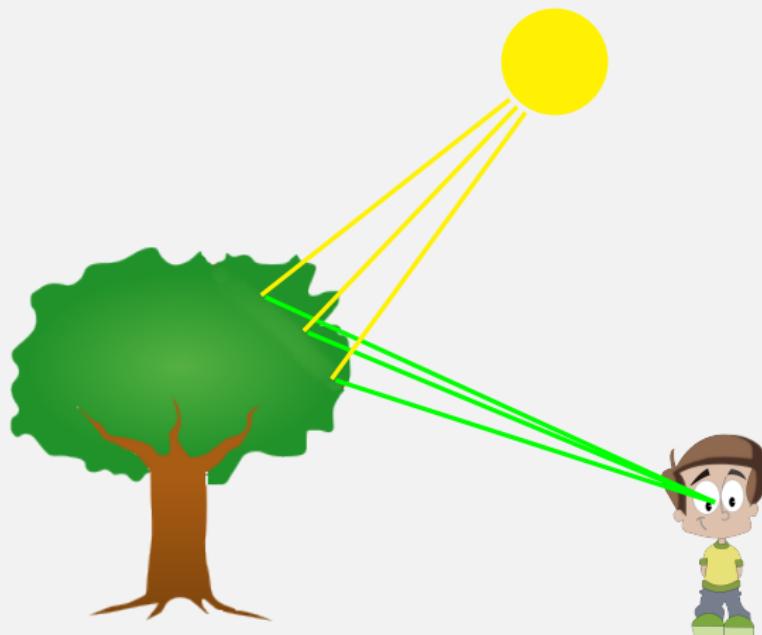
HOW DO WE SEE THINGS?



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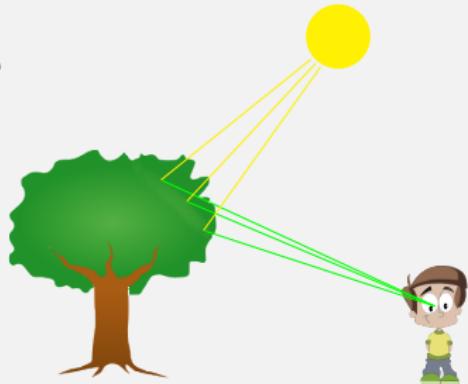


HOW DO WE SEE THINGS?



HOW DO WE SEE THINGS?

- Does the “sight” travel from our eyes to the object?
- or the “light” travels from the object to our eyes?

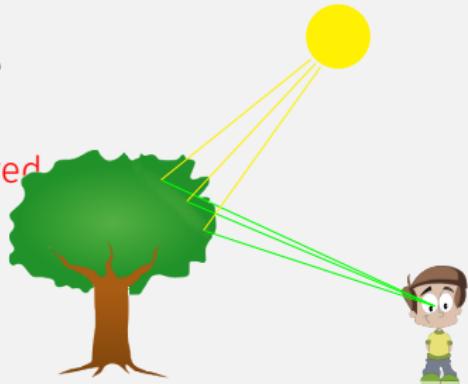


HOW DO WE SEE THINGS?

- Does the “sight” travel from our eyes to the object?

Euclid and other Greek philosophers believed so around 300 BC

- or the “light” travels from the object to our eyes?



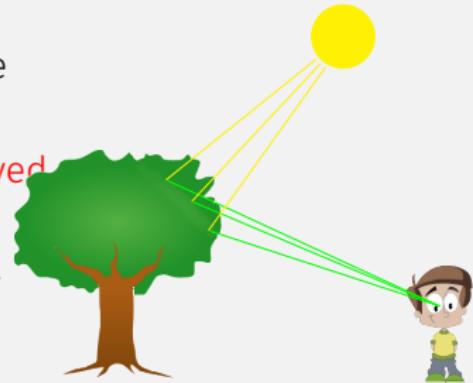
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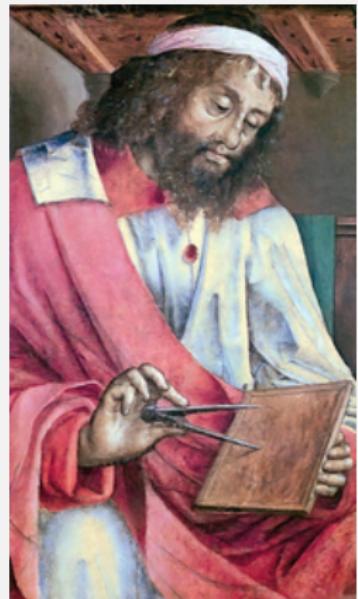
- or the “light” travels from the object to our eyes?

Modern scientists still believe so.



WHAT IS LIGHT?

- Greek philosophers believed that sight was possible because of interaction of fire in eyes and in the sun.
- Euclid, a Greek philosopher, gave us some particular insights about light.



LIGHT TRAVELS IN STRAIGHT LINES



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¹BBC:Let there be Light (2006)

WHAT IS LIGHT?

Light is something that helps us see things. It travels in straight lines (mostly!!).

MAKING A PINHOLE CAMERA

STEP 1

Take a cup and scotch tape



STEP 2

Cover the open end of cup using the scotch tape



STEP 3

Cut a circular piece of construction paper
and glue it to the cup base.



STEP 4

Pierce a pinhole through the closed end of the cup using a push pin



USING THE PINHOLE CAMERA

- Point the bottom of the cup towards the object and scotch tape towards you.
- Hold the cup about one foot away from your eyes.

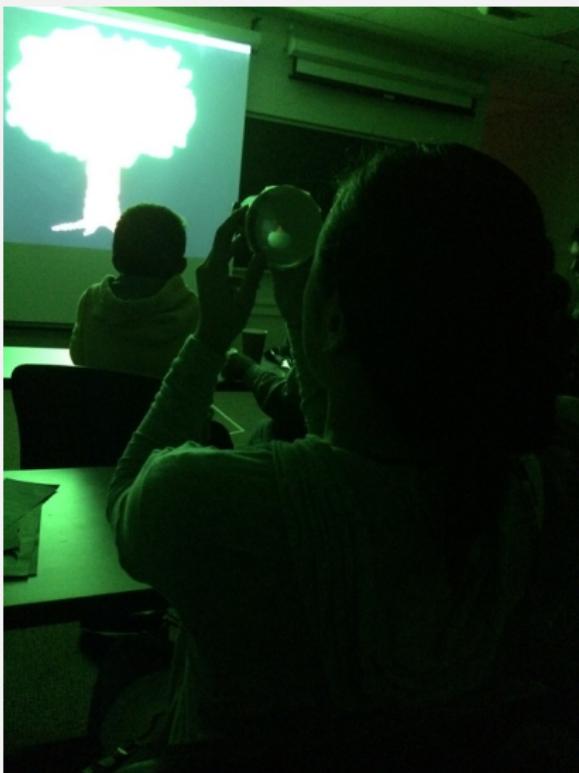


EXPERIMENT TIME

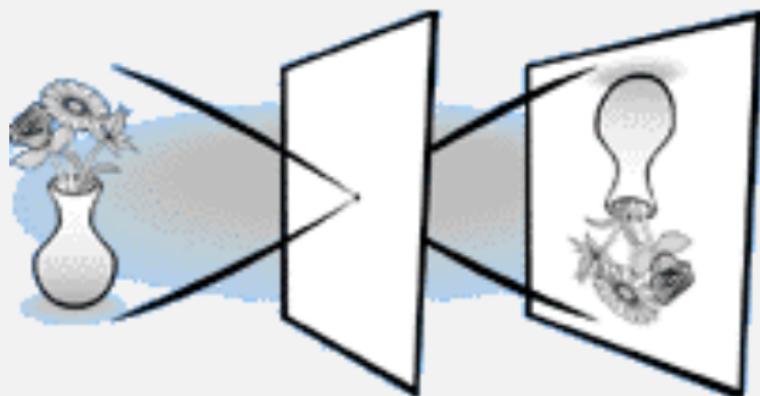
We will turn on the bulb.



WHAT DID YOU SEE?

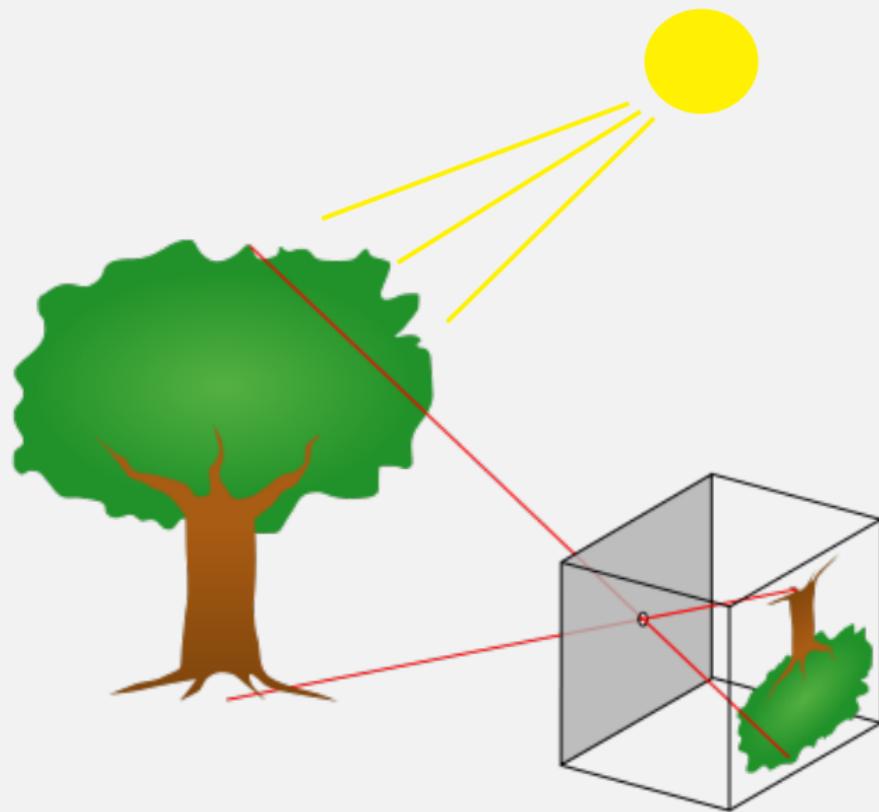


DID YOU SEE AN INVERTED IMAGE?

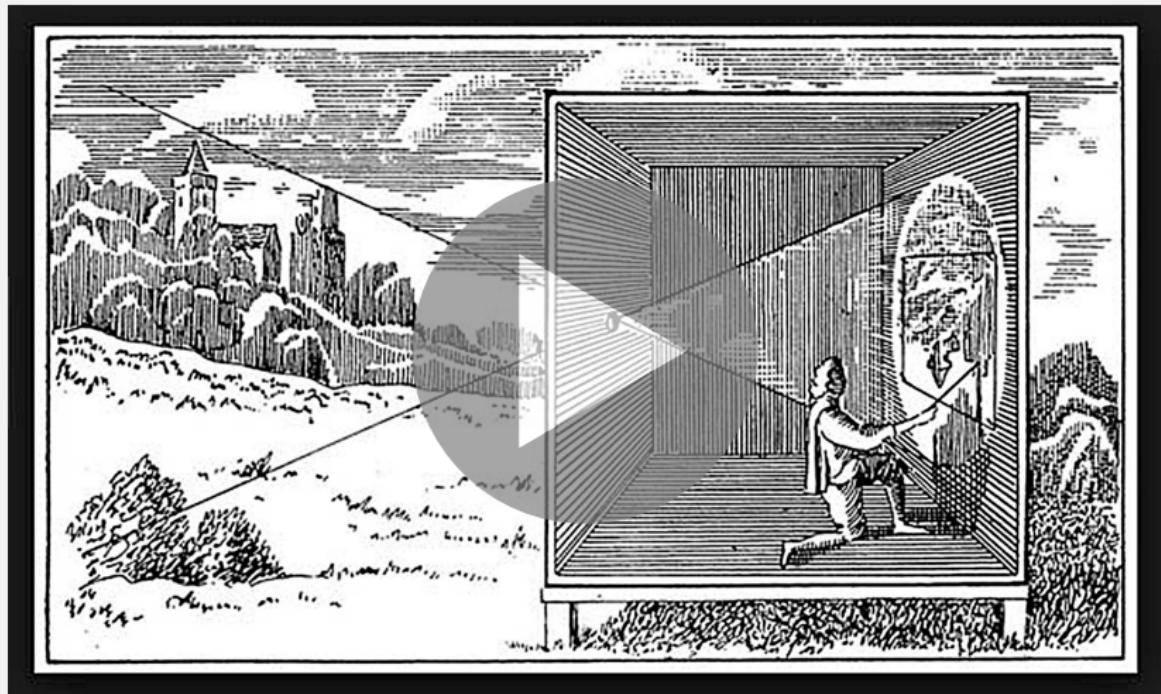


HOW DOES IT WORK

RAY DIAGRAM



CAMERA OBSCURA: DARK ROOM

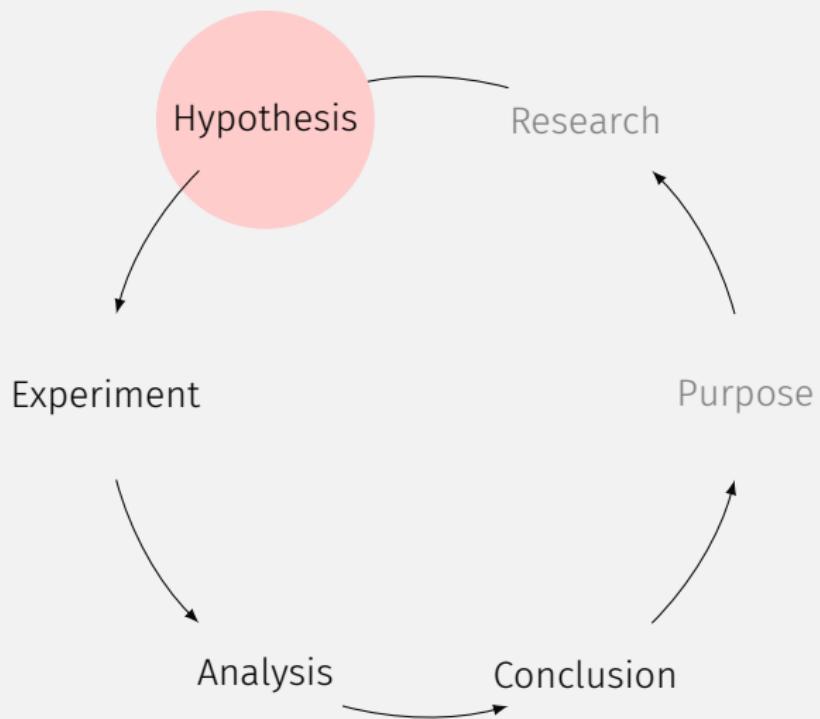


EFFECT OF DISTANCE

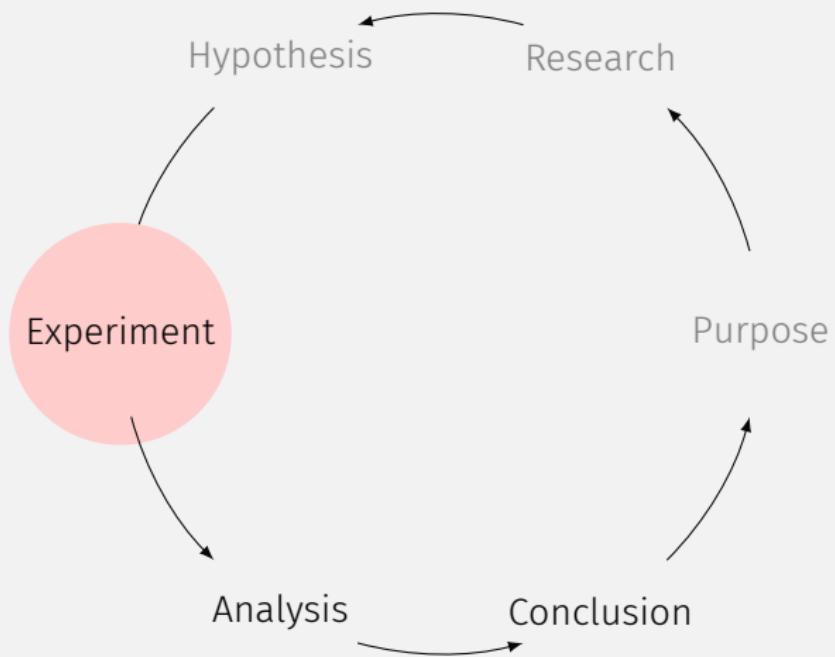
GUESS WHAT HAPPENS

... if you change the distance of the pinhole from the object?

EFFECT OF DISTANCE

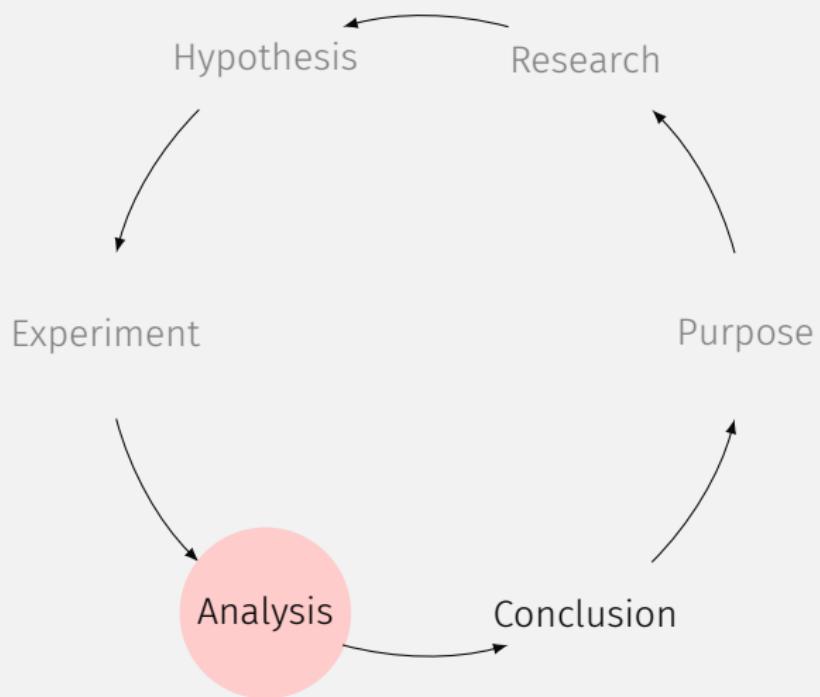


EFFECT OF DISTANCE





EFFECT OF DISTANCE



GUESS WHAT HAPPENS

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GUESS WHAT HAPPENS

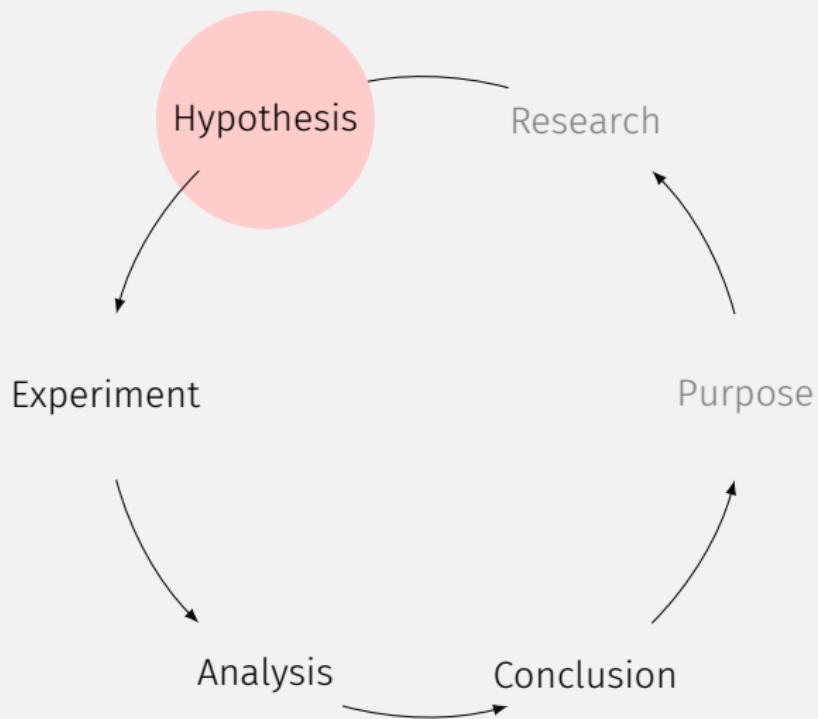
... if you change the distance of the pinhole from the object?
Does it become bigger?

EFFECT OF SHORTENING THE CAMERA

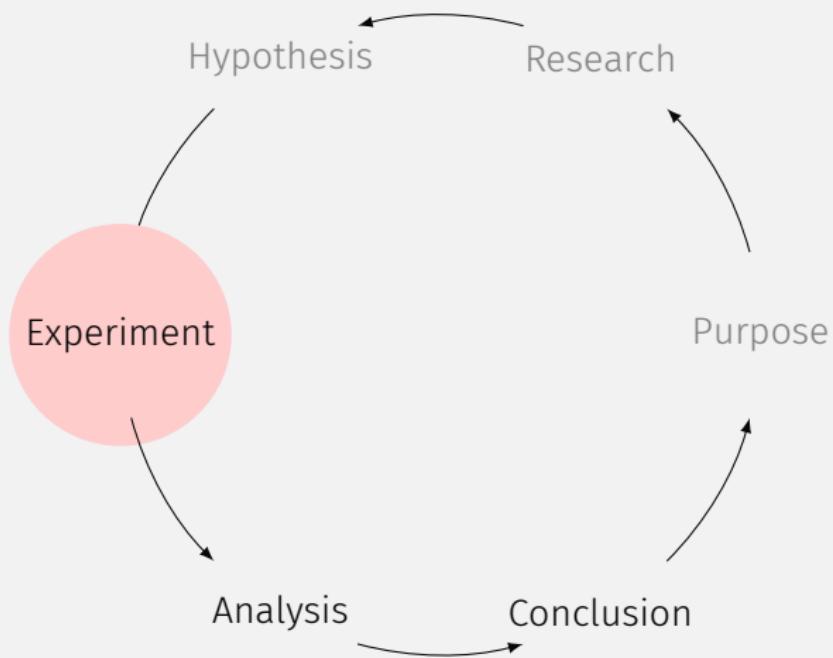
We will now study effect of shortening the camera on the image.
Let's cut the cup along the slit.



SCIENTIFIC METHOD

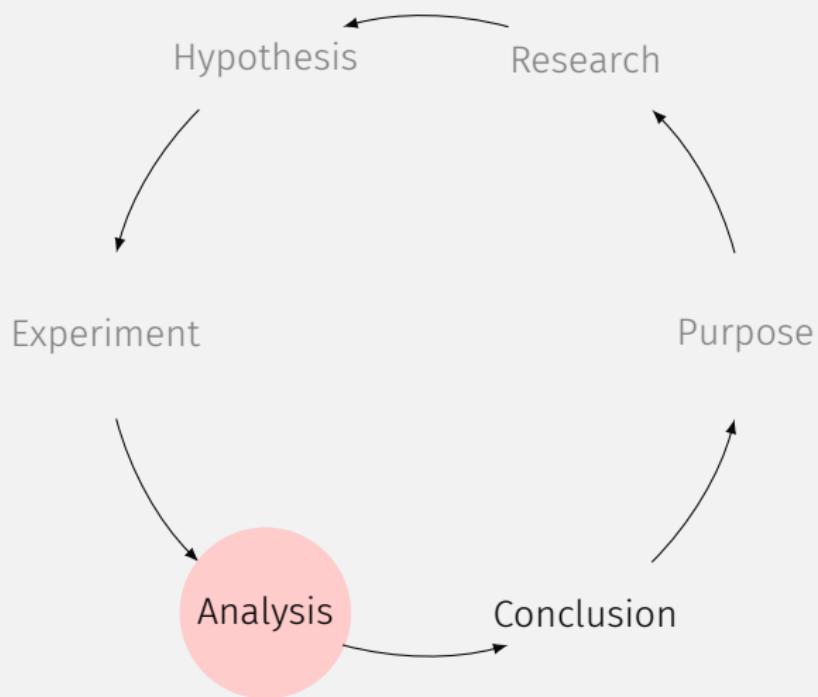


SCIENTIFIC METHOD





SCIENTIFIC METHOD



What happens when you move the screen closer to the pinhole?
Does the image get bigger or smaller?

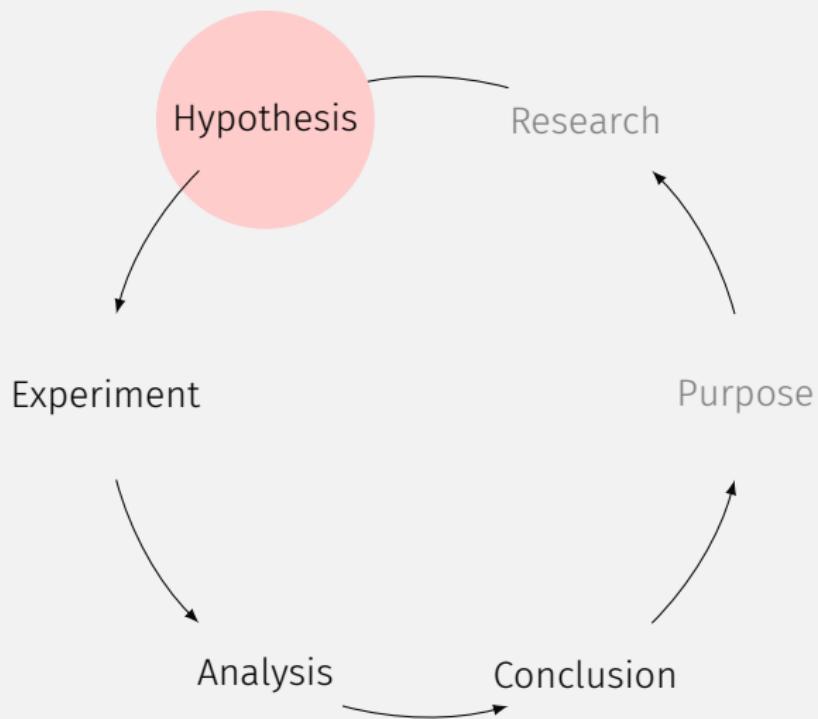
EFFECT OF PINHOLE SIZE

GUESS WHAT HAPPENS?

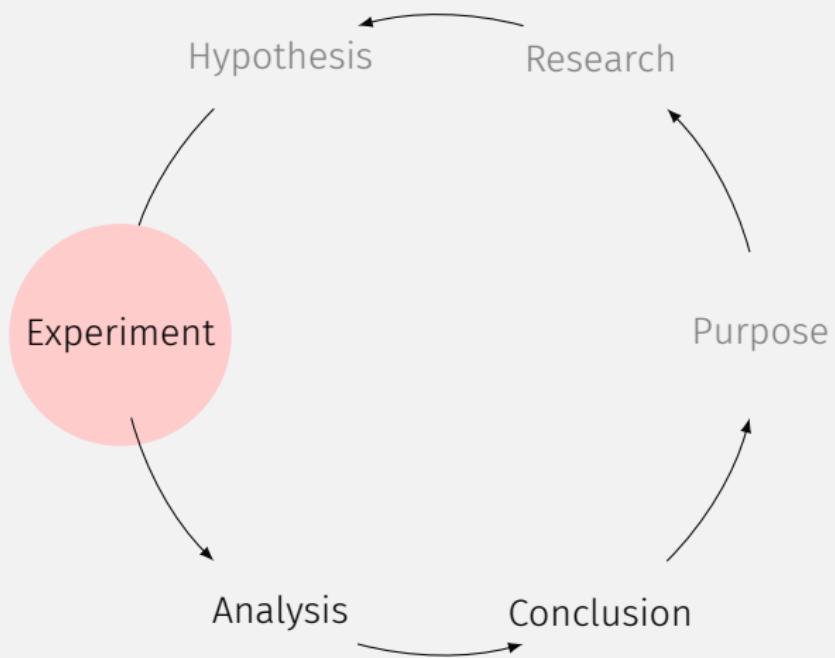
... if we make the pinhole a little bigger.



SCIENTIFIC METHOD

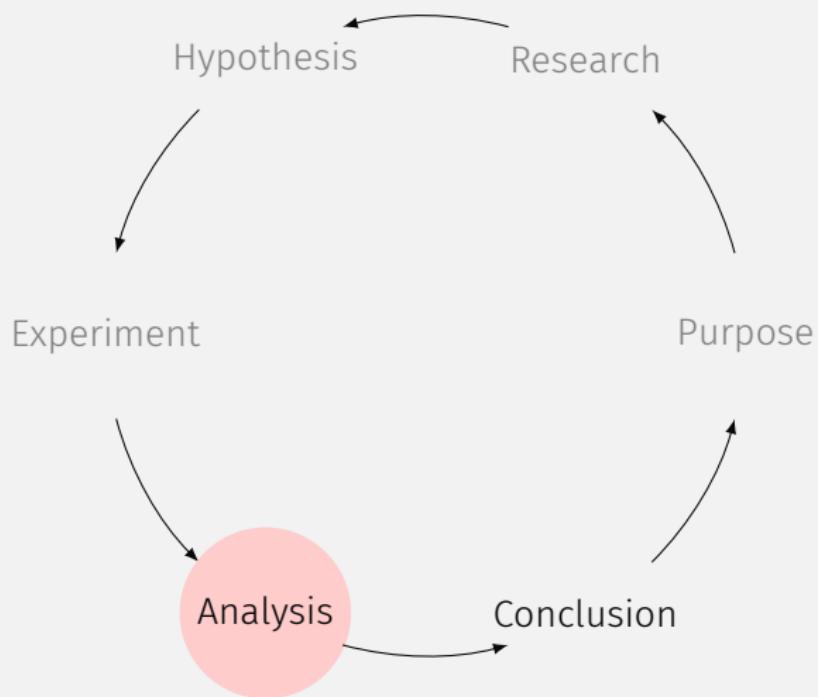


SCIENTIFIC METHOD





SCIENTIFIC METHOD



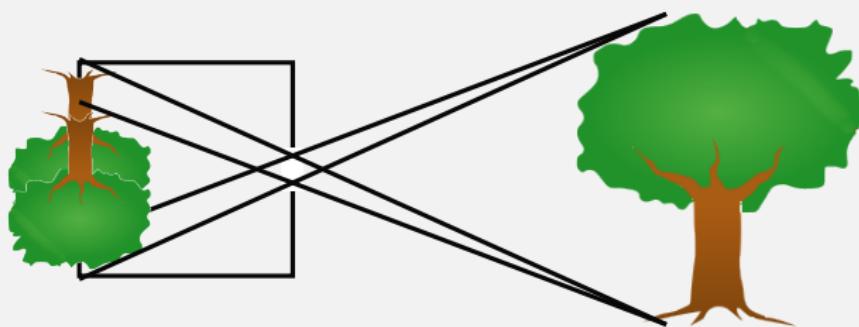
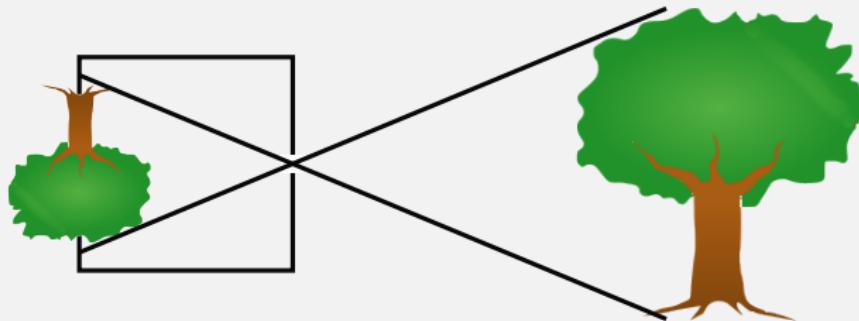
GUESS WHAT HAPPENS?

... if we make the pinhole a little bigger.

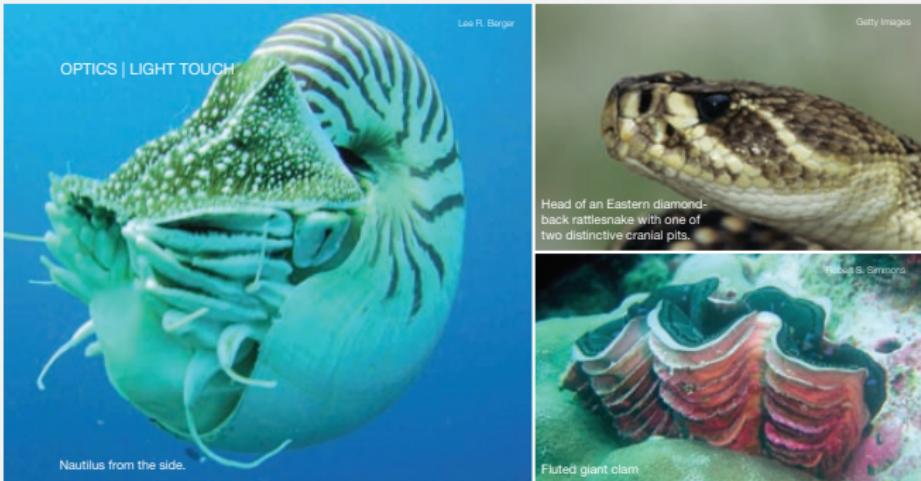
GUESS WHAT HAPPENS?

... if we make the pinhole a little bigger.
Image becomes brighter but blurred

WHY?



FUN FACT!!



The Eye in the Spiral: Animals with Pinhole Visual Systems

Stephen R. Wilk



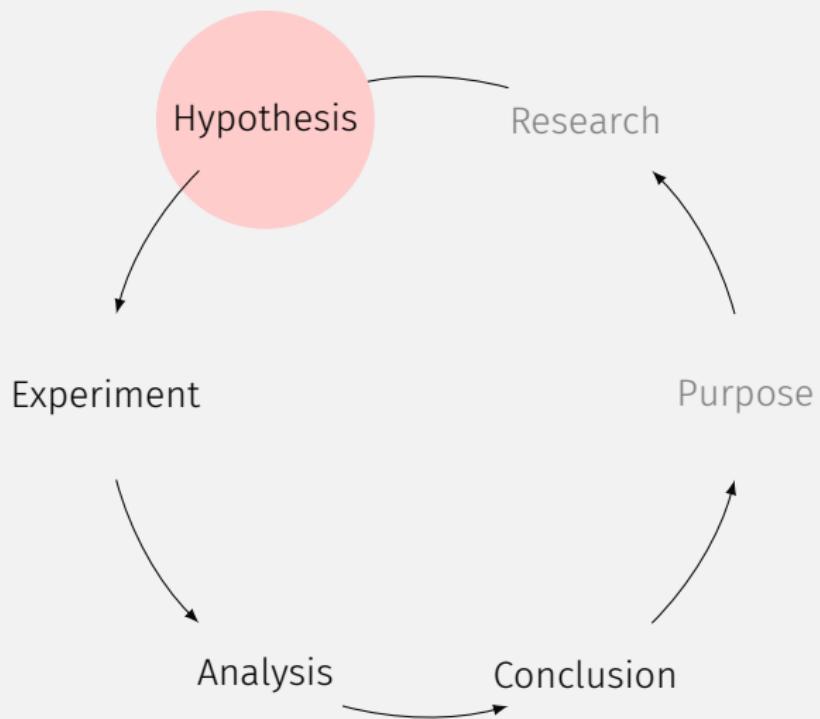
NUMBER OF PINHOLES

GUESS WHAT HAPPENS

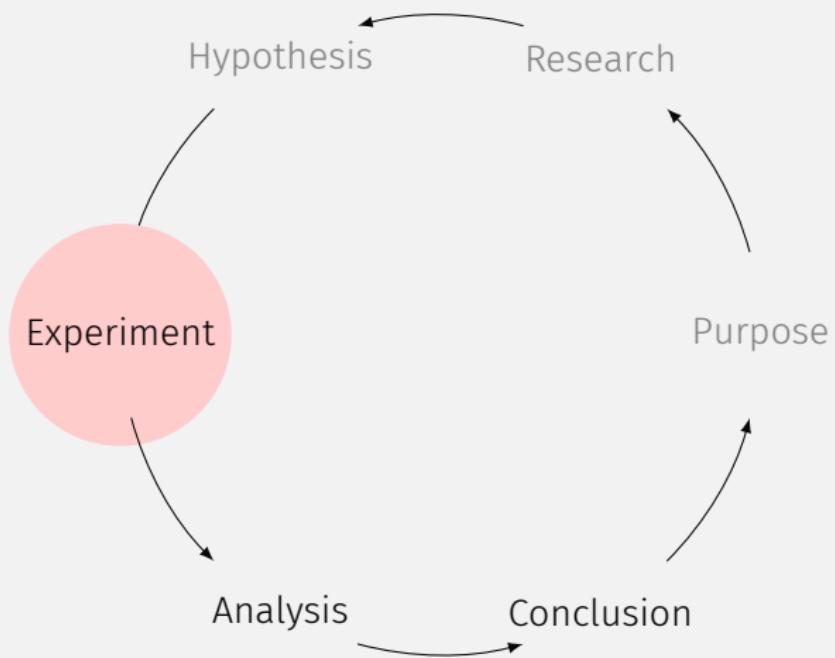
... if we make multiple holes around the pinhole?



SCIENTIFIC METHOD

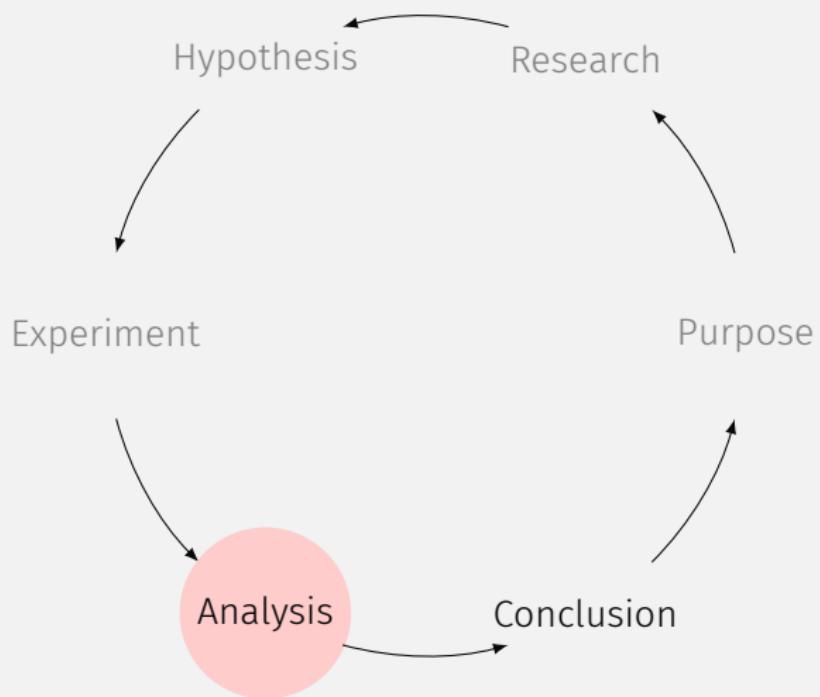


SCIENTIFIC METHOD





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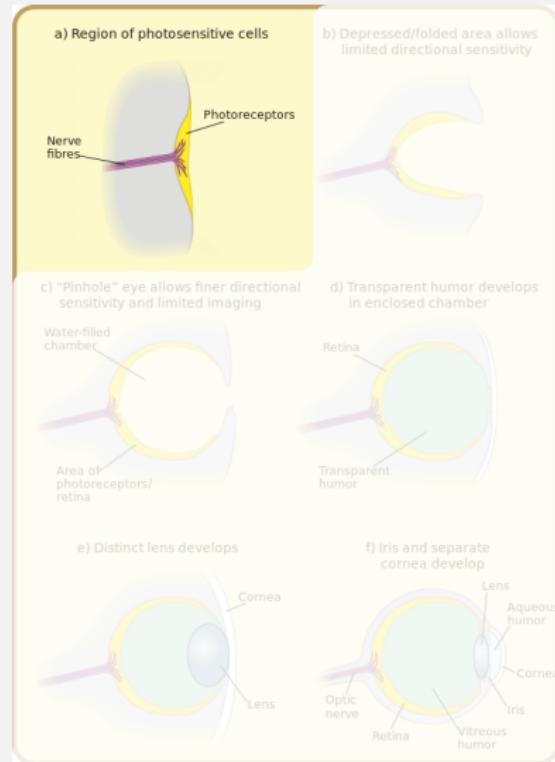
GUESS WHAT HAPPENS

... if we make multiple holes around the pinhole?

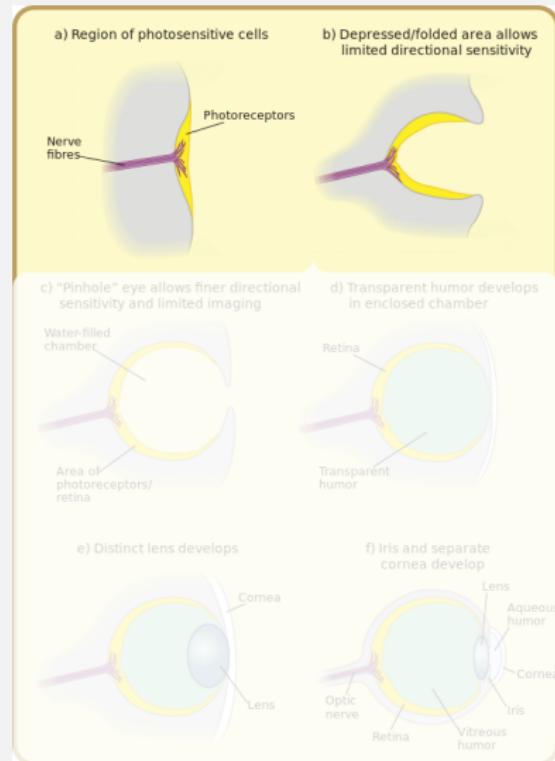
GUESS WHAT HAPPENS

... if we make multiple holes around the pinhole?
Did you get multiple images?

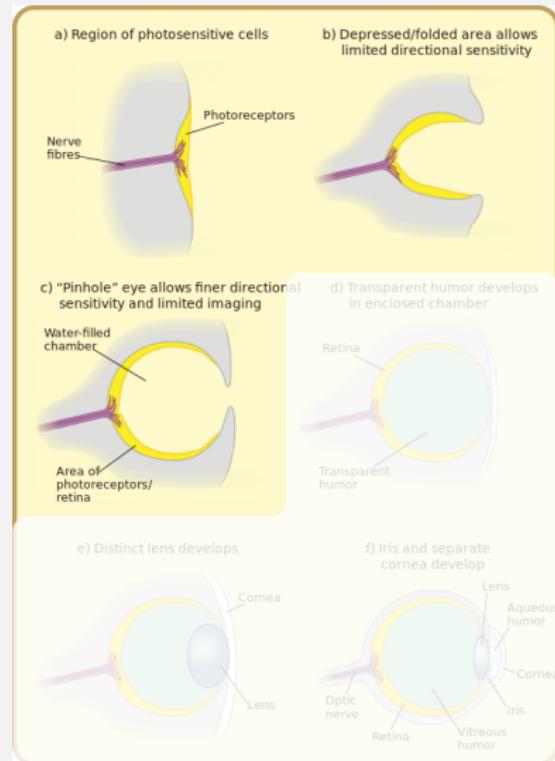
EVOLUTION OF EYE



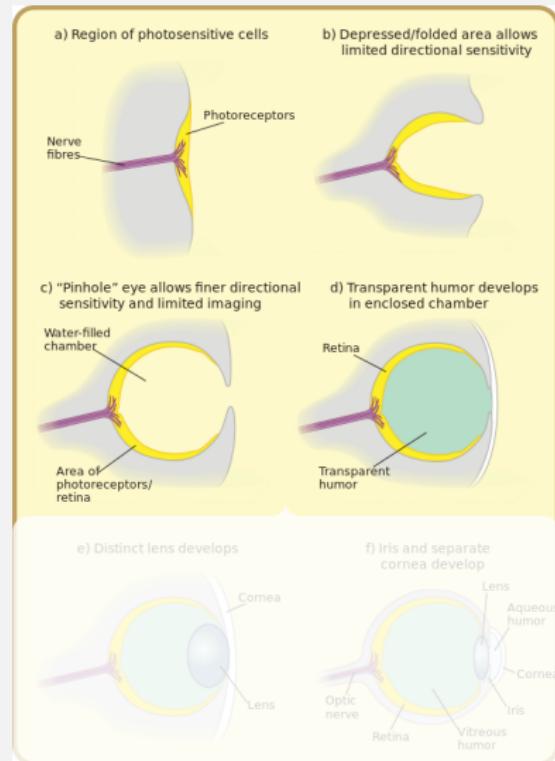
EVOLUTION OF EYE



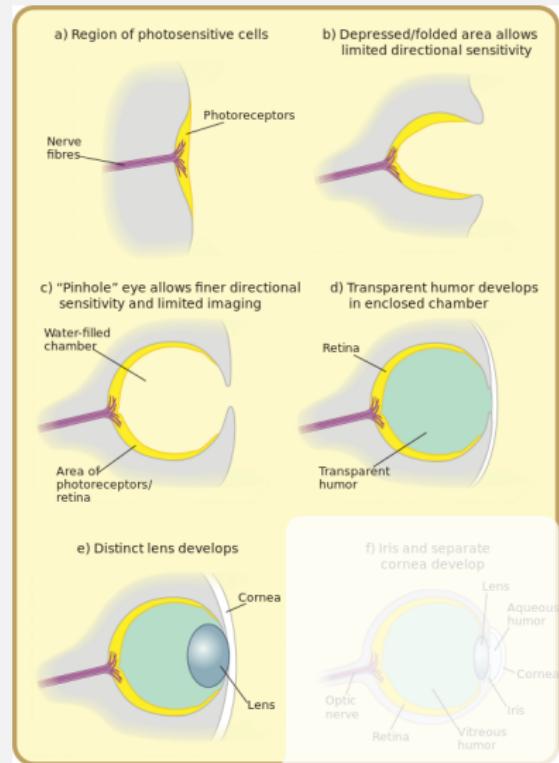
EVOLUTION OF EYE



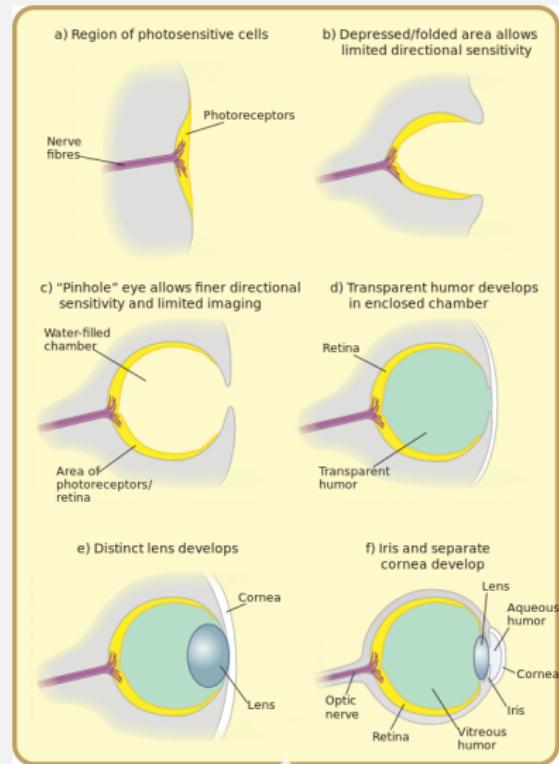
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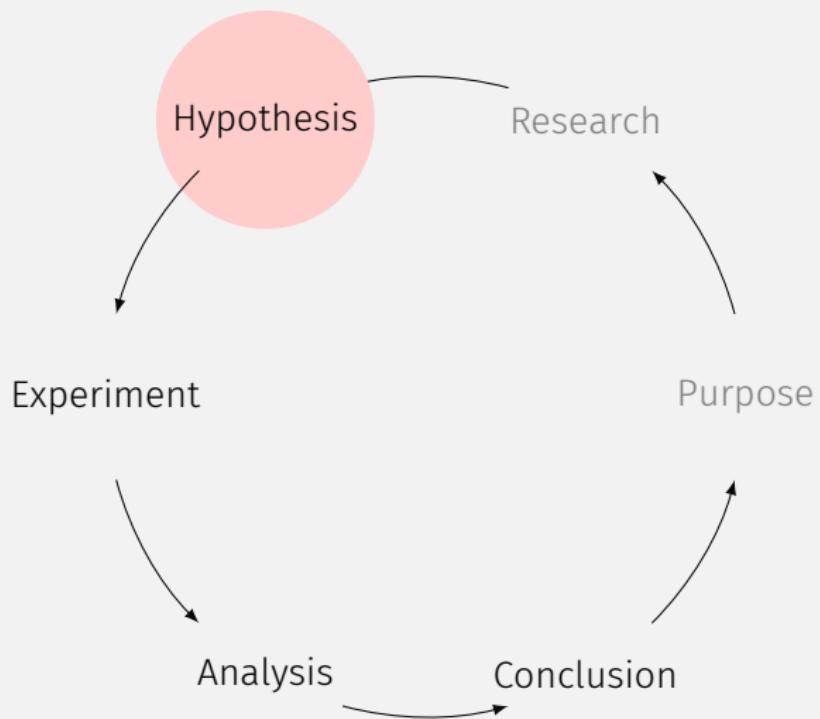


INTRODUCING LENS

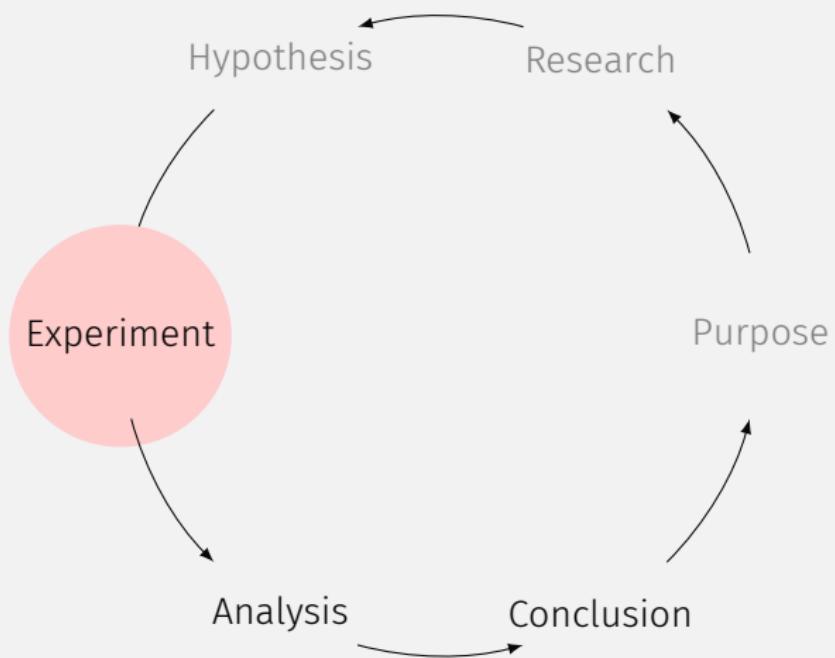
We want to find a lens that will make our camera better.



SCIENTIFIC METHOD

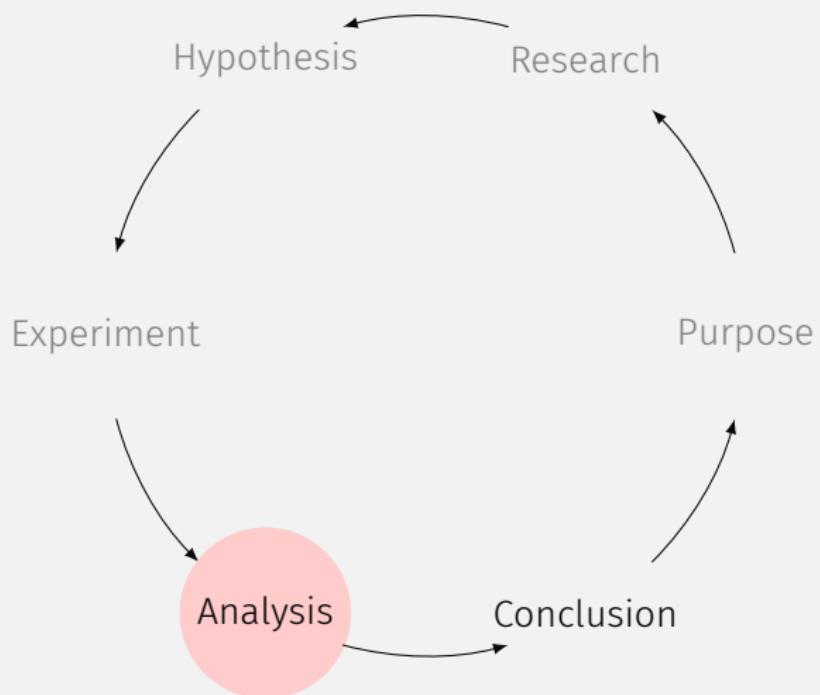


SCIENTIFIC METHOD





SCIENTIFIC METHOD



LENSES

INTRODUCING LENS

Add the double convex lens in front of multiple pinholes?

INTRODUCING LENS

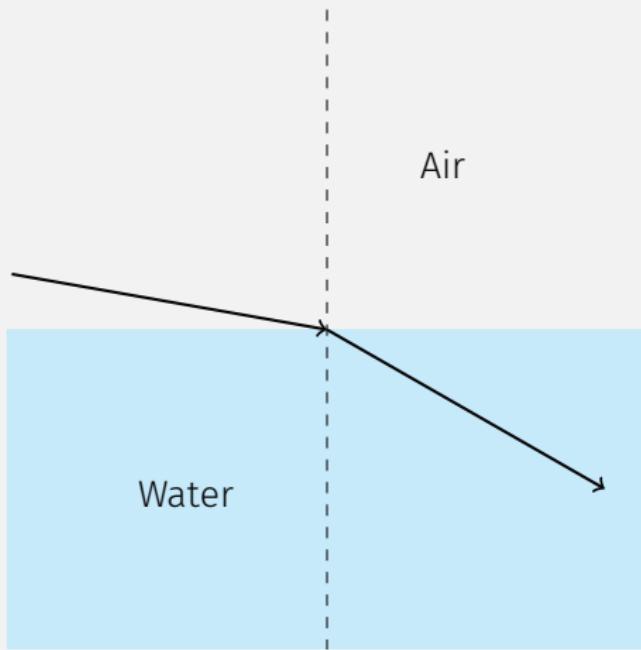
Add the double convex lens in front of multiple pinholes?
Do you see all images merging into one?
What happened?

UNDERSTANDING REFRACTION

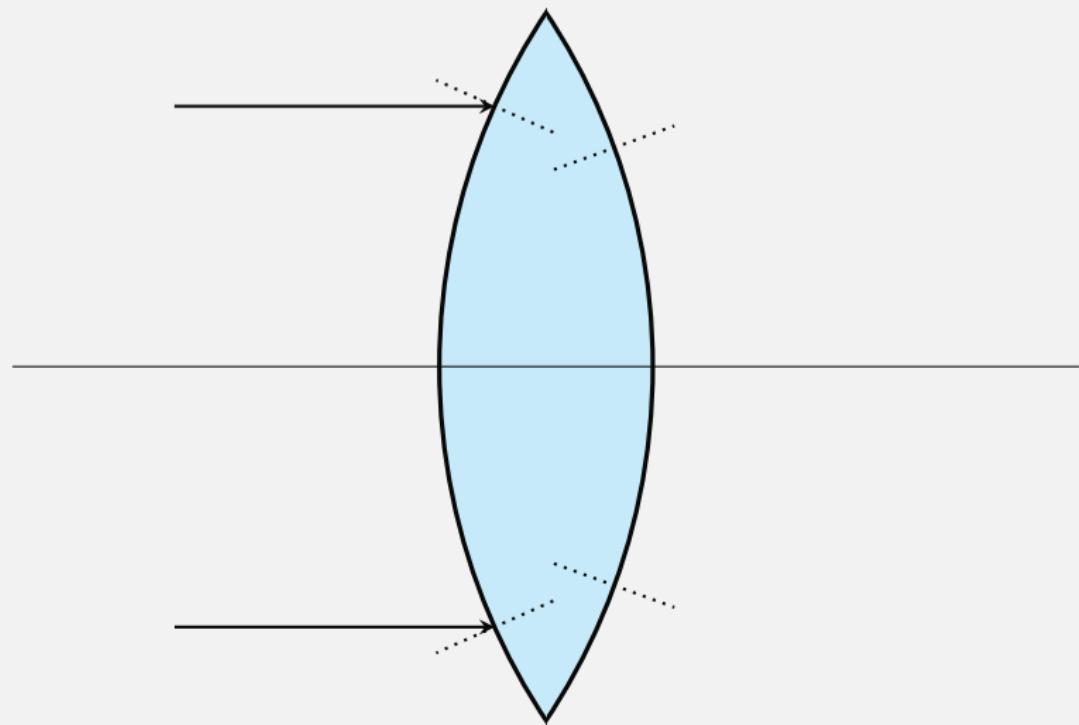


REFRACTION

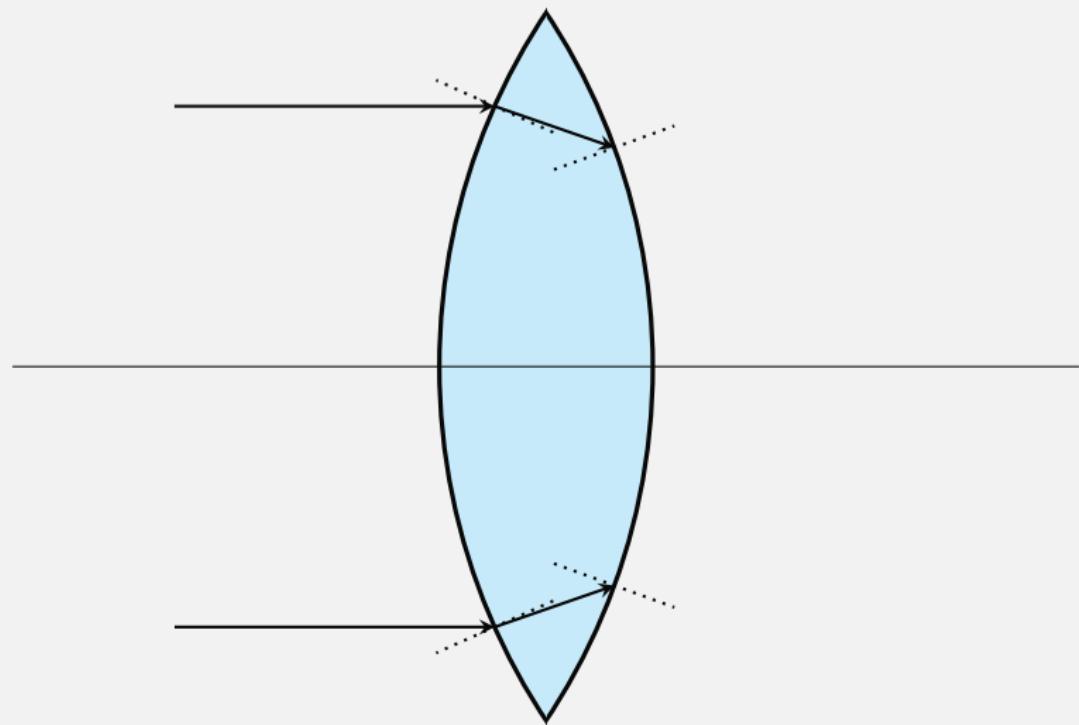
Light bends when it crosses boundaries



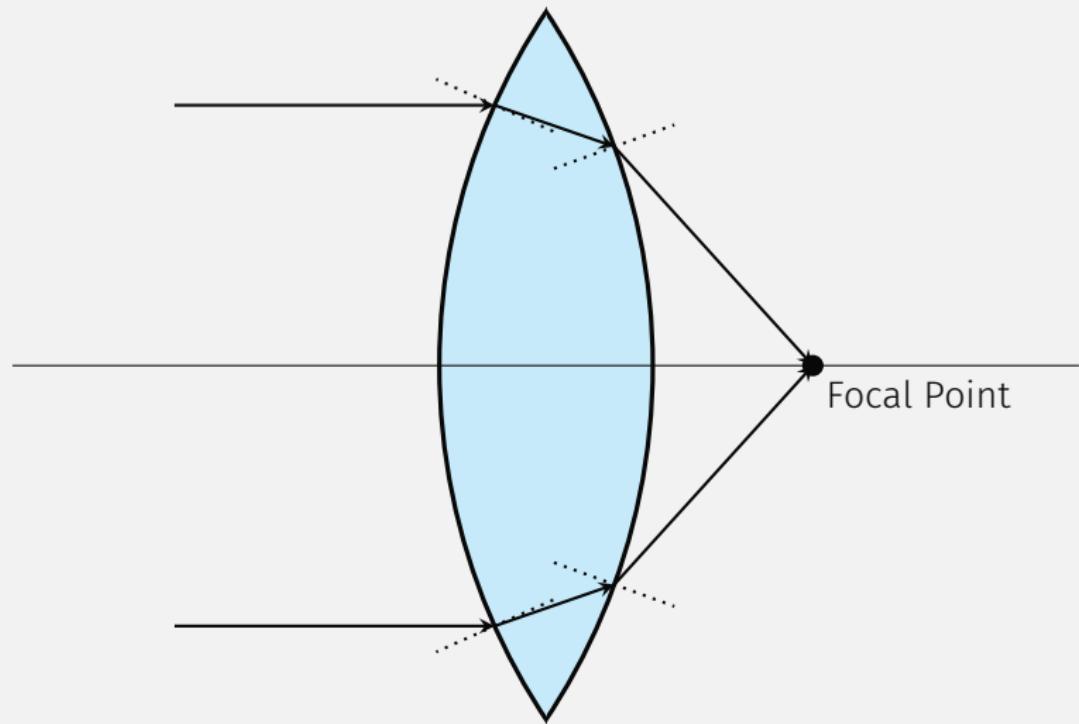
REFRACTION AT LENS



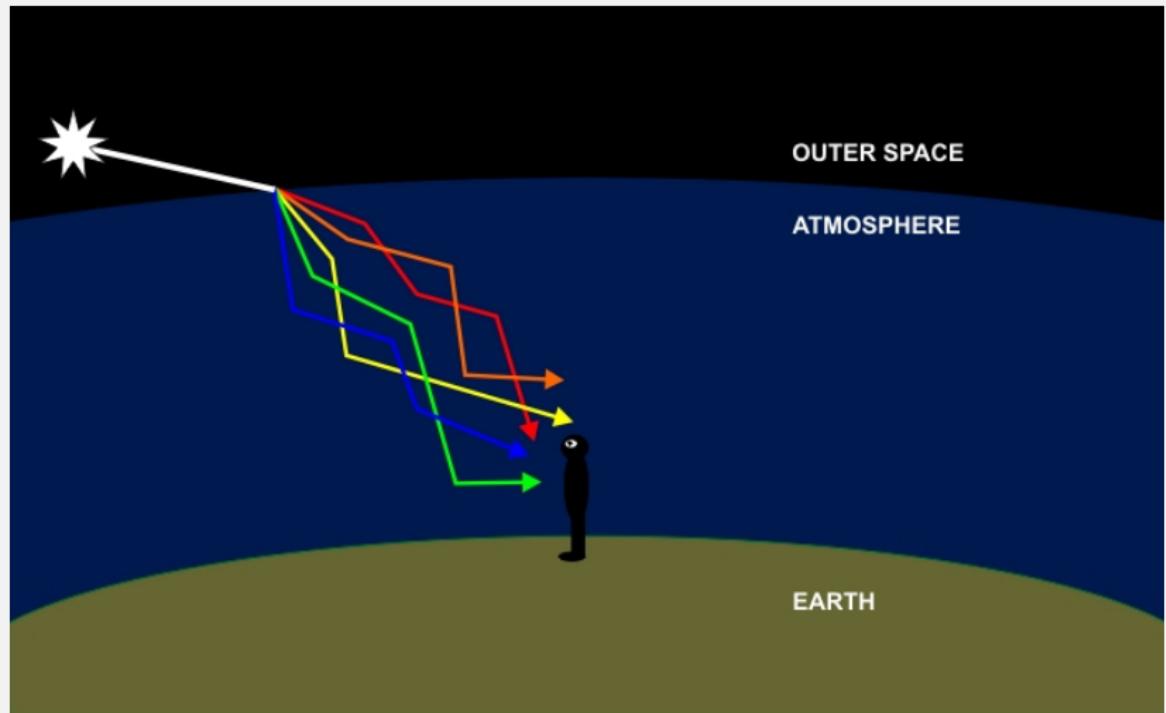
REFRACTION AT LENS



REFRACTION AT LENS



REFRACTION IN NATURE: TWINKLING STARS



QUESTIONS TO THINK ABOUT

- What is colored light?
- Why do we see things in color?
- How is rainbow formed?

SOURCES



BBC.

Let there be light.

<http://www.bbc.co.uk/programmes/b0074qv9>.



Stephen R Wilk.

The eye in the spiral: Animals with pinhole visual systems.

Optics and photonics news, 19(6):12, 2008.